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Published in:
Astronomy & Astrophysics

DOI:
10.1051/0004-6361/201116696

2012

A&A 540, A133 (2012)
DOI: 10.1051/0004-6361/201116696

Astronomy & Astrophysics

η Carinae: linelist for the emission spectrum of the Weigelt blobs in the 1700 to 10 400 Å wavelength region*

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Received 11 February 2011 / Accepted 27 January 2012

ABSTRACT

Aims. We present line identifications in the 1700 to 10 400 Å region for the Weigelt blobs B and D, located 0.″1 to 0.″3 NNW of Eta Carinae. The aim of this work is to characterize the behavior of these luminous, dense gas blobs in response to the broad high-state and the short low-state of η Carinae during its 5.54-year spectroscopic period.

Methods. The spectra were recorded in a low state (March 1998) and an early high state (February 1999) with the *Hubble* Space Telescope/Space Telescope Imaging Spectrograph (HST/STIS) from 1640 to 10 400 Å using the 52″ × 0.″1 aperture centered on Eta Carinae at position angle, PA = 332 degrees. Extractions of the reduced spectrum including both Weigelt B and D, 0.″28 in length along the slit, were used to identify the narrow, nebular emission lines, measure their wavelengths and estimate their fluxes.

Results. A linelist of 2500 lines is presented for the high and low states of the combined Weigelt blobs B and D. The spectra are dominated by emission lines from the iron-group elements, but include lines from lighter elements including parity-permitted and forbidden lines. A number of lines are fluorescent lines pumped by H Lyα. Other lines show anomalous excitation.

Key words. line: identification – circumstellar matter – stars: kinematics and dynamics – stars: individual: η Carinae

1. Introduction

The spectrum of the luminous blue variable (LBV) star Eta Carinae (η Car) has been complex and challenging ever since it was first recorded in the late 19th century. The first detailed spectral analyses were made in Cape Town by Thackeray (1953), who recorded the spectrum from 3700 to 8900 Å in the near-infrared, and by Gaviola (1953) in Córdoba, Argentina. Thackeray (1962, 1967) later extended the spectral region to cover from 3100 to 9100 Å. The spectrum showed a profusion of forbidden emission lines, predominantly from Fe II, but also from ions with higher ionization stages, such as Fe III, Ne III and Ar III. There were also permitted emission lines normally associated with collisional excitation or recombination. Ground-based images of the object implied that several diverse regions with presumably different plasma conditions contributed to the spectrum. In the infrared spectral region, η Car was known for its huge excess peaking at wavelengths around 10 μm (Neugebauer & Westphal 1968; Robinson et al. 1973).

The first real step forward to understand the complexity of the emission line spectrum was taken when Weigelt & Ebersberger (1986), using speckle interferometry, discovered four separated components. Component A proved to be the central source characterized by strong continuum and broad wind line profiles. The other three components, known as Weigelt blobs B, C and D, are narrow line emission structures later explained to be gas blobs ejected from the star during the lesser eruption of the 1890s (Smith et al. 2004). The great eruption of η Car occurred in the 1840s, rivaling Sirius in apparent magnitude. Each blob, being slightly extended, projects within tenths of an arcsecond from η Car and lies within lightdays of the central source.

The second major step was spectroscopic observations made with the *Hubble* Space Telescope (HST). Spectra, demonstrating the narrow line emission character of the Weigelt blobs, were first recorded with the Faint Object Spectrograph (FOS) (Davidson et al. 1995), then with the Goddard High Resolution Spectrograph (GHRS) (Davidson et al. 1997). While the small circular apertures, coupled with the initial spherical aberration, prevented complete isolation of η Car from the Weigelt blobs, small offsets in position demonstrated their nebular character. Clear spatial and spectral separation of the Weigelt blobs finally was achieved with the Space Telescope Imaging Spectrograph (STIS) (Gull et al. 1999). The relay-optics-corrected spatial resolution of HST, 0.″1 at visible wavelengths, makes it extremely suitable for detailed spectroscopy of the blobs well separated from the central source. The 52″ × 0.″1 aperture of the STIS instrument, at appropriate position angles, simultaneously provided spatially-resolved spectra of η Car and selected Weigelt blobs.

Based on the first FOS spectrum of η Car, Davidson et al. (1995) showed that one of the strongest emission features in the 1200 to 4000 Å spectrum appeared at about 2508 Å and originated from the Weigelt blobs. Observed earlier in *IUE* spectra of η Car (Viotti et al. 1989), this feature was identified as an Fe II fluorescence line pumped by H Lyα (Johansson & Hamann 1993). Later HST observations with the GHRS and STIS instruments have definitively confirmed the source locations of the

* Table C.1 is also available at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsarc.u-strasbg.fr/viz-bin/qcat?J/A+A/540/A133
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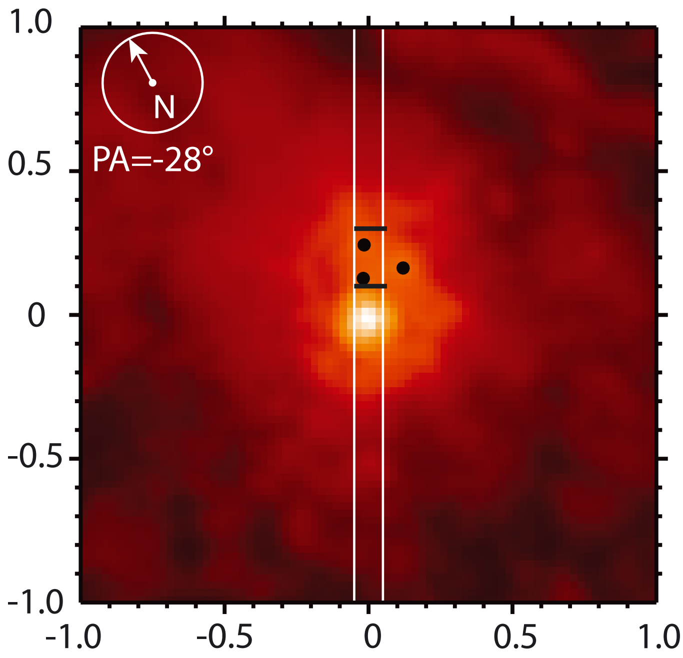

Fig. 1. Weigelt blobs B and D: taken from an HST/ACS F550M image recorded in 2002, the 2″ × 2″ field of view reveals the complex ejecta surrounding η Car (white core). Three dots define the positions of Weigelt blobs B, C and D. Superimposed (white lines) is the position of the HST/STIS 52″ × 0.″1 aperture when centered on η Car. The two black lines denote the boundary of the extracted spectra discussed in this paper. Weigelt blobs B and D are centered within the aperture, with B closest to the stars. Weigelt C is to the west (right). Note that slit position angle is 332°.

emission feature and resolved the feature into a pair of Fe II fluorescence lines at 2508 Å. The STIS spectra display a clean, well-separated blob spectrum with even more numerous narrow emission lines. These lines were later identified as part of the excitation cycle populating the upper levels of infrared lines enhanced by stimulated emission (Letokhov & Johansson 2009).

The spectrum of η Car cyclically changes with a 5.5 year period (Damineli 1996) due to the highly eccentric orbit of the massive binary composed of a luminous blue variable (LBV) primary and a hotter, less massive secondary, whose FUV radiation escapes the very extended primary wind for most of the orbit but is trapped for a short interval across the periastron passage (Nielsen et al. 2007a; Gull et al. 2009). The spectra of the Weigelt blobs change in response to the orbital modulation of the FUV by the interacting winds (Madura et al. 2012). Most higher excitation/ionization lines disappear during the several months long spectroscopic *low state* only to re-appear across each five-year spectroscopic *high state*. The transit from high to low state, when the high excitation and ionization lines disappear, is called "the spectroscopic event" (Damineli et al. 2008a,b). The event and the high/low states are observed in many wavelength regions throughout the electromagnetic spectrum, and are particularly pronounced in the X-ray region (Corcoran 2005). Variations in H I and Fe II lines were studied by Hartman et al. (2005) to estimate the physical conditions in the Weigelt blobs. The excitation and ionization processes producing some of the variable high-ionization lines have been investigated by Johansson & Letokhov (2001). Details of this variation are very complex and important for diagnostics, but beyond the scope of this paper.

The purpose of this paper is to present line identifications for the Weigelt blobs, as recorded in spectra of HST/STIS during a low state and a high state. We provide a list of identifications of 2500 emission lines, measured in two STIS spectra of the Weigelt blobs, recorded in March 1998 and February 1999. The list covers the wavelength range 1640 to 10 400 Å, and is the first comprehensive line list of the spectrum of the Weigelt blobs. The present list is primarily based on the doctoral thesis by Zethson (2001). The line list, particularly because of the excitation and ionization changes in the Weigelt blobs between low state and high state, will be of great use for line identification work on spectra of other emission line objects.

2. The HST/STIS observations

A series of spectroscopic observations centered on η Car were accomplished over a 6.3-year period beginning in 1998.0 with HST/STIS moderate dispersion gratings and the CCD detector. Appropriate grating settings permitted full coverage from 1640 to 10 400 Å[1] using the 52″ × 0.″1 aperture. Spectral resolving power, $R = \lambda/\delta\lambda$, is between 5000 and 10 500 across that spectral region. Considerable spatially-resolved information was obtained of the nebular structure in the vicinity of η Car with the 0.″05 pixels and near-diffraction-limited optics of the HST. When permitted by spacecraft orientation requirements for solar panels, the aperture, centered on η Car, was placed at 332° position angle (north through east) to include the Weigelt B and D blobs. Orientation of the slit on the field surrounding η Car is demonstrated in Fig. 1 using a direct HST/ACS image.

The spatial resolution of HST is close to the diffraction limit of the 2.4-m diameter primary and therefore changes with wavelength. While the spatial resolution is 0.″1 at 6000 Å, Weigelt B and D are 0.″1 and 0.″25 distant from η Car, respectively. The blob spectra, characterized by narrow emission lines (*FWHM* ~ 25 km s^{-1}, set by the instrument function), can be distinguished from that of η Car, characterized by continuum and very broad P Cygni wind lines (*FWHM* ~ 500 km s^{-1}), but the nebular spectra are increasingly blended spatially at longer wavelengths, leading to decreased ability to separate the spectrum of Weigelt B from that of Weigelt D. Hence, we chose to examine the combined spectrum of both objects in the wavelength region 1640 to 10 400 Å, thus avoiding issues of spatial resolution. The processed spectral images were sampled at half pixel spacing of the original 0.″506 pixel. Across the full spectral range, we extracted eleven half-pixel rows, 5.5 pixels, or 0.″28 wide, offset 0.″23 from η Car to include Weigelt B and D and to minimize the continuum contribution from η Car. The blobs are indeed resolved in the ultraviolet, but the diffraction limit of HST in the red does not resolve condensation B from D (Fig. 2). The flux and spatial extent of some nebular lines are separable for the two blobs in the 2510 to 2570 Å spectral region (Fig. 2, top), but indistinguishable in the 7000 to 7140 Å region (Fig. 2, bottom).

Considerable changes occur in the ultraviolet between the low and high states for both the central source and the Weigelt blobs (Fig. 2, top). In the low state (topmost image), the star, labeled A in the spectro-images, virtually disappears, buried under multiple absorption features that shift in velocity from below the stellar position to above. Moreover, a forest of narrow emission features pop out from Weigelt B and D. One year later, the central source, while complex in nature, is nearly continuous, but the spectral features of Weigelt B and D have faded, becoming rather diffuse in structure (Fig. 2, top, lower spectroimage). The

[1] All wavelengths in this paper are in vacuum and all velocities are heliocentric.

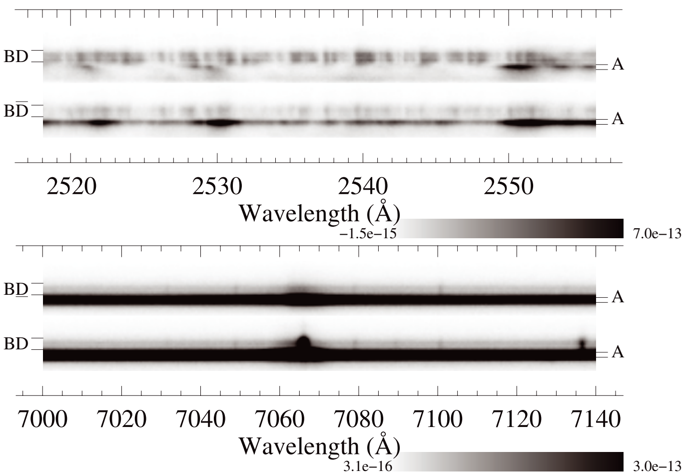

Fig. 2. Two examples of spectral segments recorded of η Car plus Weigelt blobs B and D. *Top*: the spectral region from 2518 to 2560 Å. *Bottom*: the spectral region from 7000 to 7140 Å. The two segments within each spectral region are from the low state (March 1998) and the ensuing high state (February 1999). Each spectral segment reproduces spatially resolved slit spectra that extends from 0.″3 above to 0.″3 below η Car with the HST/STIS long slit oriented at −28°. In the near ultraviolet (top pair of spectra), the diffraction limit of HST (0.″065 in the mid-ultraviolet) separates η Car and each of the Weigelt blobs. Differences between Weigelt B and D in individual line brightnesses are noticeable. In the red (bottom pair of spectra), the diffraction limit is nearly three times wider. Due to HST spatial diffraction limits, separation of the two blobs is no longer possible at 7100 Å. Bright continuum of η Car and nebular scattered starlight contaminate the Weigelt condensation emission line spectra. Major changes between the low and high states are quite noticeable especially in the ultraviolet.

spectrum of Weigelt B and D also show absorption lines from intervening gas at different velocities within the extended winds of η Car, the surrounding ejecta and the interstellar medium. The absorption components and their origin are discussed by Nielsen et al. (2007b) who used HST/STIS echelle spectra in the wavelength region, 2424 to 2706 Å, which allowed more detailed analysis of the spectral features, especially of blended spectral features where a more certain identification became possible due to the increased spectral resolution, R = 100 000.

Fewer changes are obvious in the near red between the low and high states (Fig. 2, bottom). Both the central core and the Weigelt blobs exhibit strong high excitation. The He I λ7067 P Cygni and the [Ar III] λ7137 lines provide examples. During the late low state, diffuse, broad He I emission extends from the central core towards the Weigelt blobs. The [Ar III] forbidden emission, which defines the wind-wind collision zones, is not present during the low state, but narrow line emission plus complex broad components appear across the high state (Gull et al. 2009; Madura et al. 2012). By the early high state, the broad emission has strengthened, but narrow line emission extends across the Weigelt blobs. We refer to Nielsen et al. (2007a) for discussion on the He I P Cygni profiles that originate deep within the central core in the vicinity of the binary wind-wind interaction structure.

The observations, presented in this atlas, were recorded on March 19, 1998 and February 21, 1999 (HST programs 7302 and 8036) with wavelength coverage from 1640 to 10 400 Å. The spectroscopic low state began in late December, 1997 (JD 2 450 799.8) and extended at least through March, 1998 as demonstrated by low X-ray flux (Corcoran 2005) and confirmed by the lack of high ionization lines of [Ar III], [Ne III] and [Fe III], and weak He I (Damineli et al. 2008a). Full recovery of the X-ray high state was by late summer of 1998, so the February 1999 observations are well into the early stages of the broad spectroscopic high state. Line fluxes of the Weigelt blobs B and D, recorded during a subsequent visit in March 2000, are found to be similar to fluxes in February 1999. From March 1998 to March 2004, a total of six visits were accomplished with the same HST/STIS aperture centered on η Car at the same position angle (or rotated by 180°). Other visits were accomplished at different position angles, of which two (July 2002 and July 2003) were used to observe both η Car and Weigelt D independently, but with the identical position angle for both visits. The importance of the latter two observations is that the July 2, 2002 visit was during the late stages of the broad high state and the July 4, 2003 visit was during the early stages of the several-month-long low state. Line fluxes recorded during the latter visit are quite similar to those of March 1998, the late stage of the previous low state. Since different position angles were used for other observations of η Car, inclusion of Weigelt B and D were not always possible, but spectra of other, similar emission structures, most notably Weigelt C were sometimes within the HST/STIS aperture.

3. The plots and tables

We include the following:

Appendix A: summary extracted plots of the February 1999 combined spectrum of Weigelt B and D (this spectrum represents the *high* state, when all lines are present);
Appendix B: spatially-resolved spectro-images recorded during the March 1998 and February 1999 visits with HST/STIS, showing the differences between the low- and high-state spectra (Spectral extractions are also shown with line identifications);
Appendix C: list of the identified lines with qualitative relative fluxes and notes calling out additional information.

These data sets will be referenced in following sections that describe the spectral properties and comment on various elements and ionic states. The focus of this paper is on line identification. The wavelength and intensity calibration of STIS has been used, and no additional correction is found necessary for the present analysis.

3.1. Extracted spectra

The high state spectrum recorded in February 1999, extending from 1700 to 10 400 Å, is included in Appendix A to assist the reader in understanding the overall spectral content. Prominent lines and groups of lines are marked. It can be used to find spectral regions relatively devoid of strong nebular lines and to identify areas that are quite confused due to an abundance of nebular emission and/or absorption lines. The spectra also give an overview of the elements present.

3.2. Spectro-images of the spatially resolved structures

Much insight can be obtained by direct examination of the spatially resolved spectra in the form of spectro-images as reproduced in Appendix B. While few absorption lines obscure the BD spectrum in the visible and near-red spectral regions, the ultraviolet spectral region is increasingly dominated by strong

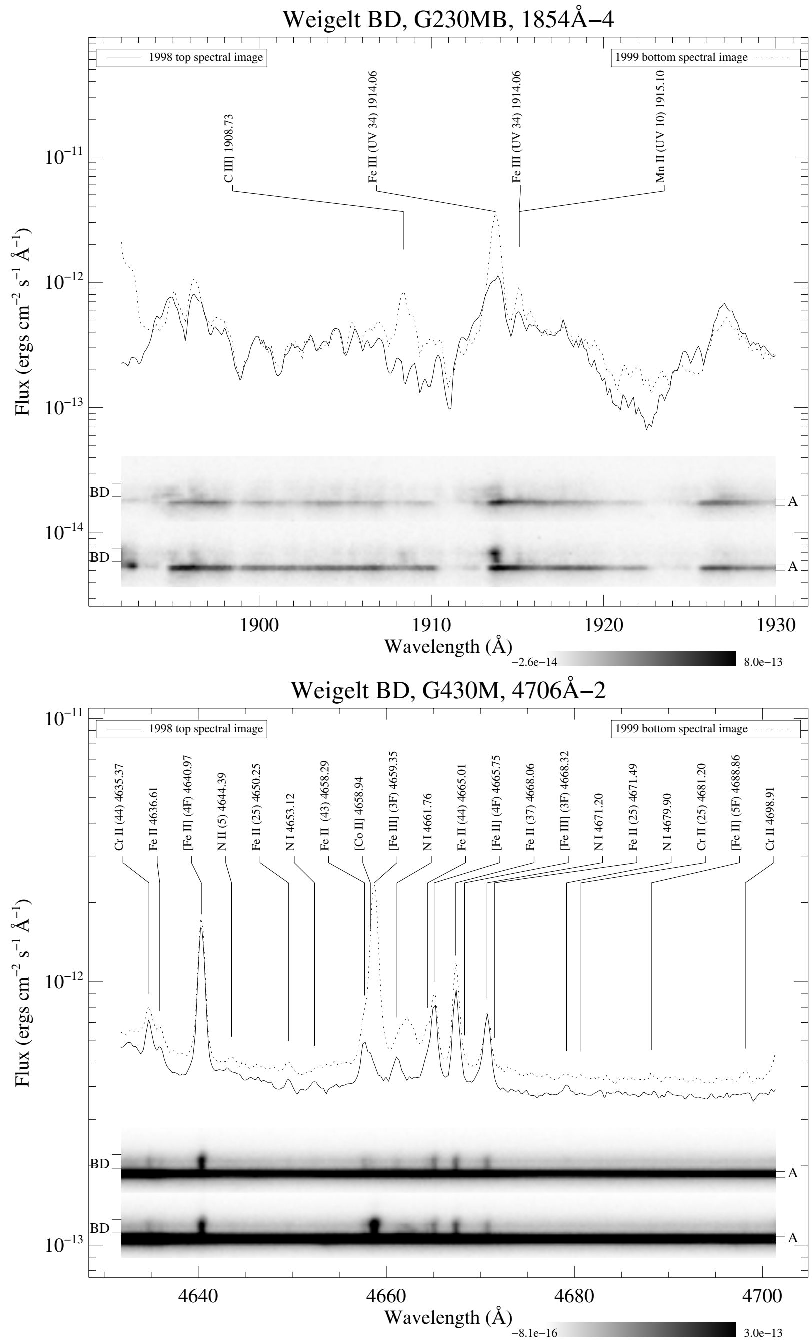

Fig. 3. Two examples of spectro-images (spatially-resolved spectra) of η Car, Weigelt B and Weigelt D. *Top plot:* spectral region from 1892 to 1930 Å recorded during March 1998 and February 1999. The dark streak, labeled "A", is the spectrum of η Car. Immediately above, labeled "BD", are the two Weigelt blobs. In the February 1999 (high state) spectrum, a narrow emission of Fe III 1914.06 Å is prominent, but is absent in the February 1998 spectrum. Much faint continuum extends from the stellar position across the blobs. Velocity shifting absorptions can be seen in both spectra. Absorptions are much more noticeable in the March 1998 (low-state) spectrum. The increase in continuum by Feb. 1999 (high state) is real. *Bottom plot*: spectral region from 4632 to 4702 Å recorded in the same HST/STIS visits. Narrow emission lines are visible in both spectra with no intervening absorptions. The [Fe III] 4659.35 Å line is present in the February 1999 (high) spectrum but absent in the March 1998 spectrum. A tilted emission feature at 4662 Å originates from the same line as the red-shifted component from an arcuate-shaped surface associated with the interacting wind cavity (Gull et al. 2009).

absorptions towards shorter wavelengths. Likewise, the nebular line density increases from the red through the visible to the near-ultraviolet around 3000 Å, but then drops as more and more absorption lines overlap the spectrum and as the photon energy associated with the wavelength approaches 8 eV. Indeed, very few nebular lines are identifiable below 2000 Å due both to the increasing absorptions and the dominance of singly-ionized species such as Fe II and Ni II.

Two examples of these spectro-images are presented in Fig. 3. In the ultraviolet (Fig. 3, top), the spectra of the Weigelt blobs and of η Car are heavily modulated by absorption lines from singly-ionized species, most notably Fe II, with ionization potentials below 8 eV and the central source exhibits weak continuum. As mentioned above, the near-diffractive spatial resolution of HST/STIS separates Weigelt B from Weigelt D. By contrast, at wavelengths in the visible (Fig. 3, bottom), line absorptions disappear. η Car is much brighter and contributes significant continuum scatter onto the Weigelt blob positions due both to nebular dust and instrument response. Further into the red, spatial resolution drops even more blending together the spectra of the two Weigelt blobs.

3.3. The line list

The identification of lines in the wavelength region, 1700 to 10 400 Å, results in 2500 identified transitions that are presented

Table 1. Excerpt of Table C.1.

λ_{obs}(vac) (Å)	Intensity	Spectrum	Transition	$\lambda_{lab}(vac)$ (Å)	Comment
8468.4	471	H I	Paschen 17	8469.59	
8469.49	1478	Fe II	$e^6D_{7/2}$–$4p\ ^4G_{9/2}$	8470.92	Lyα
8524.69	168	Fe II	$z^6D_{9/2}$–$c^4F_{7/2}$	8526.00	4p–4s
8543.15	175	Ca II (2)	$3d\ ^2D_{5/2}$–$4p\ ^2P_{3/2}$	8544.44	
8546.49	1030	H I	Paschen 15	8547.73	
		Fe II	$z^6D_{9/2}$–$c^4F_{9/2}$	8548.12	4p–4s
8579.77	131	[Cl II] (1F)	$3p^4\ ^3P_2$–$3p^4\ ^1D_2$	8581.05	?id
		[V II] (11F)	a^5F_3–a^3G_3	8581.46	?wl

Notes. The full table is included in Appendix C. A portion is shown here for guidance regarding its form and content. The full table contains around 2500 identifications of emission lines in the wavelength region 1700–10 400 Å from the STIS spectra of the Weigelt blobs recorded in March 1998 and February 1999. The identifications and laboratory wavelengths are from Kurucz database (Kurucz 2001). The laboratory wavelengths for parity forbidden lines are Ritz wavelengths derived from energy levels in the NIST Atomic Spectra Database (2006). All wavelengths are given in vacuum. The following comments are used: not in 98: the feature is not present in the 1998 observation. not in 99: the feature is not present in the 1999 observation. Lyα: Primary H Lyα pumped fluorescence transition. Lyα sec.: secondary H Lyα pumped fluorescence transition. 4p–4s: A 4p–4s transition, discussed in Sect. 5.5. rd sh: red shoulder due to extended stellar wind is noticeable out to +400 km s^{-1}. bl sh: blue shoulder due to extended stellar wind is noticeable out to –400 km s^{-1}. "?" the feature is weak and may not be a true emission line. "?id": The identification is regarded as uncertain. "?E$_u$": the upper level has an excitation energy > 10 eV, and the excitation mechanism is questionable. "?wl": plausible identification, but the radial velocity differs from the mean, –45 km s^{-1}, by >15 km s^{-1}.

in Appendix C. The line list includes the measured and laboratory wavelengths in vacuum, along with line identifications and transition data. To further assist the reader, strong lines have qualitative relative intensities and comments are added for further clarification. In particular, lines produced by fluorescence mechanisms are flagged as well as lines absent in the February 1999 spectrum. The intensities and wavelengths were measured by IDL routines that fitted Gaussian profiles to the observed lines. The intensities are estimated to be accurate to 5–10%, the smaller value for strong lines, but are included for guidance only. Due to blending and intervening absorption, no intensities are given for lines below 2700 Å. The line fluxes are not corrected for interstellar or internal extinction as the properties of extinction from dust located within the Homunculus and the central core are uncertain. Should the reader wish to obtain quantitative flux measures, the on-line spectral data is available through the *Hubble* Treasury Program[2].

A sample of the table is included as Table 1 with notation for abbreviated comments. In the NUV, the line distribution is so dense that blends are very probable, especially with the nebular and instrumental scattered broad stellar line profiles. Multiple possible identifications are given for a number of lines in the NUV. As discussed earlier, the analysis of spectral high-resolution observations by Nielsen et al. (2007b) was used for the region 2424 to 2706 Å.

A number of criteria were used to check the reliability of the line identification for an observed feature. First, consistency checks were made for other lines from the same upper levels, taking the transition probability (A-value) into account. Second, the presence of other lines from the same element at various excitation energies was considered. Third, the excitation distribution for similar elements was considered. In such a complex spectrum, these criteria are more easily fulfilled by iron-group elements, which have numerous possible transitions, compared to simple spectra where only a limited number of lines from a few elements is expected.

[2] See http://archive.stsci.edu/prepds/etacar and http://hla.stsci.edu

4. General appearance of the spectrum

Qualitatively, the line spectrum of the Weigelt blobs range from very crowded in the ultraviolet to sparse in the red, primarily because the density of resonance lines decreases to the red. Absorption dramatically modifies the spectra of the blobs and η Car. External absorption originates from dust and atomic resonance line absorptions from the foreground lobe of the primarily neutral Homunculus (−513 km s^{-1}), the internal, ionized Little Homunculus (−147 km s^{-1}) and the interstellar medium (0 km s^{-1}) (Nielsen et al. 2005). Intrinsic absorption depresses the flux of η Car relative to the Weigelt blobs (Hillier et al. 2001; Gull et al. 2009) and this effect is greatly accentuated in the blue-visible to the ultraviolet. Moreover, atomic absorption from the foreground Homunculus increasingly dominates the spectrum further into the ultraviolet, where resonance lines of the more-highly excited species might be detected were it not for the dominant intervening absorption.

Few strong, narrow emission lines are seen below 2000 Å, the exceptions being the N III], Si III] and C III] intercombination lines, ⟨Fe III⟩ fluorescence, and some special cases of Fe II emission discussed in Sect. 6. The 2000 to 2400 Å and 2550 to 2650 Å regions are heavily obscured by intervening broad absorptions from low excitation levels, primarily of Fe II and Ni II. The strength and complexity of the absorptions make it increasingly difficult to distinguish between real emission features originating from the Weigelt blobs and merely local regions of lesser absorption. Nebular lines become very dependent upon the characteristically narrow nebular line width and central line velocity. The resonance line absorption towards Weigelt D was investigated by Nielsen et al. (2007b) at resolving power, $R = \lambda/\delta\lambda = 100\,000$, over the wavelength interval 2424 to 2706 Å, thus confirming line identifications listed here and adding two new line identifications for that spectral region. The emission lines observed below 2750 Å are generally rather weak lines from medium-excitation levels of Fe II and Cr II, or strong lines of fluorescent Fe II and [Fe III].

The 2750 to 3600 Å part of the spectrum is crowded with optically thin lines of low- and medium-excitation iron-group elements, mainly Fe II. Fluorescent Fe II produces strong emission around 2850 Å. The 3600 to 4000 Å range is characterized by the Balmer series of hydrogen.

Above 4000 Å, the spectrum is typically nebular in its nature, with strong, narrow emission lines superimposed on a weak, well-defined continuum. The spectrum is dominated by forbidden and low-excitation lines of Fe II, the other strongest lines coming from H I, He I and [N II]. A few absorption features are seen, e.g. the Na I doublet at 5890 Å. Some of the emission lines have broad bases of scattered light from the stellar spectrum, as discussed below. All the brightest features above 8000 Å are due to either fluorescent Fe II or the Paschen series of H I.

4.1. Contributions of extended wind structure

A significant number of narrow and broadened lines seen in the spectro-images do not originate from the Weigelt blobs. They are easily recognized in the 2D spectro-images by an odd tilt angle, compared to the narrow nebular lines being aligned along the direction of the slit, or a broad, diffuse arcuate feature. The obvious clue is that these lines are always in the vicinity of a bright narrow line and are associable with a broad "wind" line in the stellar spectrum. Very bright lines of H I and Fe II have accompanied diffuse arcs extending from about −400 to +400 km s^{-1} that are visible during both the low and high states. Bright forbidden iron lines show tilted components that come and go. As examples, the [Fe III] 4659 and 4702 Å lines show a red-shifted arc during the high state that tilts toward lower velocity with distance from η Car. A number of [Fe II] lines, including 4815 Å, show strong arcuate structure extending in velocity from −400 to +400 km s^{-1} and spatially well above and below the position of η Car during the low state. Analysis of these and other HST/STIS spectra coupled with 3D modeling demonstrated these extended emission structures originate from the ballistic wind-wind interactions of η Car (Gull et al. 2009; Madura et al. 2012). Where these components are noticeable, a note is added for red or blue arc/shell (rd sh, bl sh) in the line list (Appendix C).

5. Representation of the elements

In this section we present discussions about non-iron-group elements producing observed emission lines in the Weigelt spectrum. Since the spectrum is dominated by lines from iron-group elements, especially in the singly-ionized stage, the iron-group elements are discussed separately in Sect. 6.

The two observations discussed below characterize the low and high states in the spectrum of the Weigelt blobs. The March 1998 spectrum is observed during a late phase of the spectroscopic low state, when the high-excitation lines, originating from species with ionization potential is greater that 13.6 eV, are still very weak. The February 1999 spectrum, observed more than a year after low state began, shows the spectrum during the spectroscopic high state. A spectrum recorded in March 2000 by HST/STIS is virtually identical to the February 1999 spectrum. The Weigelt blobs slowly strengthen in high excitation lines throughout the high state which lasts for about five years, then relax rapidly when the low state begins as indicated by ground-based monitoring (Damineli et al. 2008a).

5.1. Hydrogen

The observations cover the entire Balmer series and all but the first three members of the Paschen series. However, the observed spectrum of the Weigelt blobs include nebular-scattered starlight that is heavily dominated by Balmer lines with typical P Cygni profiles: a strong, very broad, spatially-extended emission profile with red-shifted wind and a deep blueshifted absorption. Superimposed on the emission profile is a narrow absorption feature, having a velocity of −40 to −50 km s^{-1} (Johansson et al. 2005). The Paschen lines have simpler line profiles, consisting of a narrow emission peak at −45 km s^{-1} superimposed on a broad, asymmetric base of scattered stellar emission. In both series, a narrow emission line at the velocity of the Weigelt blobs is the contribution from the Weigelt blobs. As the apparent brightness of η Car increased with time, the scattered stellar emission peaks increased in intensity in 1999 compared with1998. The nebular components do not appear to increase in brightness.

5.2. Helium

The He I line profiles are greatly influenced by the periodic spectroscopic event. In the 1998 data, only the strongest He I lines, e.g. 2p–3s transitions at 7066 and 7282 Å appear in the Weigelt blob spectrum as broad, asymmetric features, being scattered light from the spectrum of the stellar wind rather than intrinsic radiation from the Weigelt blobs themselves.

In 1999, narrow peaks appear on the broad bases, the observed line profiles being similar to those of the Paschen lines. No narrow He II lines are observed although broad He II 4686 Å emission has been observed at the stellar position of η Car during the broad spectroscopic high state, building up to peak strength months before the spectroscopic low state (Damineli et al. 2008a).

5.3. Carbon, oxygen and nitrogen

Like the outer ejecta of η Car (the Little Homunculus, the Homunculus and the fainter nebulosities further outward) the Weigelt blobs appear to have C/N/O abundances characteristic of CNO-cycle hydrogen burning with convection in very massive stars (Meynet & Maeder 2005), i.e. nitrogen is markedly overabundant relative to carbon and oxygen (Verner et al. 2005).

Several N I lines appear throughout the optical and near-IR spectrum, e.g. 3s–3p, 3s–4p, 3p–4d transitions, having excitation energies of ~13 eV. The N I lines are weaker in 1999 than in 1998, whereas the second spectrum of nitrogen is enhanced. The [N II] $\lambda\lambda$5756, 6585, 6549 are among the strongest lines in the optical spectrum in 1999, and the N II] $\lambda\lambda$2139, 2143 appear strong in 1999, being absent in 1998. Also, in 1999 a number of 3s–3p and 3p–3d lines of N II appear in the optical spectrum. Finally, the N III] lines at 1750 Å are present in 1999 but not in 1998.

Only one carbon feature is identified in the spectrum. The C III] intercombination line at 1908 Å is absent in the 1998 data but appears in 1999. Furthermore, there is no evidence that the Fe II fluorescence pumped by one of the C IV resonance lines at 1548 Å (Johansson 1983), observed in RR Tel (Hartman & Johansson 2000), is working efficiently in the Weigelt blobs, suggesting that the C IV lines are weak, if present at all.

The O I 3s ^{3}S–3p ^{3}P multiplet (opt 4) at 8447 Å, the secondary cascade in the H Lyβ pumping of oxygen proposed by Bowen (1947), is observed in the data. Some of the components of this multiplet may be enhanced by stimulated emission (Johansson & Letokhov 2005; Letokhov & Johansson 2009). The primary fluorescence decay falls at ~1.13 μm, just outside of the observed wavelength range. A feature appearing at 7255.3 Å in the 1999 data, but not present in 1998, is tentatively identified as O I 3p ^{3}P–5s ^{3}S (multiplet 20), but we see no other O I lines from levels of similar excitation energies (e.g. 3p ^{5}P –5s ^{5}S at 6456 Å or 3p ^{3}P–4d ^{3}D at 7004 Å). If the identification of the 7255.3 Å feature is correct, it remains to explain how the upper level of the transition is populated, and why the line is not present in the 1998 data, i.e. close in time to the spectroscopic low state.

The strongest line of the forbidden [O I] multiplet 1F, ^{3}P $_2$–^{1}D$_2$ λ6302, is observed. The ^{3}P$_1$–^{1}D$_2$ λ6365 line is blended with [Ni II]. [O II] might be present, only weak traces are seen. The ^{2}D–^{2}P lines at 7325 Å and the ^{4}S–^{2}P lines at 2470 Å are blended with other features, and the ^{4}S–^{2}D lines at 3730 Å coincide with the P Cygni profile of H I Balmer 13.

5.4. Neon

Doubly-ionized neon is seen only during the high state. [Ne III] (isoelectronic to O I) is absent in the 1998 spectrum, but ^{3}P$_2$–^{1}D$_2$ λ3869 is one of the strongest lines in the 3000 to 4000 Å range in 1999. ^{3}P$_1$–^{1}D$_2$ λ3968 is also observed in 1999, whereas the transitions from ^{1}S$_0$ are absent. The mechanism behind the variation of these lines during the event was investigated by Johansson & Letokhov (2004b).

5.5. Sodium

The Na I 3s–3p doublet, $\lambda\lambda$5891, 5897, appears as a complex absorption feature having multiple velocity components consistent with those catalogued in the NUV spectrum of η Car by Gull et al. (2006). No sodium emission is observed.

5.6. Magnesium

The Mg I intercombination line 3s^2 ^{1}S$_0$–3s3p ^{3}P$_1$ λ4572 is observed in emission at 4571.72 Å, whereas the ^{1}S$_0$–^{1}P$_1$ λ2852 resonance line is observed in absorption. The Mg II 3s–3p resonance lines $\lambda\lambda$2796, 2803 appear as very strong and broad absorption features, having a redshifted emission component. A few other Mg II lines are observed in emission, e.g. 4s ^{2}S–4p ^{2}P $\lambda\lambda$9220, 9246 (multiplet 1), although relatively weak.

5.7. Aluminum

The Al II intercombination line 3s^2 ^{1}S$_0$–3s3p ^{3}P$_1$ λ2669 is absent in 1998 but appears in 1999. This is the only convincing evidence of emission lines from any ionization stage of aluminum in the observed spectrum. The Al III 3s–3p $\lambda\lambda$1854, 1862 resonance lines appear as strong absorption features.

5.8. Silicon

In 1999, the Si III 3s^2 ^{1}S$_0$–3s3p ^{3}P$_1$ intercombination line at 1892 Å is the third strongest emission feature in the satellite UV region of the observed spectrum (only the Fe II $\lambda\lambda$2507, 2509 fluorescence lines are stronger). However, there is no sign of the line in the 1998 data. This constitutes one of the most striking examples of the effect of the spectroscopic event on the Weigelt BD spectrum. The excitation of the 1892 Å line has been investigated by Johansson et al. (2006) using the STIS data obtained during the June 2003 event, and is explained by resonance enhanced two-photon ionization (RETPI) from Si II, leaving Si III in an excited state.

Si II is also present in emission. Multiplets 1: (3s3p^2 ^{2}D–3s^{2}4p ^{2}P) at 3854–3863 Å, 2: (3s^{2}4s ^{2}S–3s ^{2}4p ^{2}P) at 6348 and 6372 Å, 4: (3s^{2}4p ^{2}P–3s^{2}5s ^{2}S) at 5958 and 5979 Å, and 5: (3s^{2}4p ^{2}S–3s^{2}4d ^{2}D) at 5041– 5046 Å are observed both in 1998 and 1999. Multiplet 5 is considerably stronger in 1999 than in 1998. The 3s–3p resonance lines $\lambda\lambda$1808, 1816, 1817 are observed in absorption.

5.9. Phosphorus

A line observed at 7876.90 Å is identified as [P II] ^{1}D$_2$–^{1}S$_0$. This is the strongest transition from the ^{1}S$_0$ level according to calculated transition probabilities (Mendoza & Zeippen 1982). The transitions from ^{1}D$_2$ to the ground term ^{3}P fall outside of the observed wavelength region (∼1.2 μm).

5.10. Sulfur

All eight lines belonging to [S II] multiplets 1F, 2F and 3F (^{4}S–^{2}P, ^{4}S–^{2}D and ^{2}D–^{2}P) are observed in both the low and high state spectra. In the 1999 high state spectrum, [S III] ^{3}P$_{1,2}$–^{1}D$_2$ $\lambda\lambda$9071, 9533 and ^{1}D$_2$–^{1}S$_0$ λ6313 also appear, being relatively strong. ^{3}P$_{1,2}$–^{1}S$_0$ $\lambda\lambda$3722, 3798 are blended with H I Balmer lines.

5.11. Chlorine

A line observed at 8579.77 Å is identified as [Cl II] ^{3}P$_2$–^{1}D$_2$. According to calculations (Mendoza & Zeippen 1983) this is the strongest of the forbidden ^{3}P–^{1}D transitions in Cl II. The second strongest line, ^{3}P$_1$–^{1}D$_2$ λ9126, is blended with an Fe II fluorescence line. Transitions from the ^{1}S$_0$ level are not observed.

5.12. Argon

[Ar III] ^{3}P$_2$–^{1}D$_2$ λ7137 and ^{3}P$_1$–^{1}D$_2$ λ7751 are observed in the February 1999 spectrum. In contrast to the [Ne III] case, we also observe the two strongest transitions from the ^{1}S$_0$ level, ^{1}D$_2$–^{1}S$_0$ λ5193 and ^{3}P$_1$–^{1}S$_0$ λ3110. [Ar III] is not present in the 1998 spectrum. The excitation mechanism was discussed by Johansson & Letokhov (2004b).

5.13. Potassium

The K I 4s–4p resonance lines $\lambda\lambda$7667, 7701 are represented by weak, probably interstellar, narrow absorption features. No other potassium lines are observed in the spectrum.

5.14. Calcium

Ca II emission is represented by multiplets 2 (3d–4p, in the near IR) and 3 (4p–5s, in the near UV). Both lines of the forbidden 4s–3d doublet $\lambda\lambda$7293, 7325 are also observed. The H and K resonance lines are strong in absorption at velocities consistent to those catalogued in the NUV by Gull et al. (2006).

5.15. Copper

Two lines of [Cu II] are observed, 3d^{10} ^{1}S$_0$–3d^{9}4s ^{1}D$_2$ λ3807 and 3d^{10} ^{1}S$_0$–3d^{9}4s ^{3}D$_2$ λ4376.

6. The iron-group elements

The entire observed spectrum, from the UV to the near-IR, is characterized by lines from singly-ionized iron-group elements. All elements from titanium to nickel are observed with Fe II, by the number of lines, being the dominant species.

Scandium is not detected. By contrast, the HST/STIS spectrum of the Strontium Filament, studied by Hartman et al. (2004), includes emission lines of strontium, scandium, vanadium in addition to the iron-peak elements. The Strontium Filament, an ionized metal region, is photo-ionized by radiation with energies less that 7.8 eV. Hence many elements, commonly in doubly-ionized or higher states, survive as neutrals or singly ionized species. The Strontium Filament, with its peculiar metal abundances, has been studied extensively by Bautista et al. (2006, 2009, 2011).

In the following discussion the iron-group lines will be divided into a number of subgroups depending on the energy of the upper levels of the transitions: forbidden lines, low-excitation lines, medium-excitation lines and high-excitation lines. Finally, a description will be given of the appearance of "pseudo-forbidden" lines: lines that are not parity-forbidden, but still come from levels that have relatively long lifetimes and can be regarded as semi-metastable. It is not clear in all cases how these states are populated, but some of them occur in closed loops pumped by H Lyα, e.g. in the same loop as the strong Fe II 2507, 2509 Å lines. These pseudo-metastable states are of particular interest, since they produce strong emission lines that can be enhanced by stimulated emission (Johansson & Letokhov 2004a).

Higher ionization stages are represented in the 1999 spectrum, but not the 1998 spectrum, by [Fe III] in particular and by weak lines from [Fe IV] and possibly [Ni III]. Lines from neutral iron-group elements are absent, with the possible exception of weak Fe I fluorescence, as will be discussed below.

6.1. Forbidden lines

All singly-ionized iron-group elements have many metastable energy levels belonging to the low even-parity configurations $3d^k$, $3d^{k-1}4s$ and $3d^{k-2}4s^2$. In a low density plasma, such as the Weigelt components, these will give rise to several parity-forbidden emission lines. While forbidden lines in astrophysical plasmas generally are considered to be collisionally excited, many of the metastable states of the iron-group elements are also populated by cascades from odd 4p levels. This makes the use of these lines as diagnostic tools somewhat uncertain (see the discussion on the "pseudo-forbidden" lines below).

The Weigelt blob spectrum is rich in [Fe II], which dominates the optical region of the spectrum, especially in the 4000 to 6000 Å wavelength range in which the forbidden multiplets 6F (a^6D–b^4F), 7F (a^6D–a^6S), 18F (a^4F–b^4P), 19F (a^4F–a^4H), 20F (a^4F–b^4F) and 21F (a^4F–a^4G) are observed to be very strong. The 14F $a^4F_{9/2}$–$a^2G_{9/2}$ λ7157 line is the strongest feature in the spectrum redward of Hα.

Thackeray (1953) reported the presence of blueshifted absorption components of some of the [Fe II] lines. The velocity associated with the absorption ranged from −395 to −600 km s^{-1} which he suggested agreed well with that of other strong absorption features in the spectrum, e.g. from H I, Ca II and Fe II. While numerous absorption lines of permitted transitions in singly-ionized metals have been observed in high resolution STIS spectra, none were observed in forbidden lines (Gull et al. 2006). One of the dominating components, formed in the Homunculus, has a blueshift of 513 km s^{-1}, but has a characteristic line width of several km s^{-1}. Examination of the twelve [Fe II] lines listed by Thackeray (1953) shows no absorption features in either the η Car or Weigelt spectra.

Lines of [Ni II] and [Cr II] are also present at considerable strengths. The [Ni II] multiplet 2F (a^2D–a^2F) at ~7400 Å and the [Cr II] multiplet 1F (a ^6S–a^6D) at ~8000 Å produce the strongest emissions. Several lines of [V II], [Mn II] and [Co II] are observed, [Co II] being the strongest.

Only a few, weak lines are seen of [Ti II], which on the other hand is prominent in another spatial region of the η Car nebula, the so called Strontium Filament (Hartman et al. 2004). In addition, [Sc II] is observed in this region but absent in the spectrum of the Weigelt blobs.

6.2. Low-excitation lines

The lowest odd 4p levels of the singly-ionized iron-group elements have excitation energies ranging from ~3.5 eV for Ti II to ~6.5 eV for Ni II. The decays from these levels having the highest transition probabilities fall in the 2000–4000 Å wavelength range. Many of the transitions to the lowest lying even parity levels, e.g. the Fe II multiplets UV1–3 and UV35–36 where the lower levels belong to the ground term a^6D and the a^4F term 0.3 eV above the ground, are optically thick and show up mostly in absorption. Additional absorptions from intermediate material, as the SE lobe of the Homunculus, result in the strong, broad, blue-shifted absorption profiles that characterize the 2000–3000 Å region of the STIS observations. These absorptions are due mainly to Fe II, Ni II and Cr II. Other transitions are optically thinner, due to higher excitation energies of the lower levels and/or lower transition probabilities, and are observed both in emission and absorption. Examples of such transitions are the UV60–62 Fe II multiplets and the UV5, UV8 Cr II multiplets, having emission peaks accompanied by blue-shifted P Cygni profiles.

The z^4D and z^4F levels in Fe II can also decay to even $3d^64s$ quartet terms, such as b^4P, b^4F and a^4G, having excitation energies of ~3 eV. These optically thin lines (e.g. multiplets 27, 37, 38, 41, 48, and 49) fall in the optical region of the spectrum, and are observed to be very strong in the Weigelt blobs, the $a^4G_{11/2}$–$z^4F_{9/2}$ λ5318 transition being the brightest non-hydrogenic feature in the visible wavelength range. The transition probabilities of these optical lines are smaller than those of the UV lines by 1–2 orders of magnitude, and their strength in the spectrum can be explained by line leakage from the optically thicker line (Jordan 1967; Johansson & Jordan 1984). The optical lines are also observed as strong, broad P Cygni lines in the spectrum of the central star, and their line profiles in the Weigelt spectrum resembles the He I and H I Paschen line profiles, with a narrow peak superimposed on a broad base of scattered star light. The three lines of Fe II multiplet 42, a^6S–z^6P, that are observed in many emission line objects are analogous to these lines.

6.3. Medium-excitation lines

Emission from 4p levels in Fe II and Cr II having excitation energies between 7.5 and 9.5 eV is observed in the spectrum. The strongest transitions fall in the UV range, between 2400 and 3500 Å. Only a few, weak lines from these levels are seen at longer wavelengths. A possible excitation mechanism for these levels is absorption of continuum radiation below 2000 Å. The UV191 multiplet of Fe II, a^6S–x^6P, is also observed. The

Table 2. Fe ii and Cr ii energy levels that can be populated by absorption of H Lyα ± 5 Å photons.

Fe ii	Cr ii
(^{5}D)5p ^{4}P$_{5/2}$	(^{5}D)5p ^{4}P$_{5/2}$
(^{5}D)5p ^{4}D$_{1/2,3/2,5/2,7/2}$	(^{5}D)5p ^{6}P$_{3/2,5/2,7/2}$
(^{5}D)5p ^{4}F$_{3/2,5/2,7/2,9/2}$	(^{5}D)5p ^{4}F$_{3/2,5/2,7/2,9/2}$
(^{5}D)5p ^{6}F$_{1/2,3/2,5/2,7/2,9/2}$	(^{4}P)4s4p x^{6}D$_{1/2,3/2,5/2,7/2,9/2}$
(^{3}P1)4p ^{4}S$_{3/2}$	(^{3}P1)4p v^{2}P$_{1/2,3/2}$
(^{3}P1)4p ^{4}P$_{1/2,3/2}$	(^{4}F)4s4p s^{2}F$_{7/2}$
(^{3}F1)4p ^{4}G$_{7/2,9/2}$	

multiplet consists of three lines having wavelengths of 1785.27, 1786.75 and 1788.00 Å, corresponding to J = 7/2, 5/2 and 3/2 of the x^{6}P term, respectively. The lines are strong in emission in many objects. Various explanations for the population of the upper levels have been given, e.g. photoexcitation by continuum radiation, collisional excitation, and dielectronic recombination (Johansson & Hansen 1988). The $\lambda\lambda$1785 and 1786 lines are observed in the Weigelt spectrum, whereas the λ1788 line coincides with an absorption feature due to a Ni ii UV5 line.

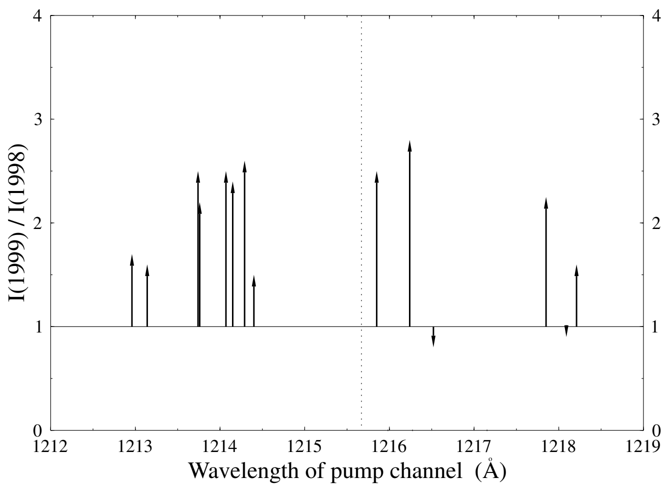

Fig. 4. Observed intensity changes of the Fe ii fluorescence lines between 1998 and 1999. Each arrow, placed at the wavelength of the appropriate pumping channel, represents the intensity ratio of I/I of lines originating from one of the pumped levels. Arrows pointing upward indicate an increase; downward a decrease. The dashed vertical line marks the rest wavelength of H Lyα.

6.4. High-excitation lines

Absorption of H Lyα photons from the a^{4}D term in Fe ii and the a^{6}D term in Cr ii can populate a number of 4p, 5p, and 4s4p levels having excitation energies between 11 and 12 eV. The primary decays from these levels give rise to strong fluorescence radiation in the UV and near-IR. The secondary decay chain involves lines from the 5s terms e^{4}D and e^{6}D, with excitation energies of ~10 eV, and, in the case of Fe ii, IR lines from the 4s terms c ^{4}P and c^{4}F.

All the Fe ii levels in Table 2, with the possible exceptions of 5p ^{6}F$_{1/2}$ and 4p ^{4}G$_{7/2}$ (the transitions from these two levels are blended with other features), produce observed emission lines in the STIS spectrum of the Weigelt components. All of the strongest (non-hydrogenic) emission features between 2000 and 3000 Å, and above 8000 Å are members of the primary and secondary decay chains from these levels. The Cr ii fluorescence lines are considerably weaker than the Fe ii lines due to the lower Cr ii abundance in the Weigelt blobs (Verner et al. 2005). The fluorescence of Cr ii is discussed in more detail by Zethson et al. (2001).

The intensities of the fluorescence lines are, in general, larger in 1999 than in 1998. The magnitude of the intensity changes differs between lines from different upper levels, indicating that the individual pumping channels populating the levels are not equally affected by the spectroscopic event. Figure 4 shows the ratios of the observed intensities of the infrared Fe ii fluorescence lines in the 1999 and 1998 STIS spectra. Included are lines from Fe II levels in Table 3 showing fluorescence lines in the infrared region, except (^{3}P1)4p ^{4}P$_{1/2,3/2}$ where the fluorescence lines are too blended or weak to derive reliable line ratios. In Fig. 4, each arrow represents lines from one of the levels in Table 2. The horizontal position of an arrow corresponds to the wavelength of the pump channel populating that level. The dashed vertical line marks the rest wavelength of H Lyα. From the figure it is seen that the pumped levels can be divided into three subgroups. The lines from the first group of levels have increased their intensity by a factor of ~2.5 in 1999 as compared to 1998, while the lines from the second group are observed to be stronger by a factor of ~1.5. The upper levels of the $\lambda\lambda$2507, 2509 lines, 5p ^{6}F$_{9/2}$ and 4p ^{4}G$_{9/2}$, respectively, belong to the first and second group, respectively, and the change in intensity of the two UV lines matches the changes of the IR lines from these two levels. Finally, there is the anomalous case of the lines from 5p ^{6}F$_{3/2}$ and 5p ^{6}F$_{5/2}$, whose intensities have *decreased* in 1999. This strange behavior is hard to explain, especially since the pump channels populating these two levels lie very close in wavelength to transitions populating levels from the first two subgroups.

The Cr ii fluorescence lines are all observed stronger by a factor of 1.5–2 in February 1999 compared with March 1998.

The fluorescence mechanism described above does not explain all the observed Fe ii emission coming from levels with excitation energies larger than 10 eV in the STIS spectrum. Lines from several (^{5}D)5p levels other than those included in Table 2, and also from (^{4}P)4s4p and (^{4}D)4s4p levels, are seen in the near infrared. They are weaker than most of the fluorescence lines, but many of the lines have intensities comparable with lines from other species, e.g. N I. A few lines from Cr ii (^{5}D)5p levels, not included in Table 2, are also observed.

The strongest examples of these lines are the Fe ii multiplets e^{6}D–(^{5}D)5p w^{6}P around 7700 Å, and e^{6}D–(^{5}D)5p ^{6}D around 9300 Å. Photoexcitation of these levels by absorptions of H Lyα photons from the a^{4}D term would require a width of Lyα of more than 30 Å (3700 km s^{-1}), the pump channels having wavelengths of ~1200 Å for the w^{6}P levels and ~1235 Å for the 5p ^{6}D levels. Others of the observed (weaker) lines require even larger widths if they are to be explained as Lyα-induced fluorescence. Such high velocity components of H Lyα are not out of scope as models of the wind-wind interactions leading to the observed X-ray spectra require mass loss velocities of the secondary, η Car B, to be 3000 km s^{-1} (Pittard & Corcoran 2002). Indeed intensity enhancements of Fe II fluorescent lines are evidence that support greatly broadened wind lines from η Car B.

Another possible excitation mechanism for the lines, resulting from channels with wavelengths more than 5Å from H Lyα, would be photoexcitation from the a^{6}D ground term by continuum radiation, since many of the upper levels in question have strong transition channels at ∼1100 Å to a^{6}D levels. A similar process could also explain the presence of several very weak Fe ii lines in the 5000–5500 Å range coming from (^{5}D)4f levels having excitation energies of ∼13 eV. These levels are connected to the a^{4}F term with transitions falling at 1000 Å, and their strongest decay channels are to (^{5}D)4d levels, giving rise to the emission lines observed in the STIS spectrum. The (^{5}D)4f levels have J-values of 1/2–15/2, but the $J = 13/2$ and $J = 15/2$ levels can not be populated by absorption from the a^{4}F term, the highest J-value of which is 9/2. The proposed excitation mechanism is supported by the fact that no emission lines are seen from the $J = 13/2$ and $J = 15/2$ levels, even though the transitions from these levels have the largest transition probabilities of the 4d–4f lines.

The only other examples of emission from highly-excited levels of the iron-group elements are from Mn ii. A number of relatively weak lines between 6123 and 6132 Å are identified as Mn ii 4d e^{5}D–(^{6}S)4f ^{5}F (multiplet 13), the upper levels having excitation energies of ∼12 eV. They are seen in emission in other objects as well, e.g. helium-weak stars (Sigut et al. 2000), and have also been observed in earlier observations of η Car. Their appearance in the η Car spectrum has been explained as fluorescence, pumped by the Si ii UV5 multiplet at ∼1195 Å (Johansson et al. 1995).

6.5. "Pseudo-forbidden" lines

The following discussion regards Fe ii, but an analogous reasoning is applicable to the other iron-group elements as well.

Figure 5 shows a schematic diagram of the Fe ii term system. The 3d^6 configuration in the parent ion, Fe iii, gives rise to 16 different LS terms: ^{1}S, ^{1}S, ^{1}D, ^{1}D, ^{1}F, ^{1}G, ^{1}G, ^{1}I, ^{3}P, ^{3}P, ^{3}D, ^{3}F, ^{3}F, ^{3}G, ^{3}H, and ^{5}D. In accordance with Hund's rule for equivalent electrons, the ^{5}D term is most tightly bound and is thus the ground term. The two highest terms of the 3d^6 configuration, ^{1}S and ^{1}D, have not been found in Fe iii.

The 3d^6 terms of Fe iii are the parent terms of the 3d^6nl configurations in Fe ii, and the latter are represented by the boxes in Fig. 5. Each parent term gives rise to a subsystem of Fe ii 3d^6(^ML)nl configurations, the configurations of the individual subsystems being connected by vertical lines in the figure. The resulting LS- terms of the subconfigurations are obtained by coupling the nl- electron to the ^ML parent term.

As seen in the figure, the parent structure is closely reproduced by the subconfiguration structure, the distance in energy between the levels of the configurations 3d^6(^ML)nl and 3d^6($^{M'}L'$)nl in Fe ii being roughly equal to the energy difference between the ^ML and $^{M'}L'$ terms in Fe iii. As a result of this resemblance in structure, the 3d^{6}4s configurations belonging to the highest parent terms, b^{3}P, b^{3}F, and b^{1}G are located *above* the lowest 3d^{6}4p levels of the ^{5}D parent, and can consequently decay downwards in allowed 4s → 4p transitions.

These high 4s levels have long lifetimes, being on the order of 1–10 ms, as compared to normal lifetimes of excited levels (1–10 ns). The metastable 3d^7 and 3d^{6}4s states that give rise to the parity-forbidden emission lines discussed above have lifetimes of 1 ms–10 s, and the high 4s levels can thus be regarded as "pseudo-metastable". They differ from the metastable states in that they can make allowed transitions down to lower 4p levels. The transition probabilities, or A-values, of these decays are small, having values several orders of magnitude smaller than transitions from normal excited states. But in a low-density plasma producing [Fe ii], such as the Weigelt blobs, they will

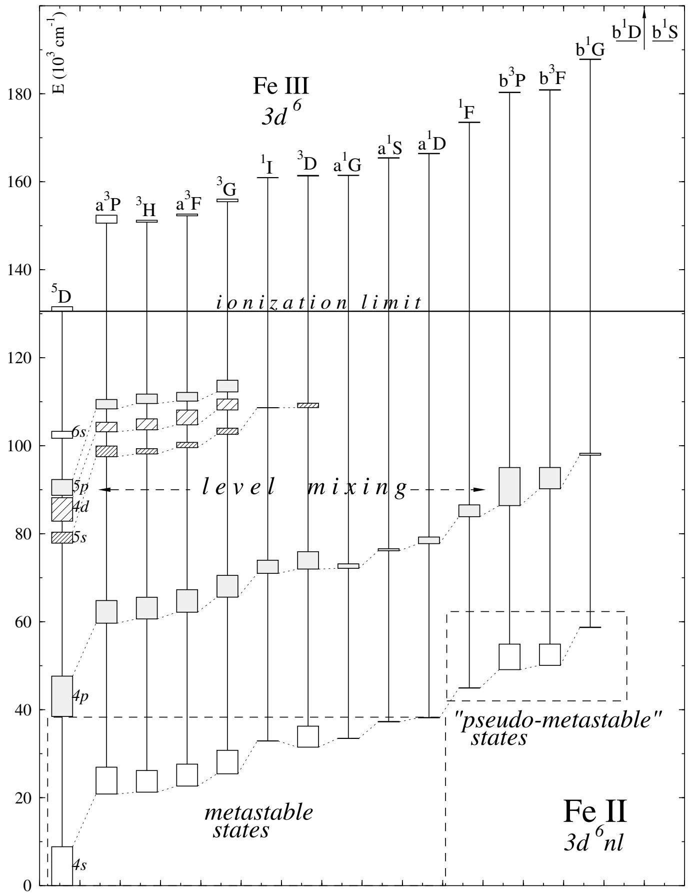

Fig. 5. The term system of Fe ii.

show up in emission, at wavelengths reaching from the visible (∼6000 Å) to the infrared.

A similar case regards the 3d^{5}4s^2 configuration. (The terms of this configuration can not be assigned to a specific parent term in Fe iii due to the Pauli principle; the 3d^{5}4s terms in Fe iii are parent terms of the 3d^{5}4snl configurations in Fe ii having $nl \neq$ 4s.) The 3d^{5}4s^2 configuration spans a wide energy range, and the highest levels of the configuration lie above the lowest 4p terms, thus producing observable emission lines. The lifetimes of the 3d^{5}4s^2 levels are shorter than the lifetimes of the high 3d^{6}4s levels, ∼10 μs. An exception is the lowest level of 3d^{5}4s^2, a^{6}S$_{5/2}$, which is metastable and has a lifetime of 0.23 s (Rostohar et al. 2001).

Since the high 3d^{6}4s and 3d^{5}4s^2 levels are of even parity, they can not be pumped from low-lying metastable states by continuum radiation or by a coincidence in wavelength with a strong emission line. Some of the 3d^{6}4s levels will be populated by primary cascades of the H Lyα-induced Fe ii fluorescence, but this is an exceptional case in the Weigelt blob spectrum, as no strong emission lines going to the 4s′′ levels are observed. The only strong transitions ending on the 3d^{5}4s^2 levels come from highly-excited 4s4p and 5p levels above 13 eV, meaning that these levels in general can not be fed by cascades either.

Most of the pseudo-metastable levels are therefore purely collisionally excited, in contrast to many of the true metastable states, which are populated through decays from higher 4p levels. This probably makes the "pseudo-forbidden" emission lines from these levels good diagnostic tools, especially when it comes to abundance studies of the emitting plasma. To our knowledge, these lines have never been used for such purposes.

Many of the pseudo-forbidden Fe II lines, observed in the Weigelt spectrum, are presented in more detail by Zethson (2001, Appendix A). For further discussions on some of these lines, see Johansson & Zethson (1999) and Johansson et al. (2001). Other examples of similar lines come from Mn II and Cr II. The Mn II 4p z^5P–4s ^{2} c^5D multiplet shows up in relatively strong emission between 8000 and 8800 Å. These lines were first identified by Thackeray & Velasco (1976). They are the strongest Mn II lines in the entire observed spectrum. A number of weak lines above 9500 Å are tentatively identified as Mn II 4p z^5P – 3d^6 e^3F and 4p z^5P–3d^6 c^3P. This is yet another case of pseudo-forbidden lines, where the highest levels of the 3d^k configuration are located above the lowest 3d^{k-1}4p levels (cf. Fig. 5), giving rise to 4p–3d transitions. Finally, a few, weak lines are observed from the pseudo-metastable 3d^{3}4s^2 d^4P term in Cr II.

6.6. Fe I

There is only weak evidence for the presence of neutral iron in Weigelt BD. A feature at 2844.4 Å, partly blended with a stronger Cr II line, is identified as the a^5F_2–y^5G_3 λ2844.83 transition in Fe I (UV44). The other lines in the same multiplet coming from the y^5G_3 level have wavelengths of 2796.36 and 2824.11 Å, respectively. The shorter of these wavelengths almost exactly coincides with the Mg II 3s–3p resonance line at 2796.35 Å, and since the energy of the a^5F-term is low, ~7500 cm^{-1}, the y^5G_3 level might be pumped by the Mg II line (Gahm 1974). The 2824.11 Å line, most likely not the line leading to pumping, is unfortunately blended with a Fe II line (UV198).

No other lines from Fe I or [Fe I] are observed in the spectrum.

6.7. Third spectra lines

[Fe III] is well represented in the 1999 spectrum, e.g. by multiplets 1F and 3F between 4500 and 5300 Å. A few lines of Fe III are also observed in the UV; the H Lyα pumped Fe III fluorescence discussed by Johansson et al. (2000), and also the two strongest lines of the a^5S–z^5P multiplet (UV 48) at 2070 Å.

A line appearing at 7891 Å in 1999, being absent in 1998, is tentatively identified as the $^3F_3$–$^1D_2$ transition of [Ni III]. The other strong line of that multiplet, $^3F_2$–$^1D_2$ λ8502 is blended by a Fe II fluorescence line.

6.8. [Fe IV]

Thirteen rather weak lines, present in the 1999 data but missing in 1998 data, have been identified as [Fe IV]. Some of the proposed [Fe IV] lines are blended with other species, but for a few of the features no other explanations have been found. In a paper on [Fe IV] in RR Tel, Thackeray (1954) notes that a number of unidentified lines in the RR Tel spectrum could be explained as [Fe IV], and that one of these lines also had been observed in η Car, but we have not found any further mentions of [Fe IV] in η Car in the literature. The source of excitation leading to [Fe IV] emission is thought to be the hot companion, η Car B, characterized by Verner et al. (2005); Mehner et al. (2010); Madura et al. (2012) to be an O or WR star capable of ionizing many elements to higher energy states.

The wavelengths, intensities and calculated transition probabilities of the proposed [Fe IV] lines are presented by Zethson (2001, Appendix B).

Table 3. Radial velocities for lines from the Weigelt blobs.

Spectrum	Number of lines	Mean radial velocity (km s^{-1})	Standard deviation (km s^{-1})
Fe II	240	−45.2	4.0
[Fe II]	146	−44.5	3.9
[Fe III]	16	−45.4	4.5
H I [a]	22	−46.7	3.2
He I	22	−46.9	3.2
N I	34	−45.6	2.8
N II	9	−49.1	7.2
[N II]	3	−44.0	11.3
[Ar III] [b]	4	−51.2	7.5
[Ne III]	2	−48.2	1.3
All lines (λ > 3500 Å)	747	−45.1	4.5

Notes. The last lines gives the average for all lines above 3500 Å. [(a)] Only Paschen lines. [(b)] [Ar III] λ3110 is also included.

7. Radial velocities

The radial velocity of the Weigelt blobs can provide clues on when they were ejected from the central star. Previous GHRS observations have shown that the Weigelt blobs have a heliocentric radial velocity of ~−45 km s^{-1} (Davidson et al. 1997).

Table 3 lists the radial velocities for some of the observed spectral species. The differences among the spectral lines are small, but some discrepancies do exist. Most notably are the velocities of the [N II] and [Ar III] lines. [N II] λ5756 is observed blueshifted by 57 km s^{-1}, while $\lambda\lambda$6549, 6585 are blueshifted by 35 and 43 km s^{-1}, respectively. The 5756 Å line originates from the $^1S_0$ level, while the two other lines originate from the $^1D_2$ level. The excitation energy of $^1D_2$ is ~2 eV lower than $^1S_0$, and the difference in observed velocity might suggest that the lines are emitted from different regions in the observed plasma. However, for [Ar III] the situation is more puzzling. $^1S_0 \rightarrow {}^3P_1$ λ3110 and $^1S_0 \rightarrow {}^1D_2$ λ5193 have radial velocities of −52 and −59 km s^{-1}, respectively, while $^1D_2 \rightarrow {}^3P_2$ λ7137 and $^1D_2 \rightarrow {}^3P_1$ λ7753 have radial velocities of −41 and −52 km s^{-1}, respectively. Smith et al. (2004) also observe high excitation lines, fluorescent ⟨Fe II⟩ and [Ne III], to have a larger Doppler shift compared to forbidden [Fe II] and [Ni II] lines. A reason for this difference is the possibility that lines are emitted from different parts of the Weigelt condensation as discussed by Hartman et al. (2005). Nielsen et al. (2007b), using the HST/STIS echelle high dispersion mode centered on Weigelt D, measured H I Lyα-pumped lines in the mid-ultraviolet to have heliocentric velocities of −47 ± 0.7 km s^{-1}, in good agreement with the present measures.

Acknowledgements. We are grateful to Nick Collins for providing the tools and producing the 2D spectro-images plots. The observations of the Weigelt blobs were made with the STIS on the NASA/ESA HST under programs 7302 and 8036, and were obtained by the Space Telescope Science Institute, which is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS5-26555. H. Hartman acknowledges support from the Swedish Research Council (VR) through contract 621-2006-3085. The research on η Car at Lund University has received long term support from the Swedish National Space Board (SNSB), which is greatly appreciated. All analysis was done using STIS GTO IDL software tools on data available through the HST η Car Treasury archive. Don Lindler provided very useful display tools for generating the spectro-images. We are grateful to the referee for improvements to the manuscript.

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Appendix A: Overview spectra

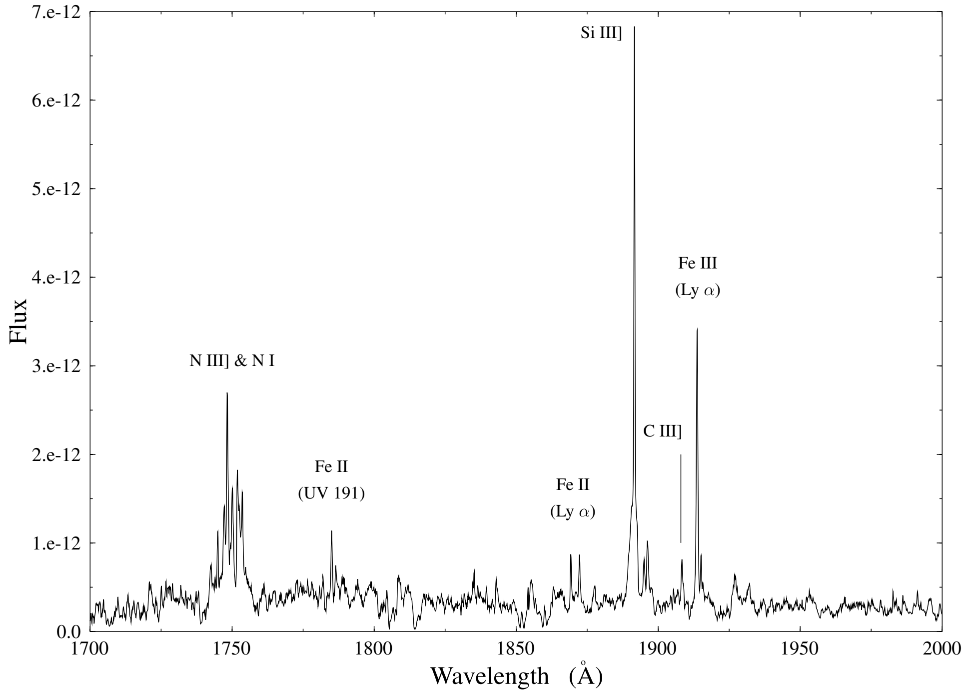


Fig. A.1. The 1700–2000 Å spectrum.

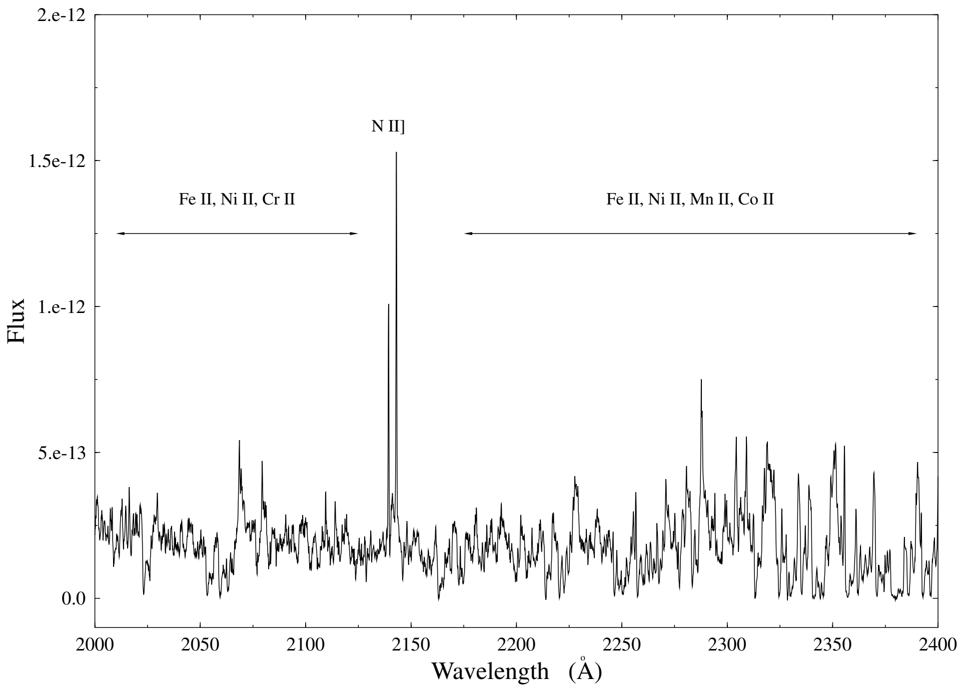


Fig. A.2. The 2000–2400 Å spectrum.

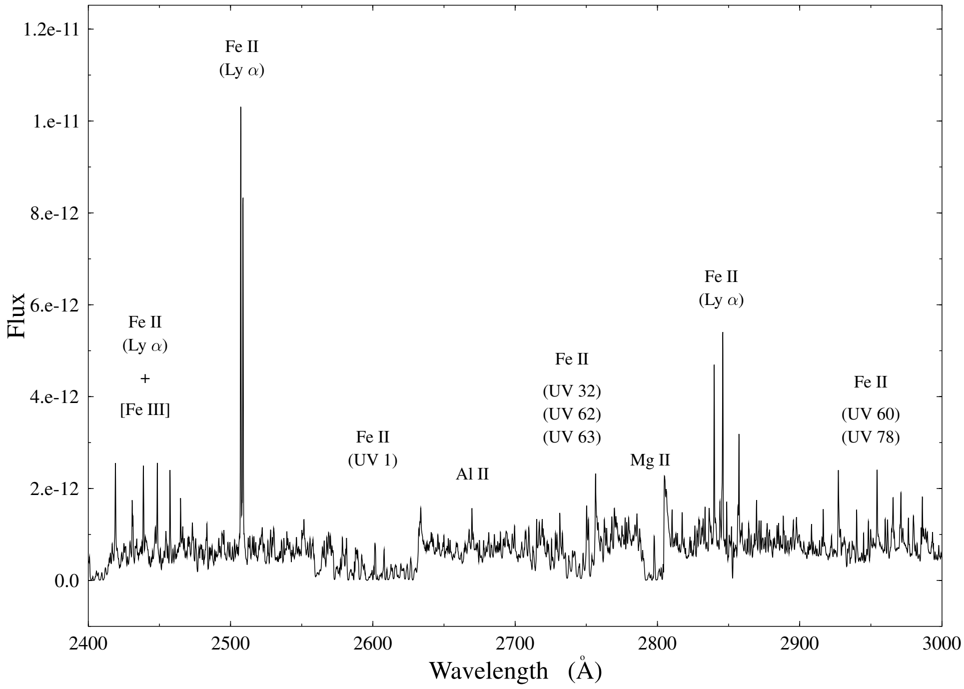


Fig. A.3. The 2400–3000 Å spectrum.

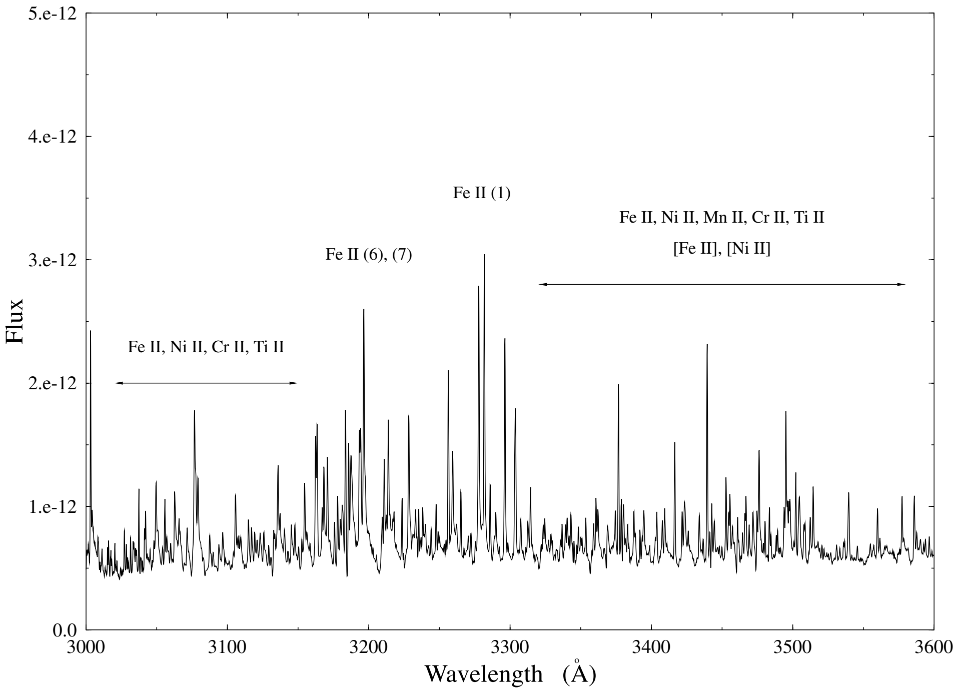


Fig. A.4. The 3000–3600 Å spectrum.

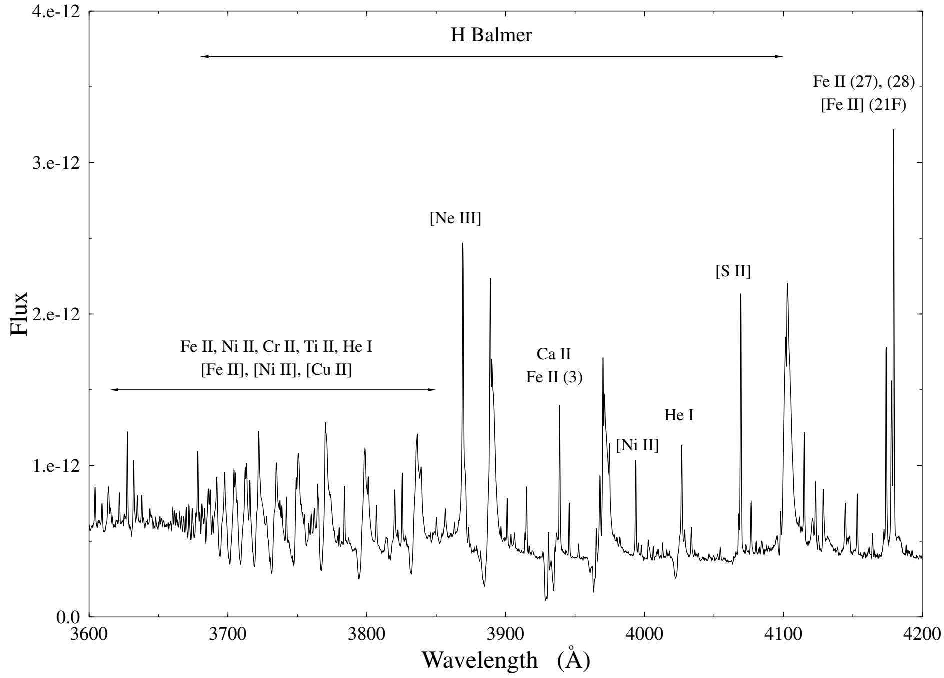


Fig. A.5. The 3600–4200 Å spectrum.

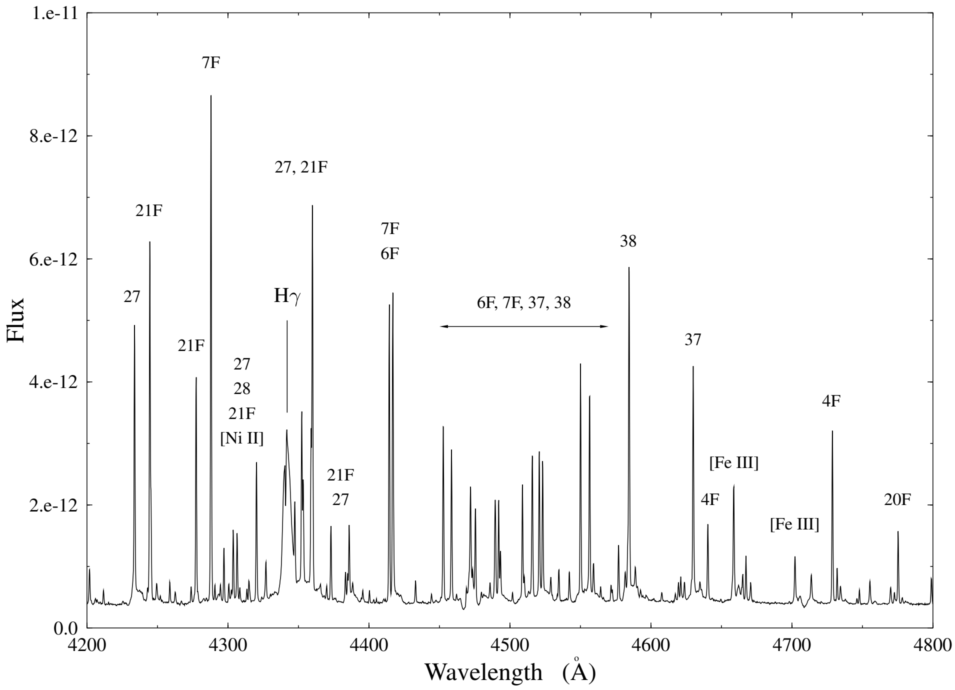


Fig. A.6. The 4200–4800 Å spectrum.

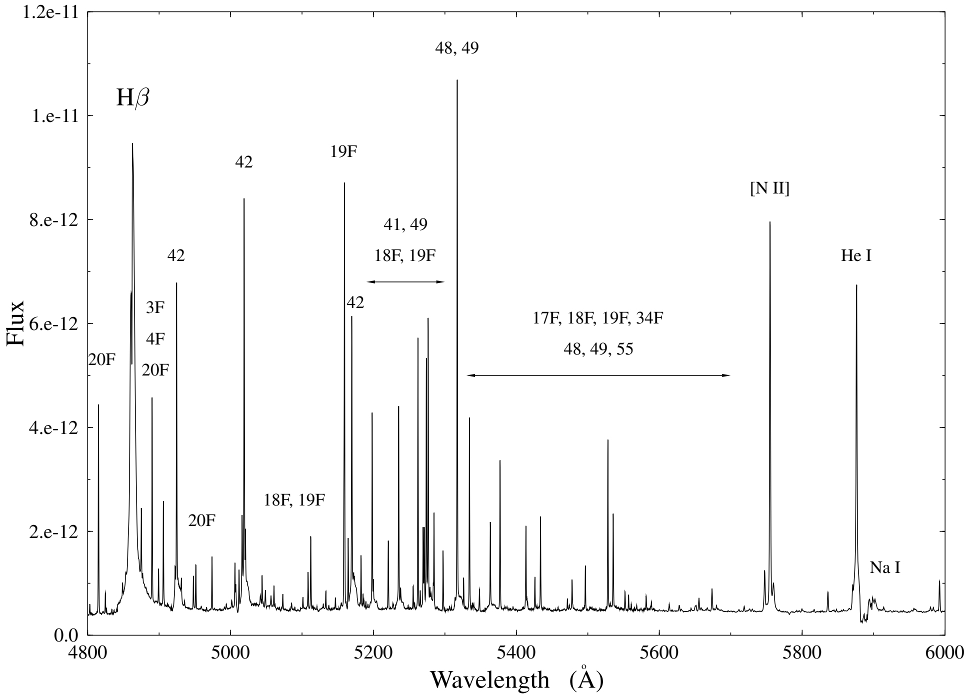


Fig. A.7. The 4800–6000 Å spectrum.

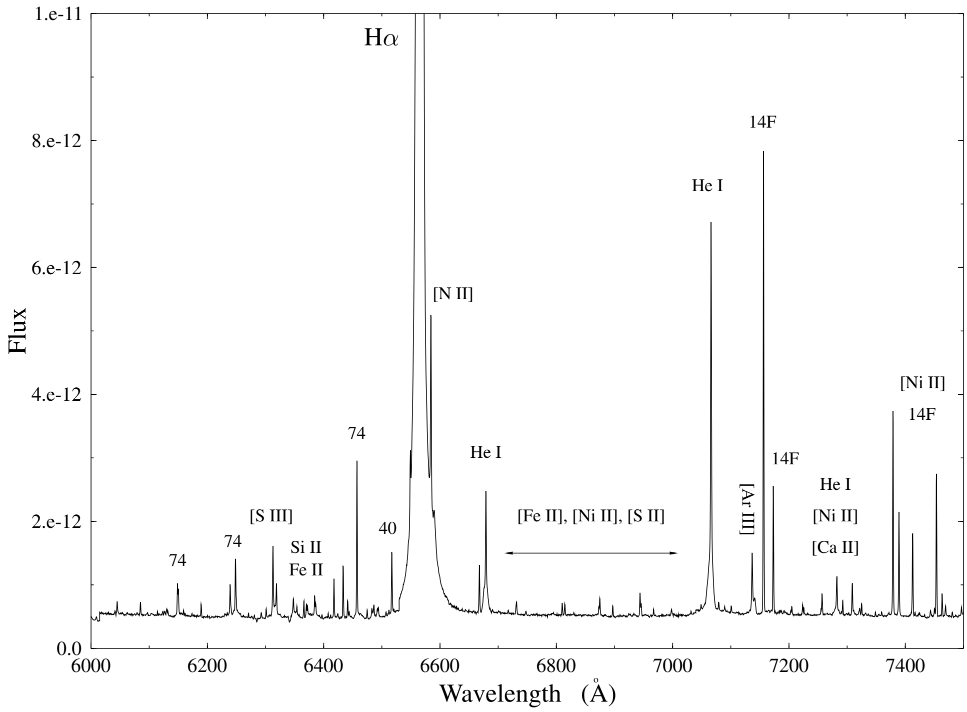


Fig. A.8. The 6000–7500 Å spectrum.

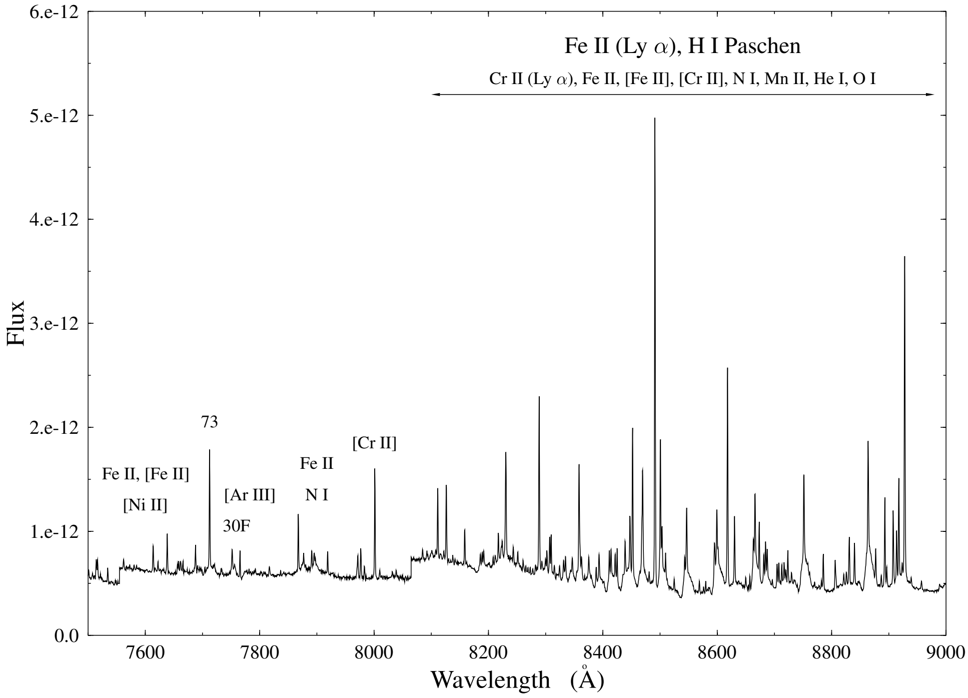


Fig. A.9. The 7500–9000 Å spectrum. The dicontinuities seen at 7550 and 8100 Å are not real, but instrumental artifacts caused by overlaps of two adjacent observations.

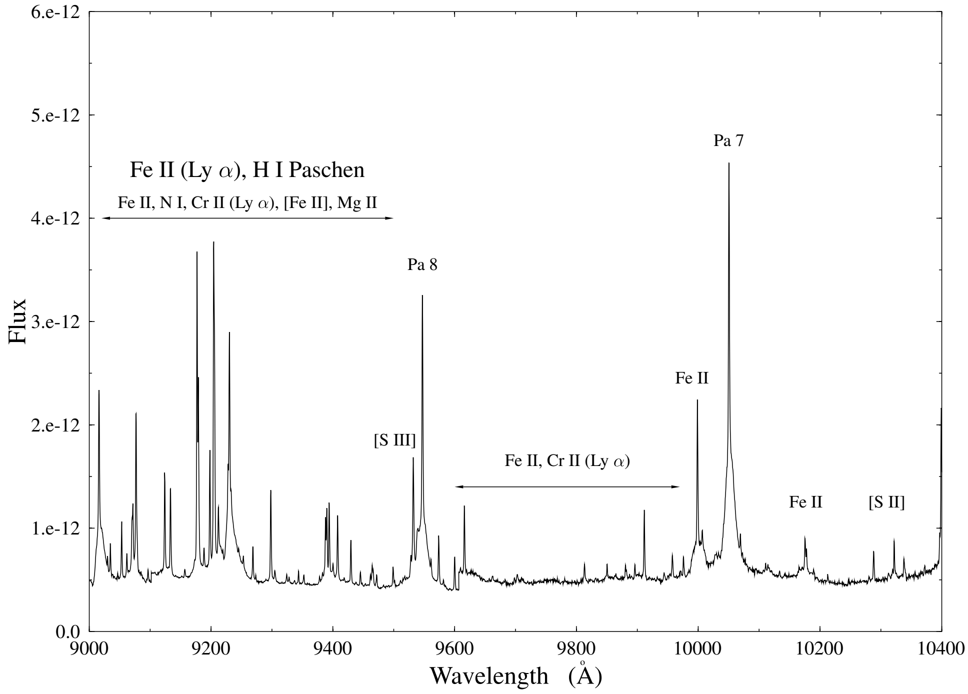


Fig. A.10. The 9000–10 400 Å spectrum. For the discontinuity at 9600 Å, see previous figure.

Appendix B: Spectro-images

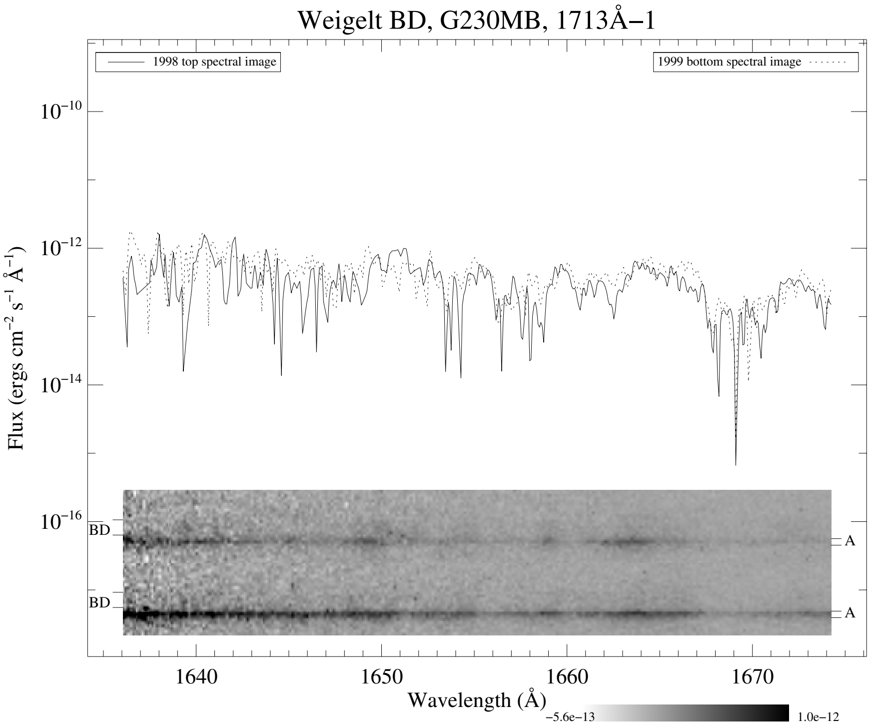


Fig. B.1. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

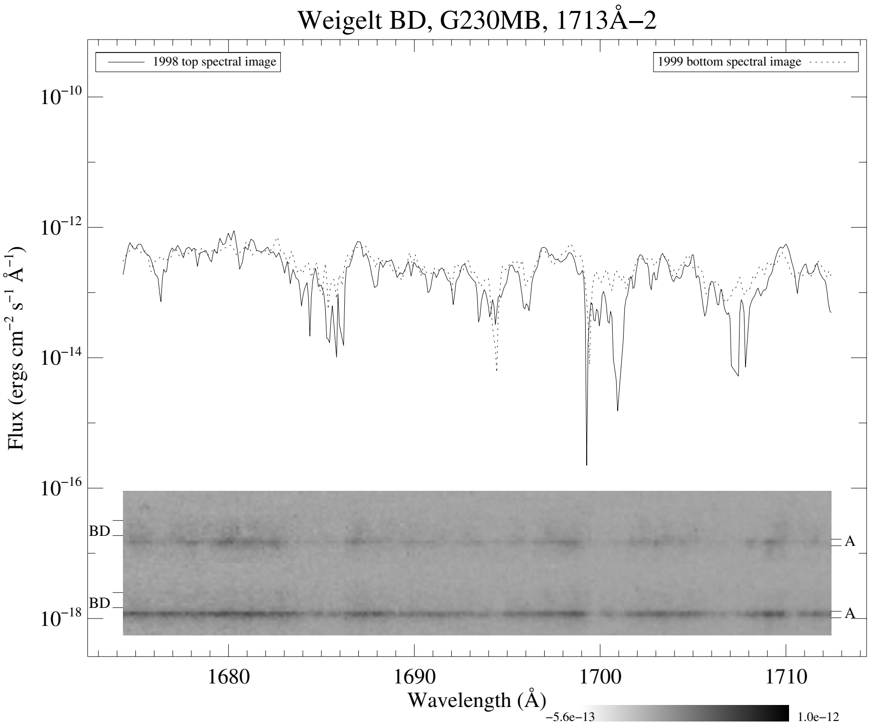


Fig. B.2. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

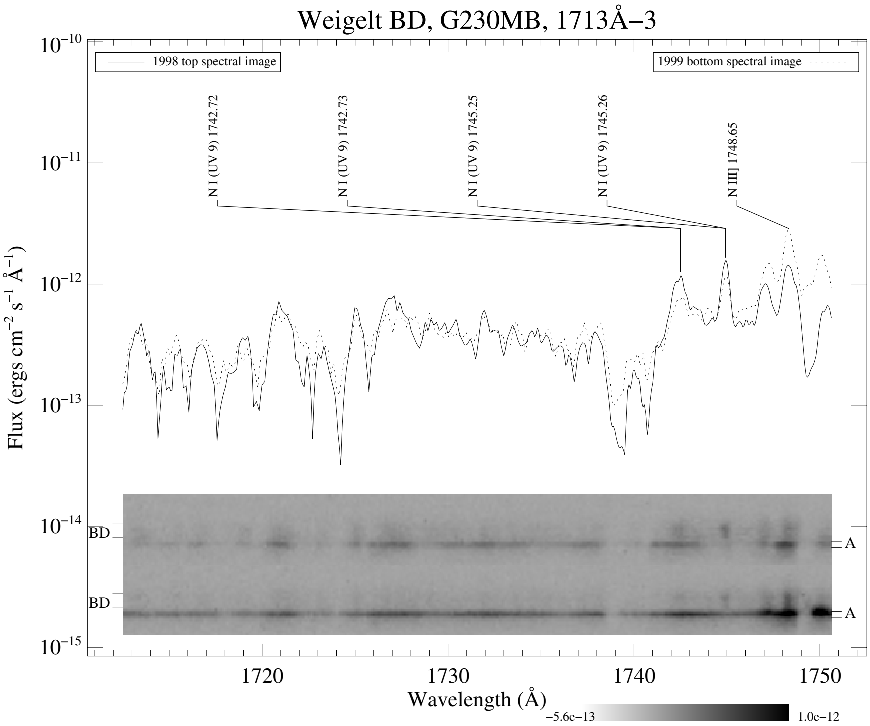


Fig. B.3. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

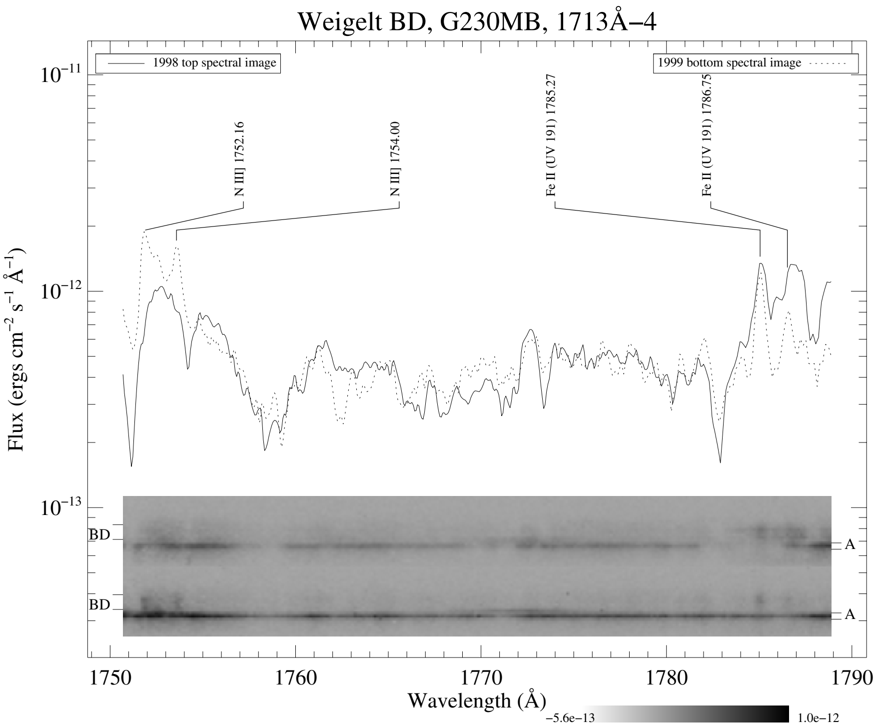


Fig. B.4. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

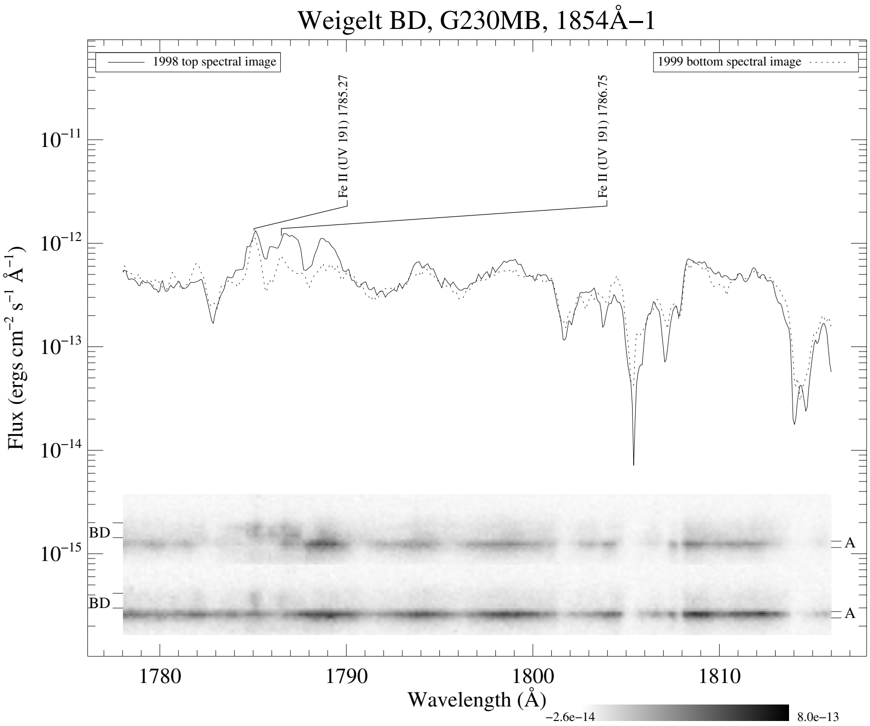


Fig. B.5. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

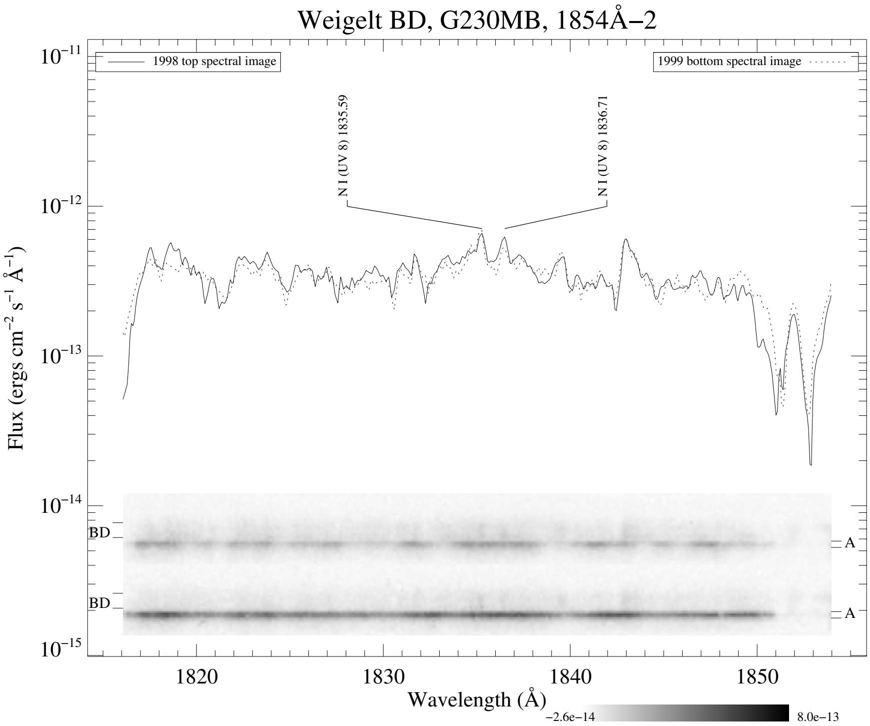


Fig. B.6. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

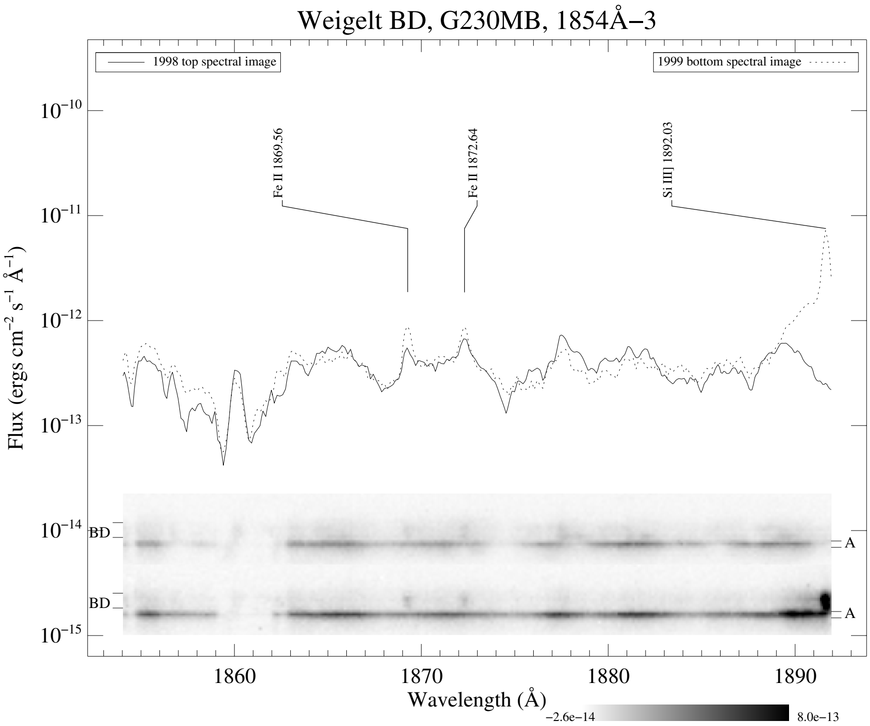


Fig. B.7. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

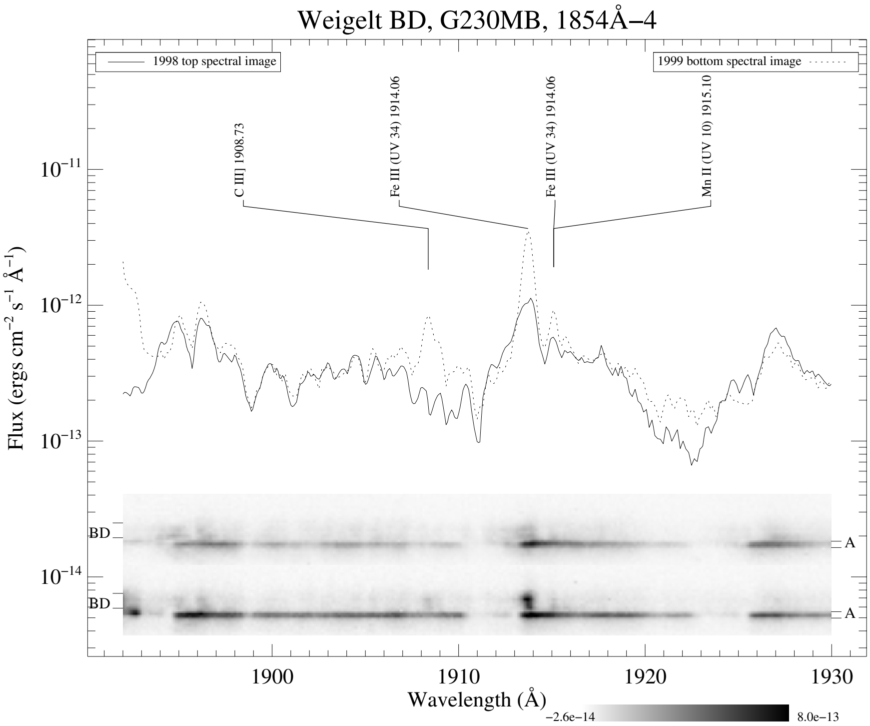


Fig. B.8. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

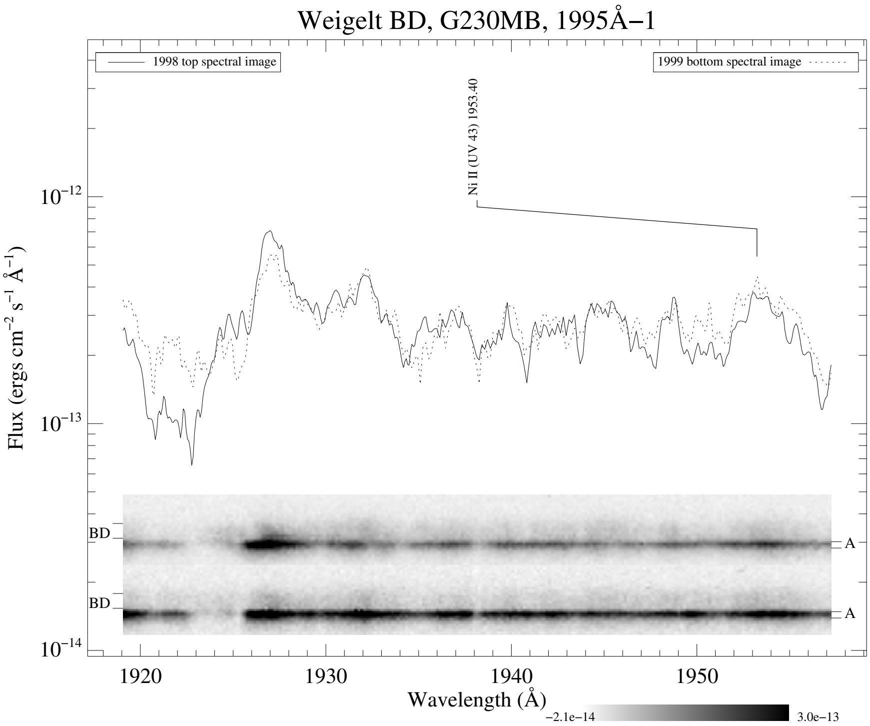


Fig. B.9. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

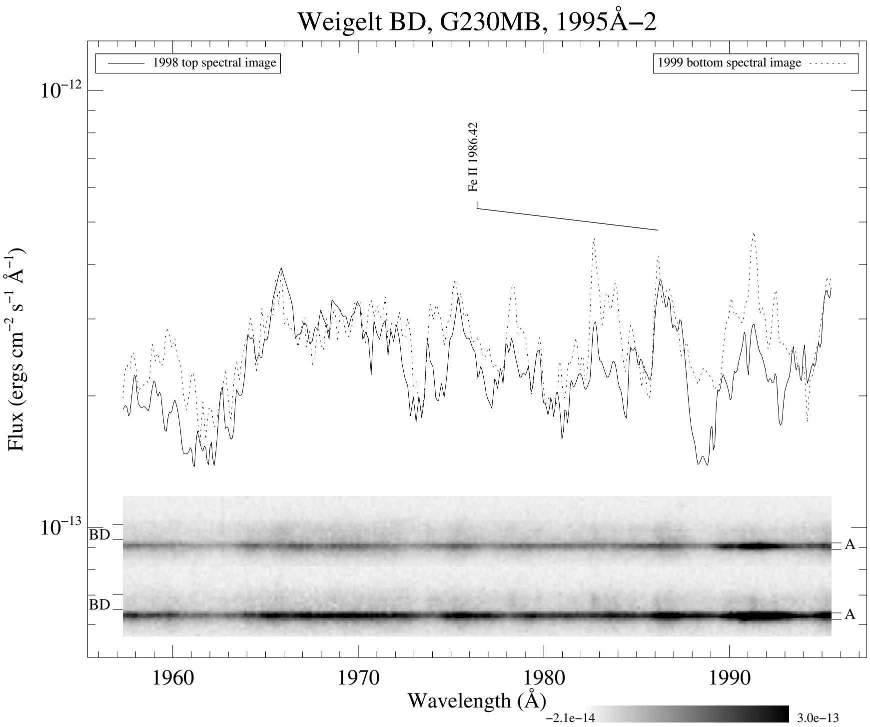


Fig. B.10. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

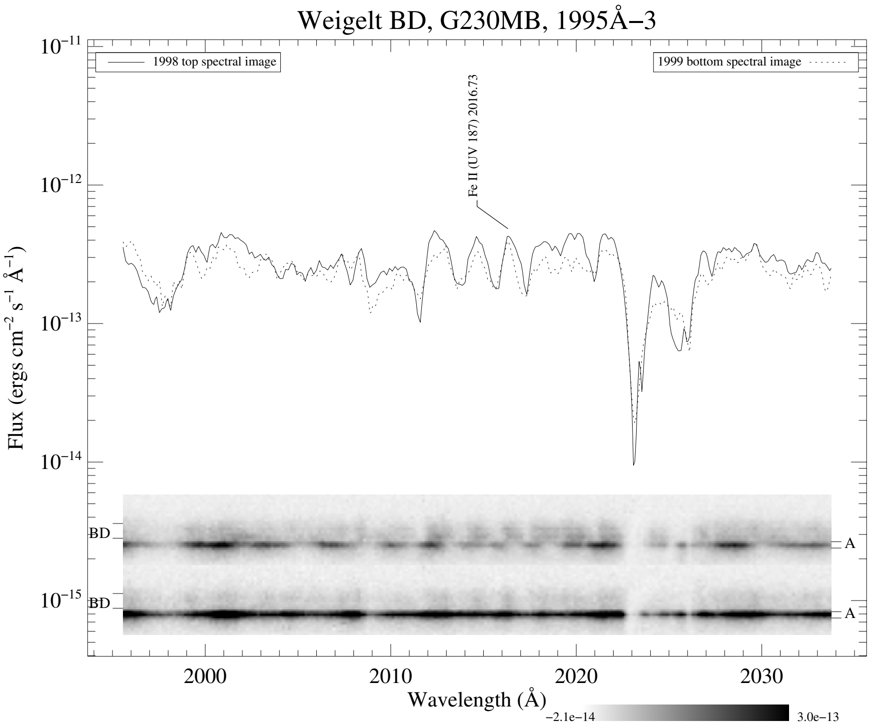


Fig. B.11. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

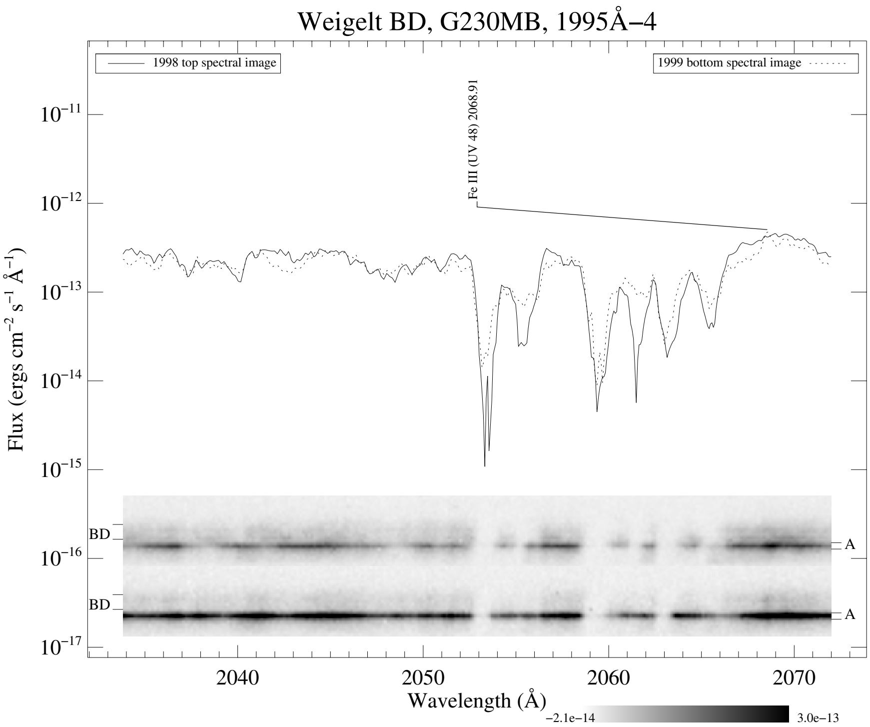


Fig. B.12. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

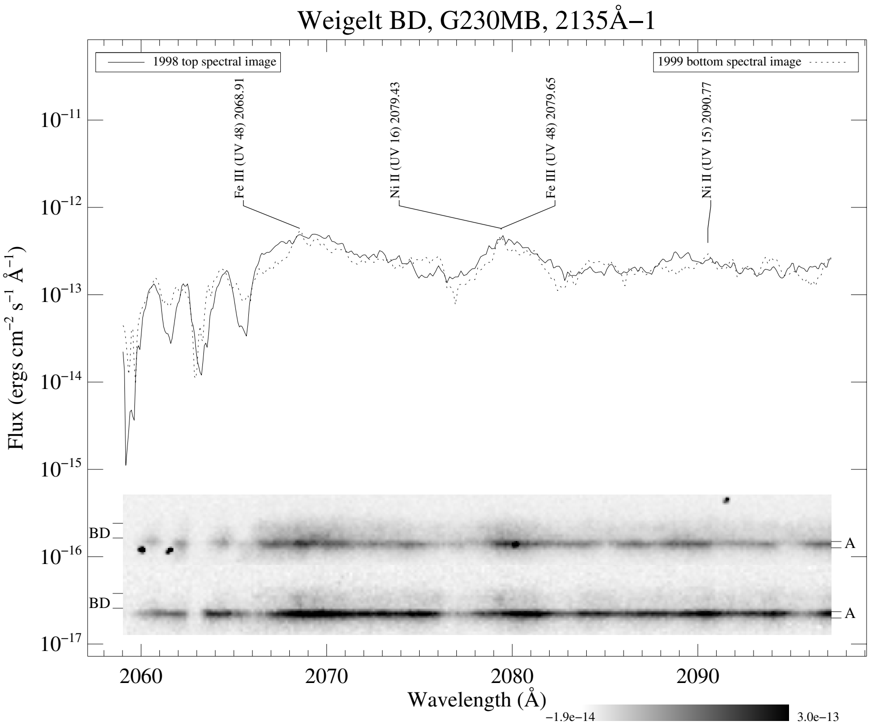


Fig. B.13. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

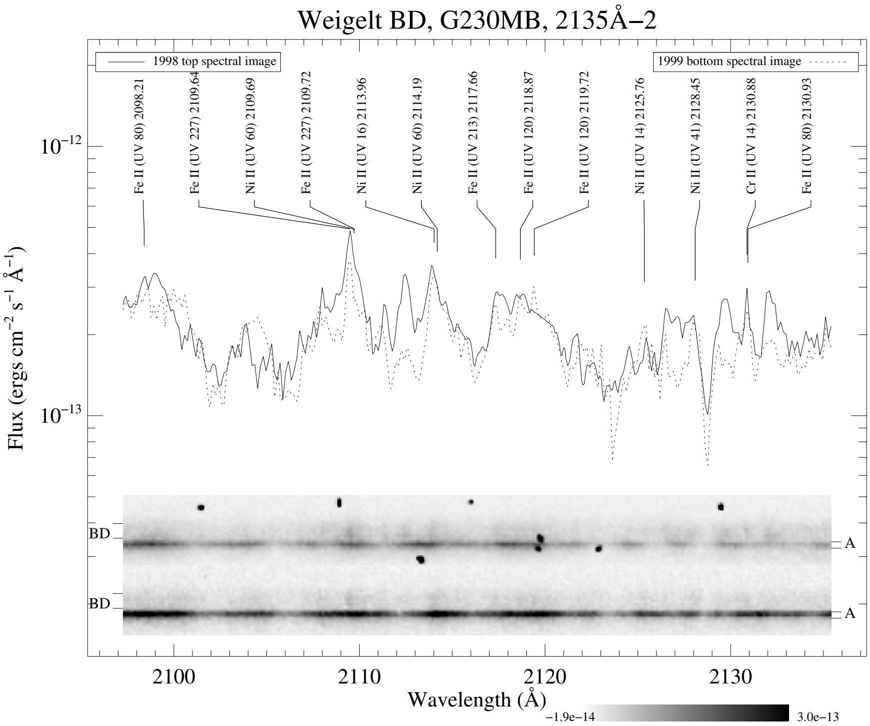


Fig. B.14. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

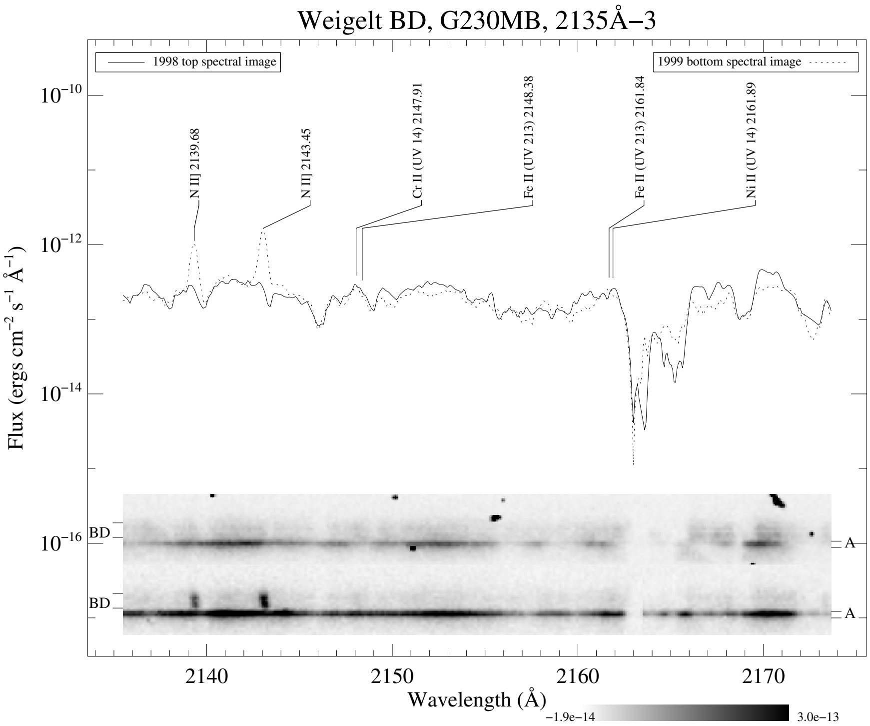


Fig. B.15. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

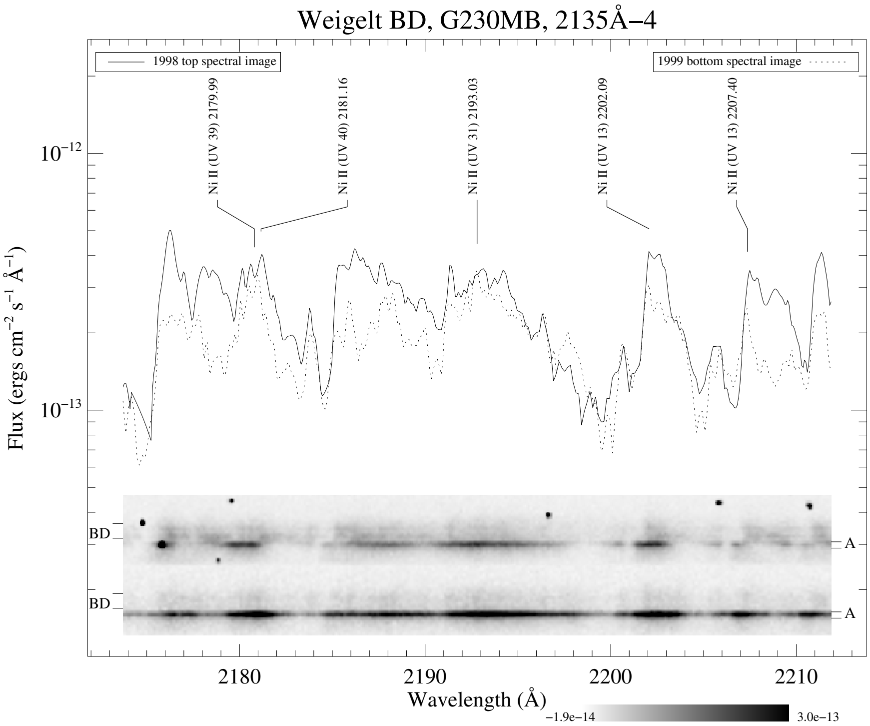


Fig. B.16. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

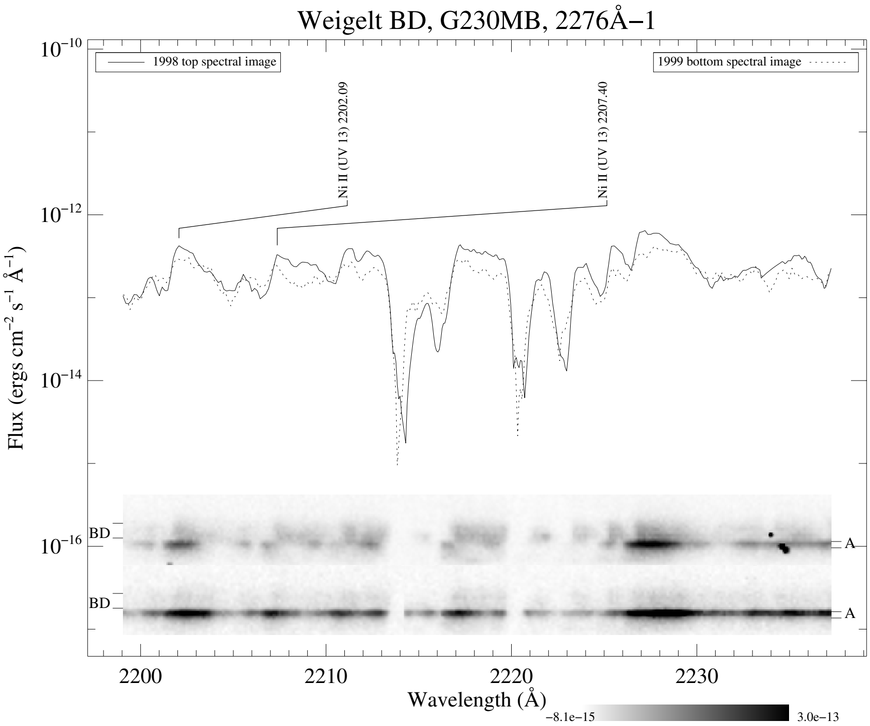


Fig. B.17. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

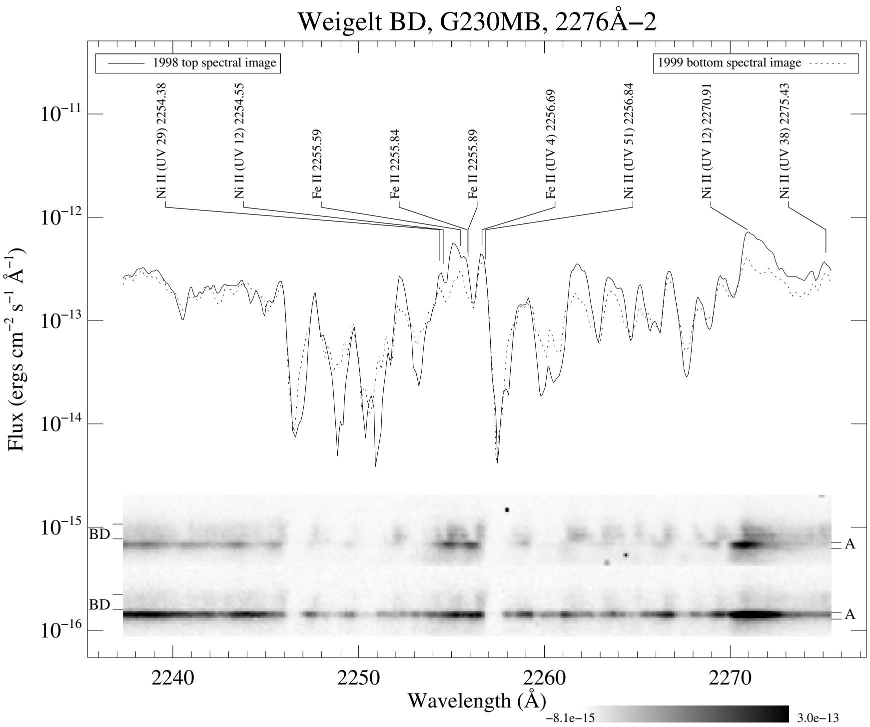


Fig. B.18. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

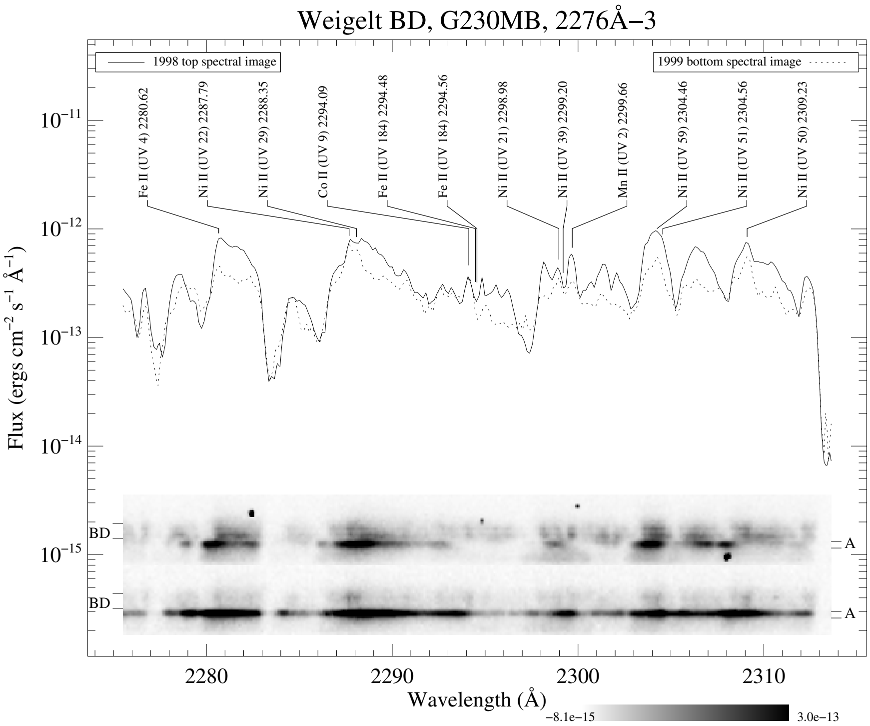


Fig. B.19. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

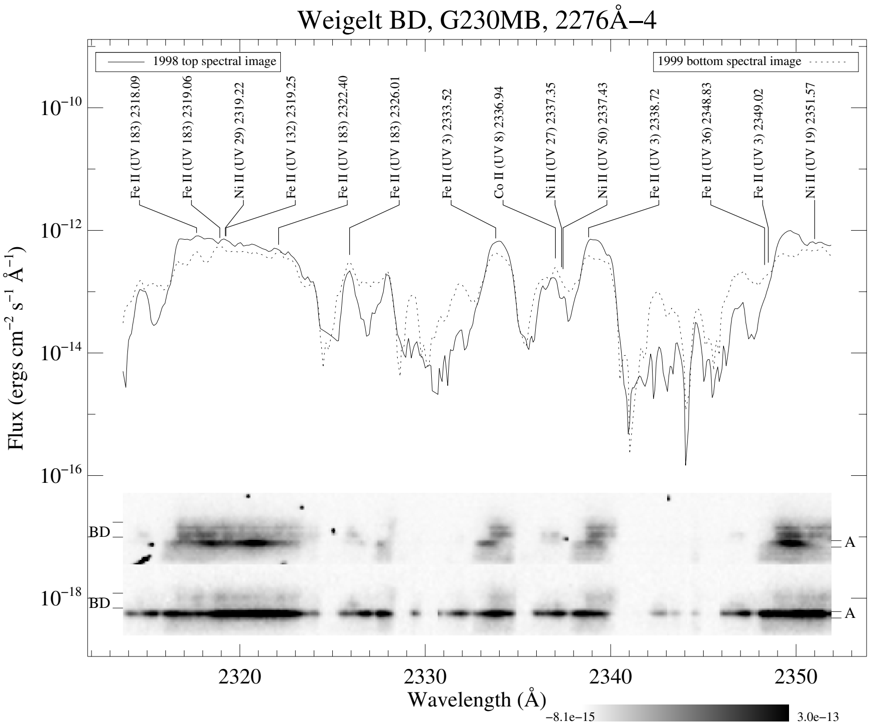


Fig. B.20. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

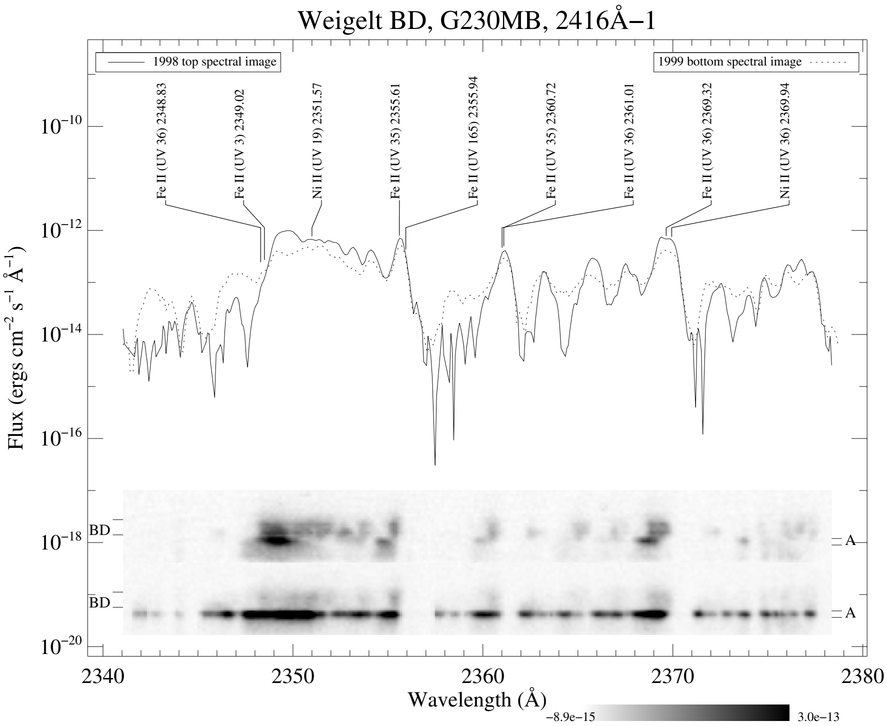


Fig. B.21. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

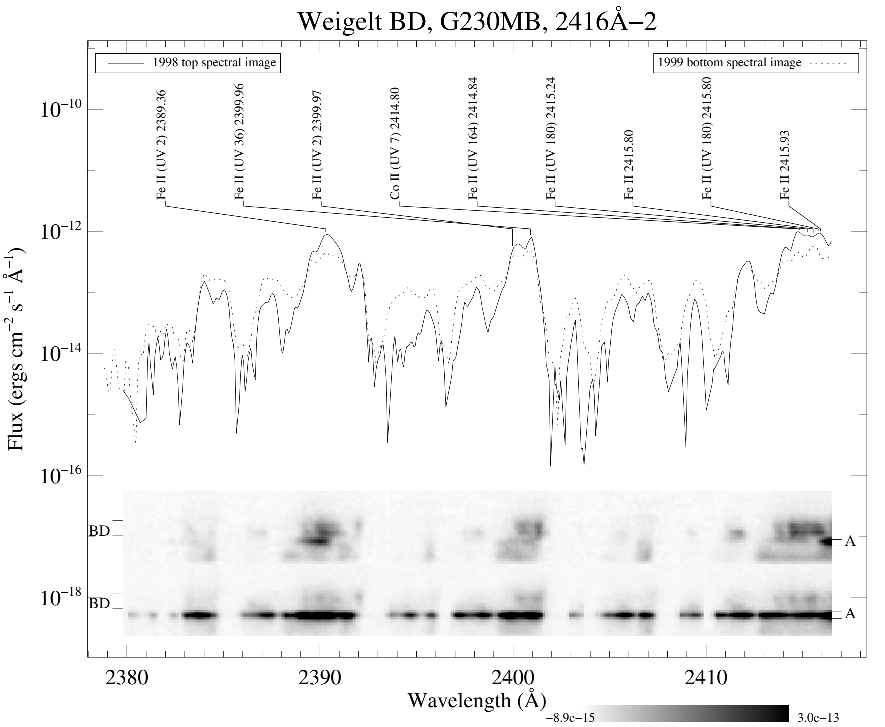


Fig. B.22. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

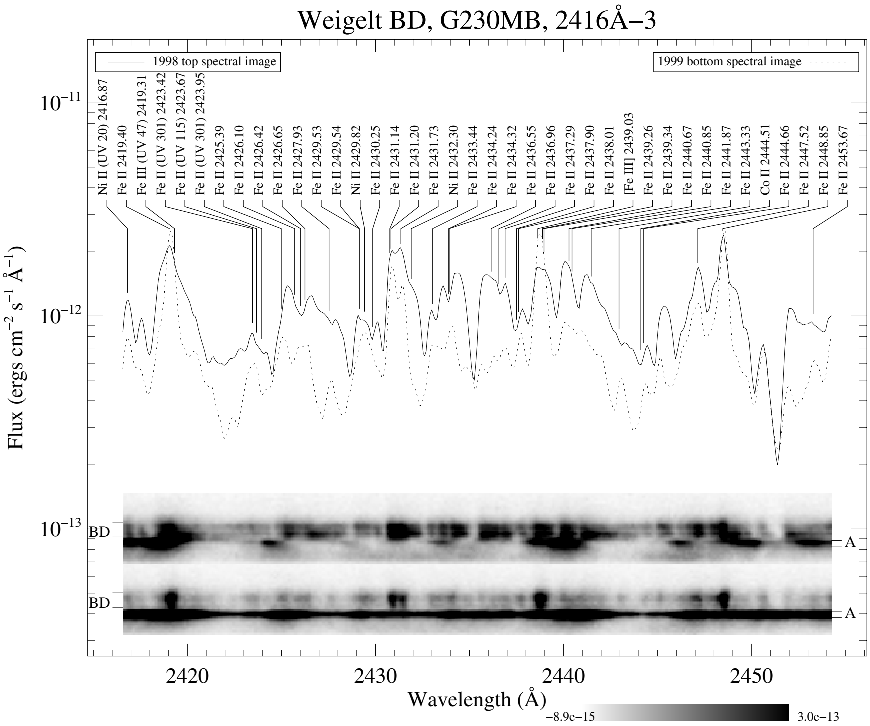


Fig. B.23. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

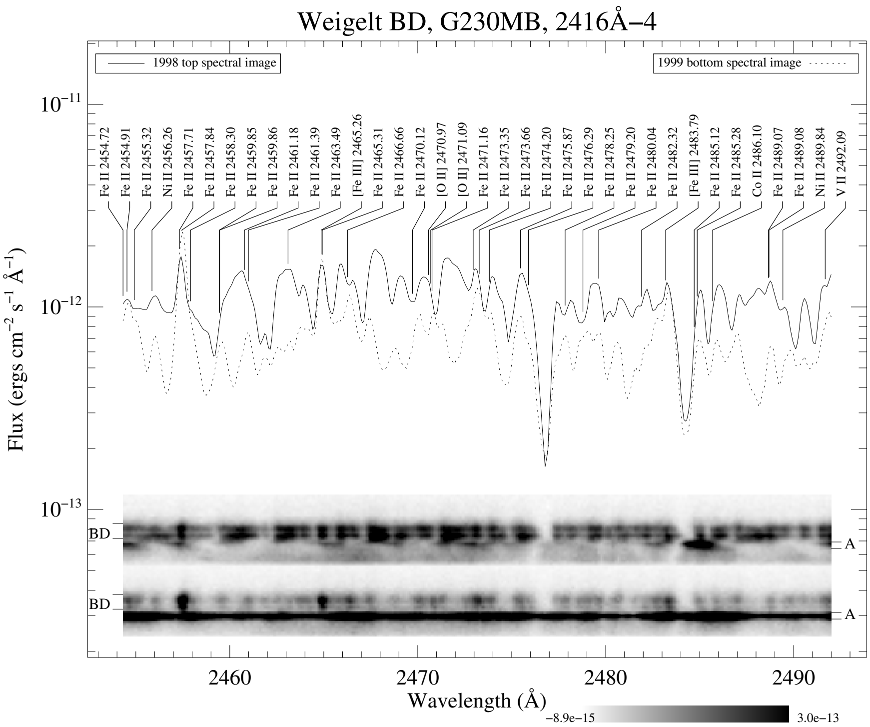


Fig. B.24. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

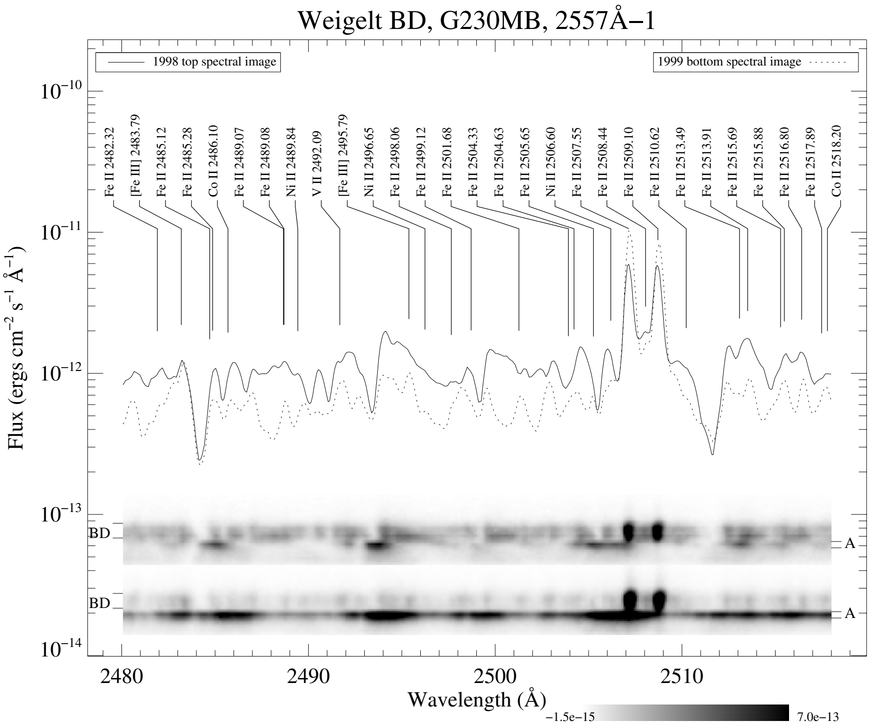


Fig. B.25. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

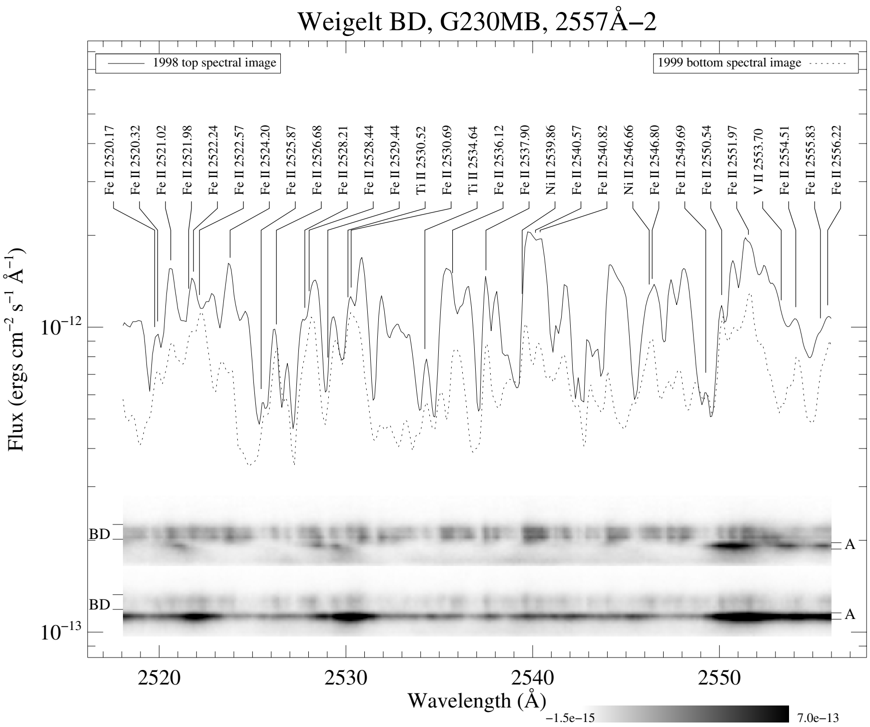


Fig. B.26. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

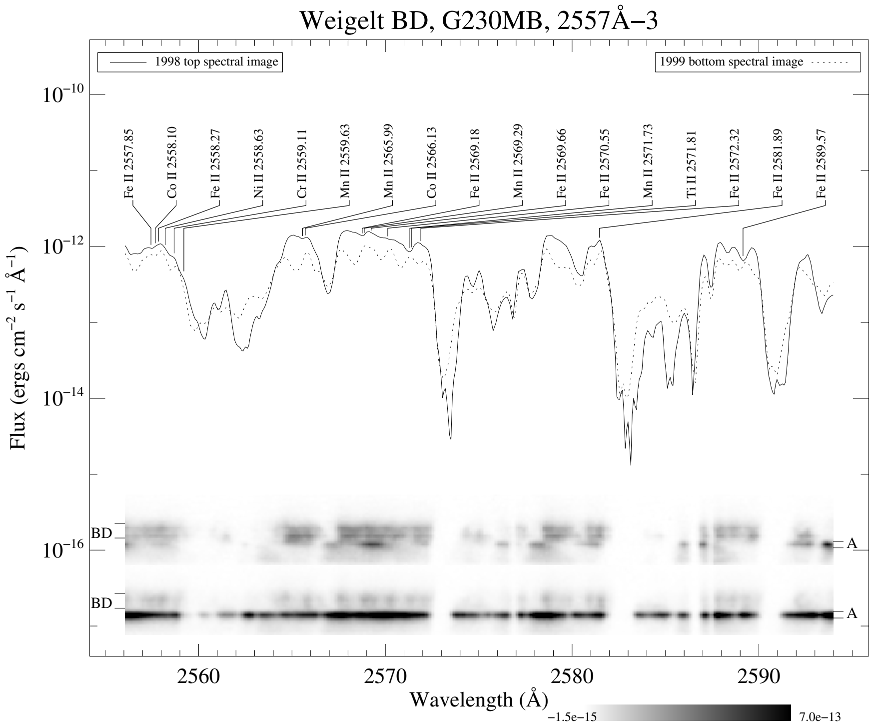


Fig. B.27. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

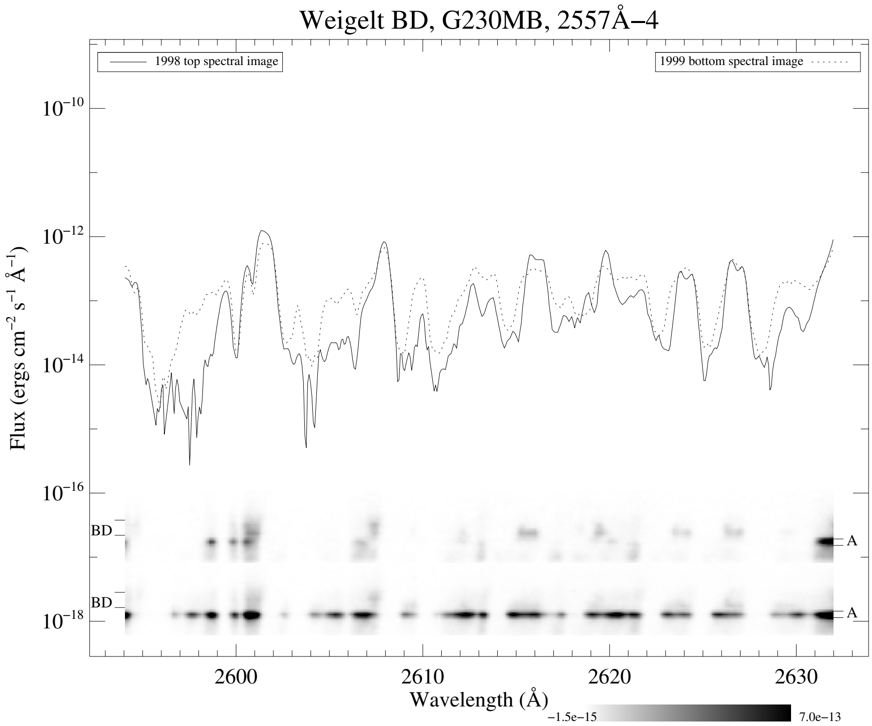


Fig. B.28. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

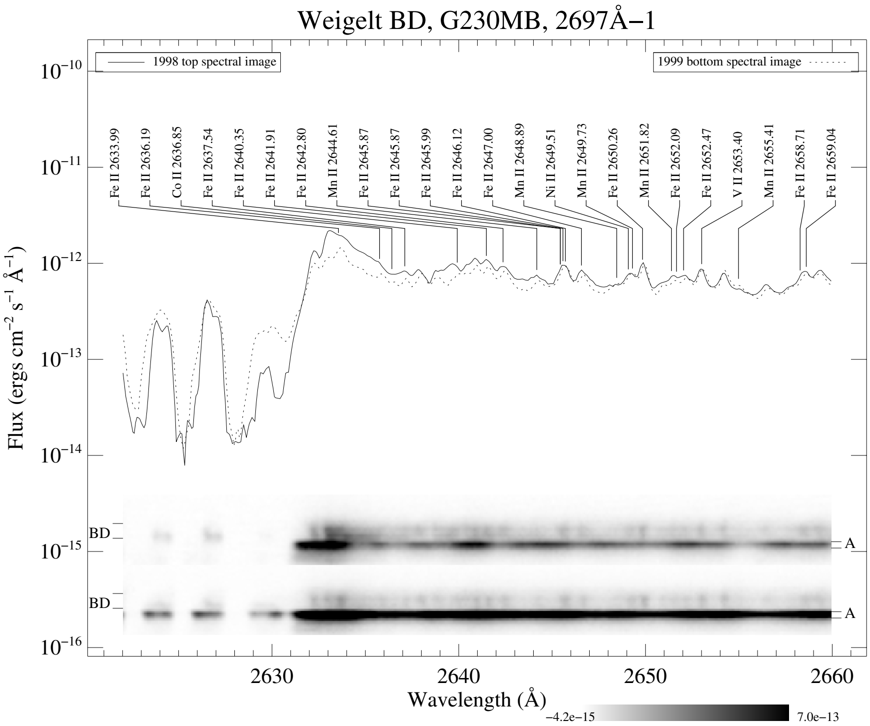


Fig. B.29. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

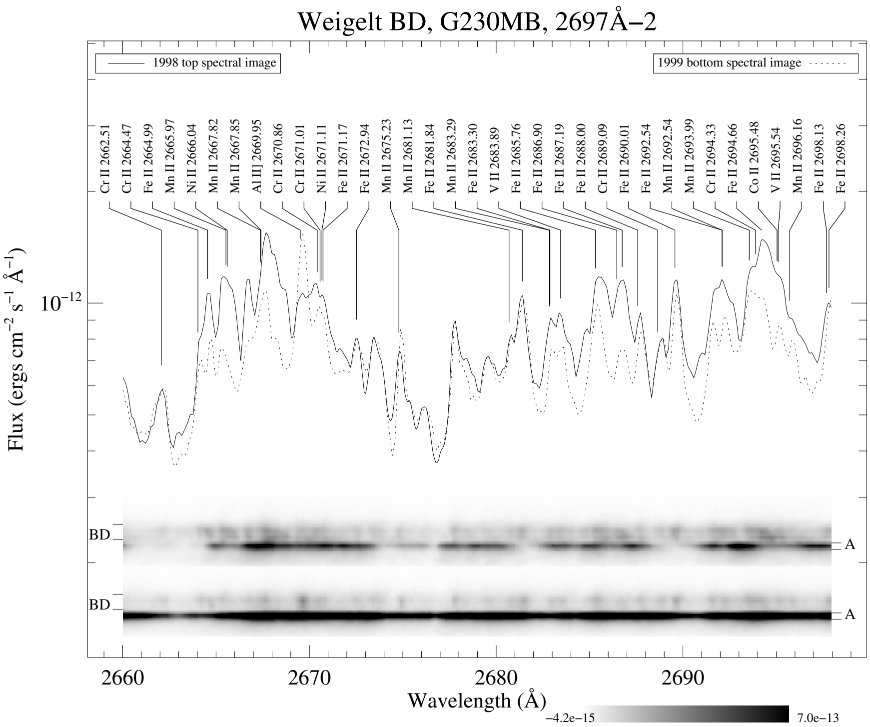


Fig. B.30. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

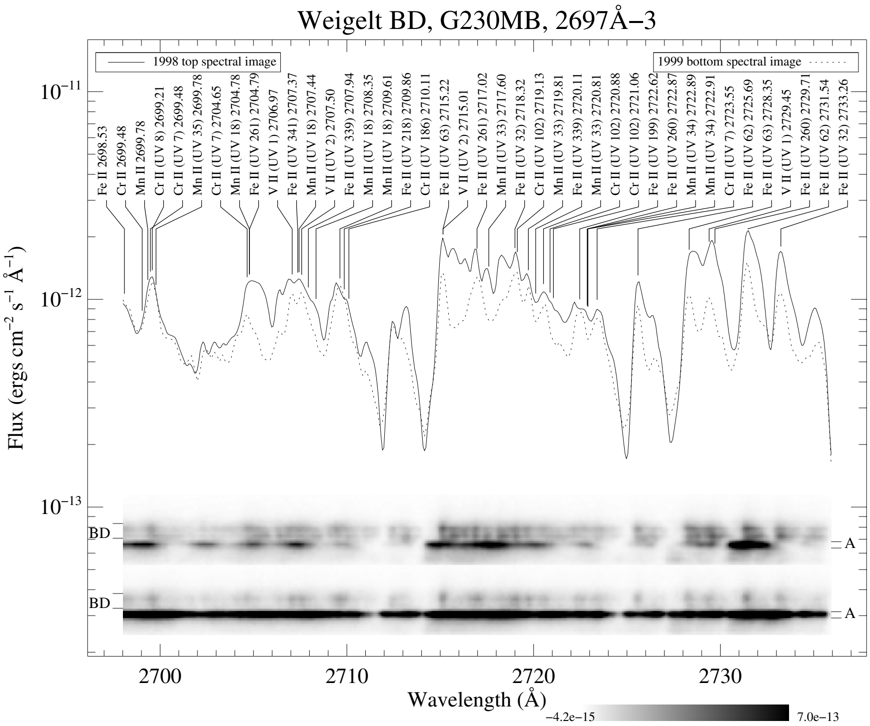


Fig. B.31. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

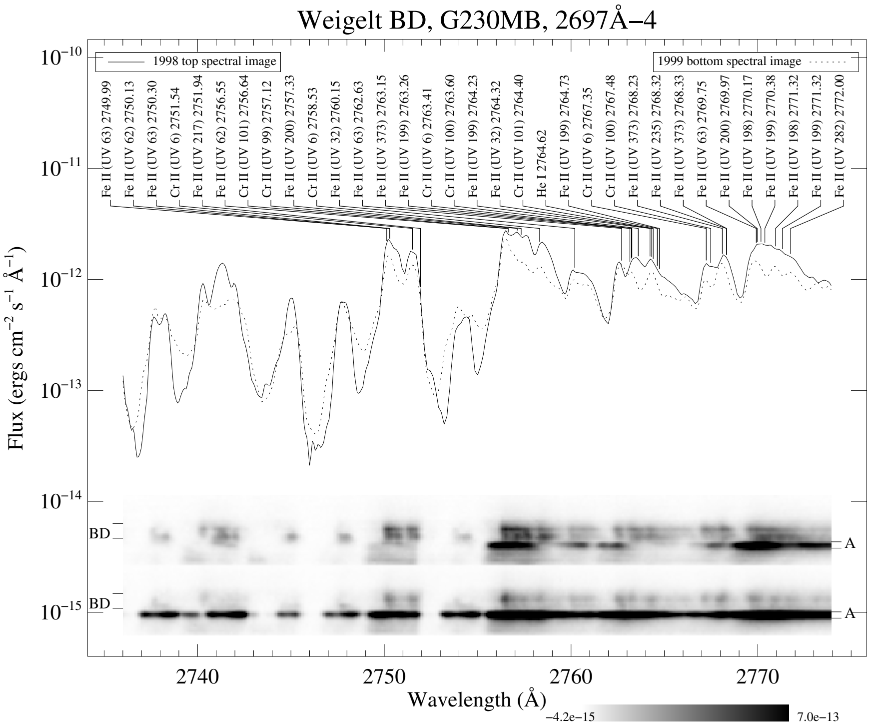


Fig. B.32. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

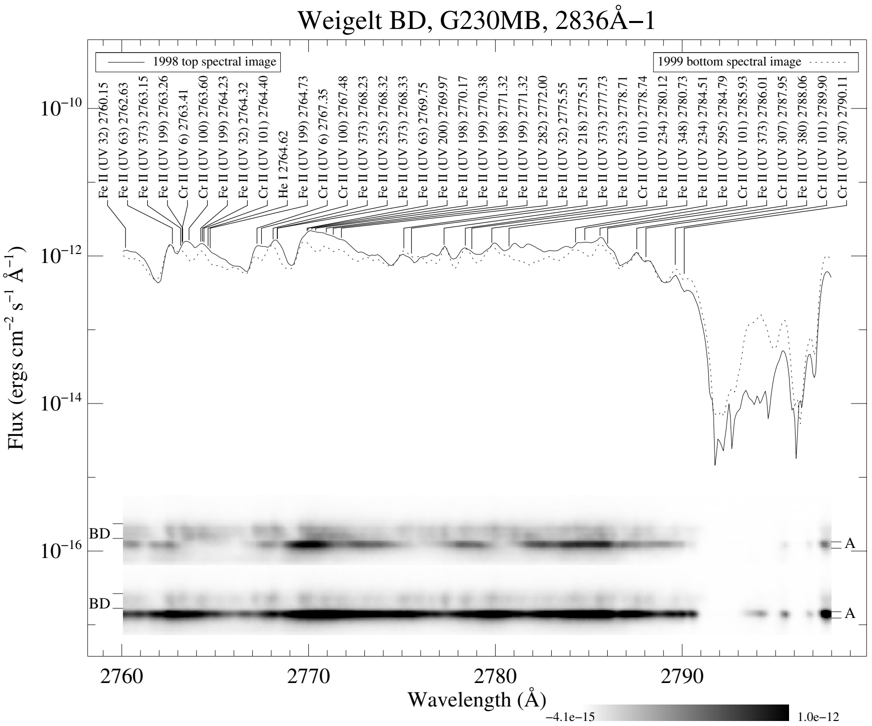


Fig. B.33. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

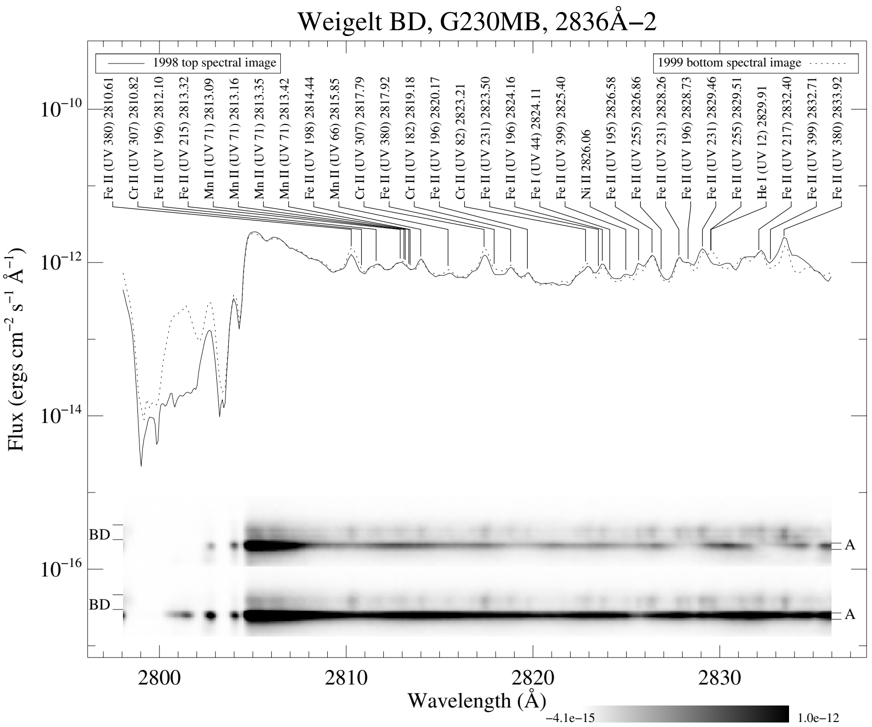


Fig. B.34. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

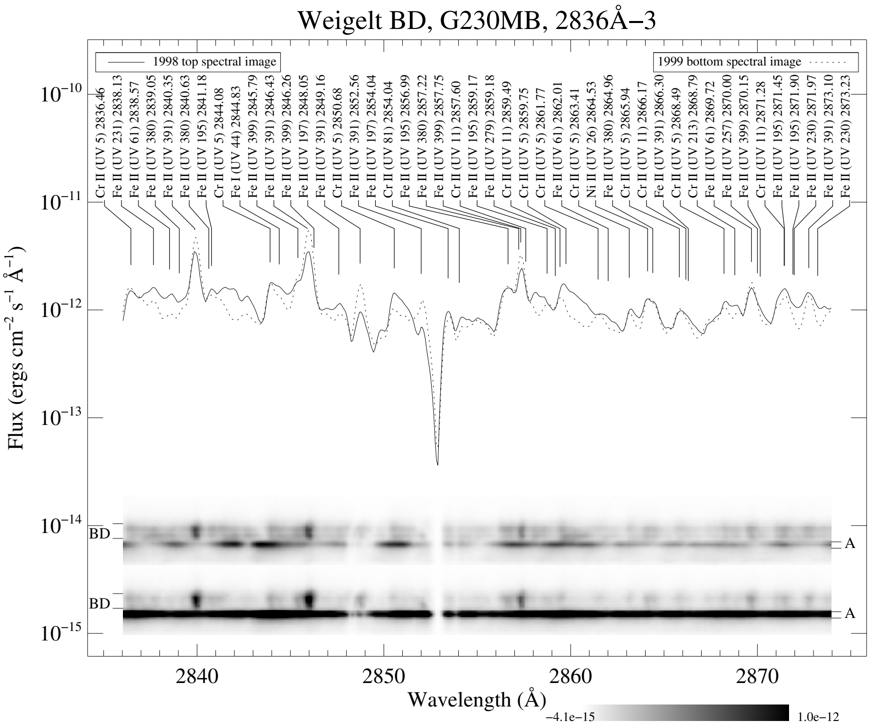


Fig. B.35. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

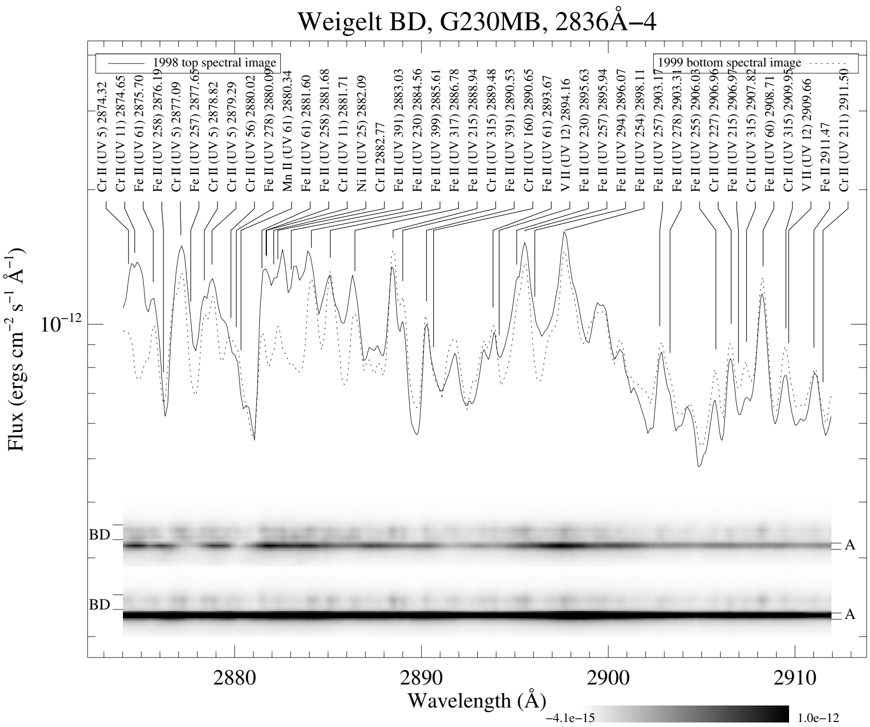


Fig. B.36. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

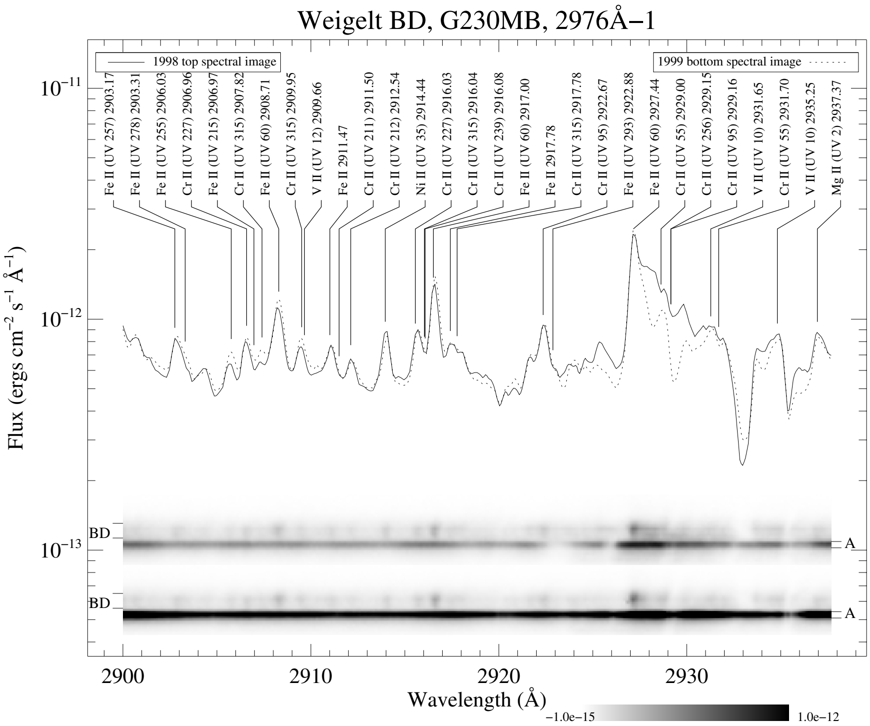


Fig. B.37. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

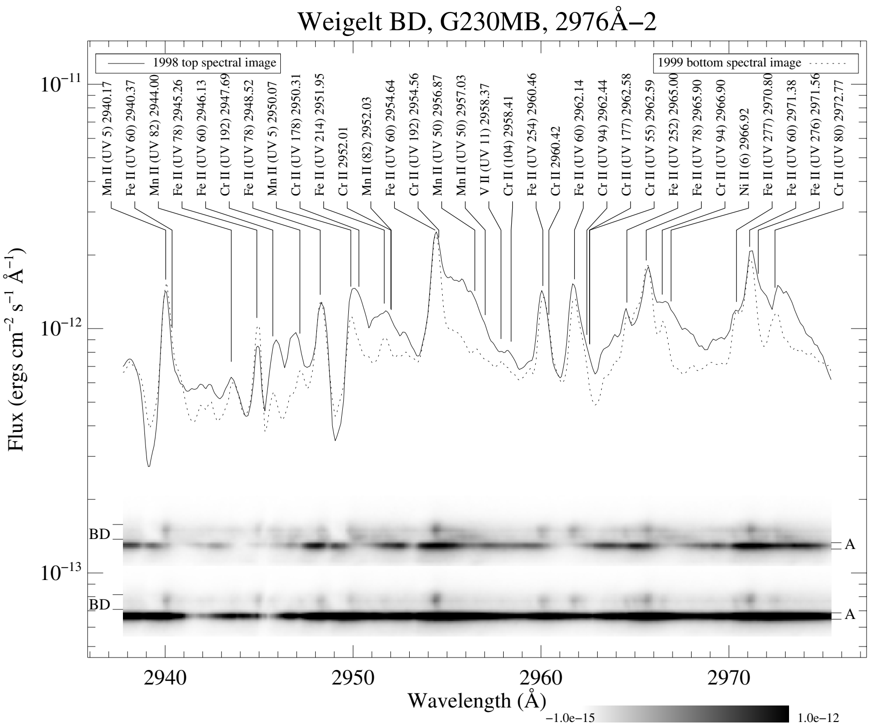


Fig. B.38. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

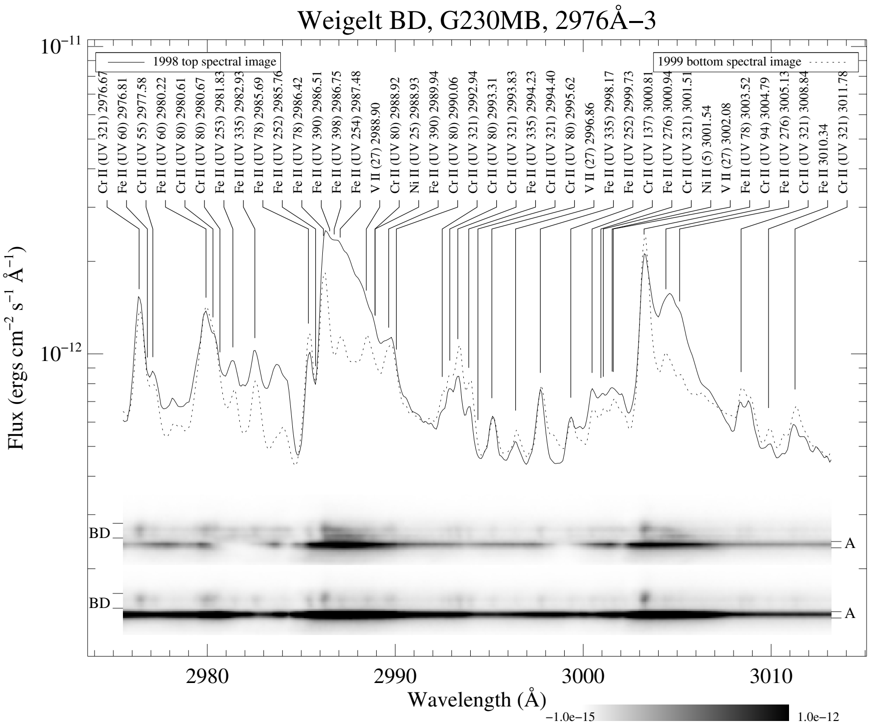


Fig. B.39. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

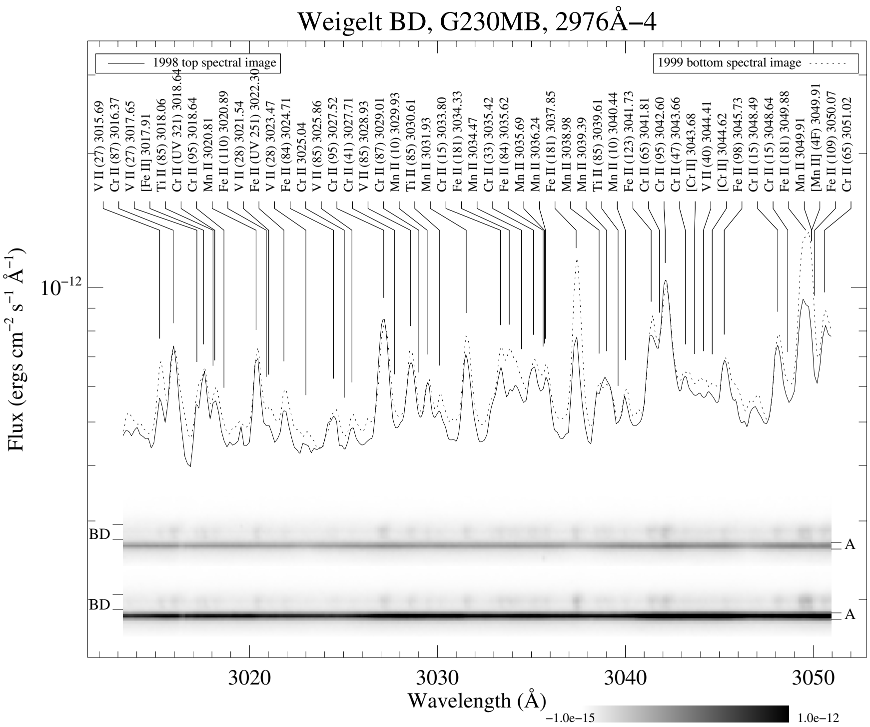


Fig. B.40. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

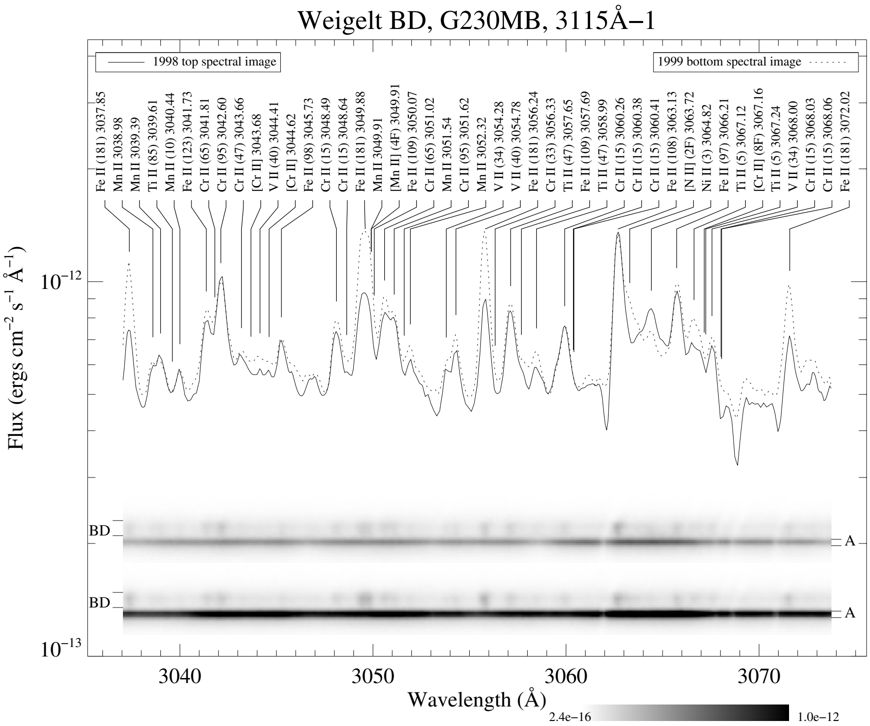


Fig. B.41. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

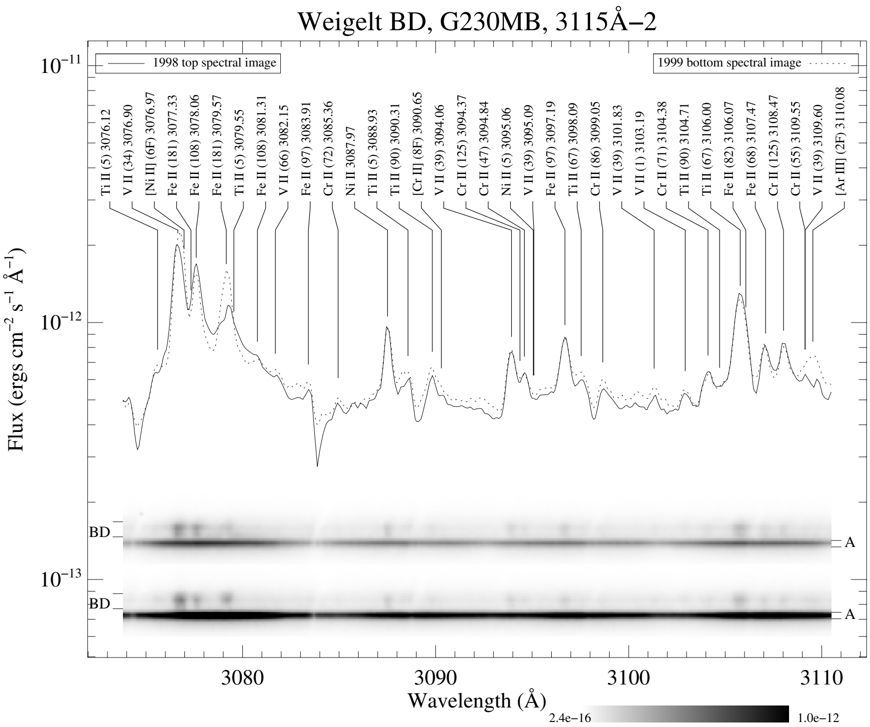


Fig. B.42. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

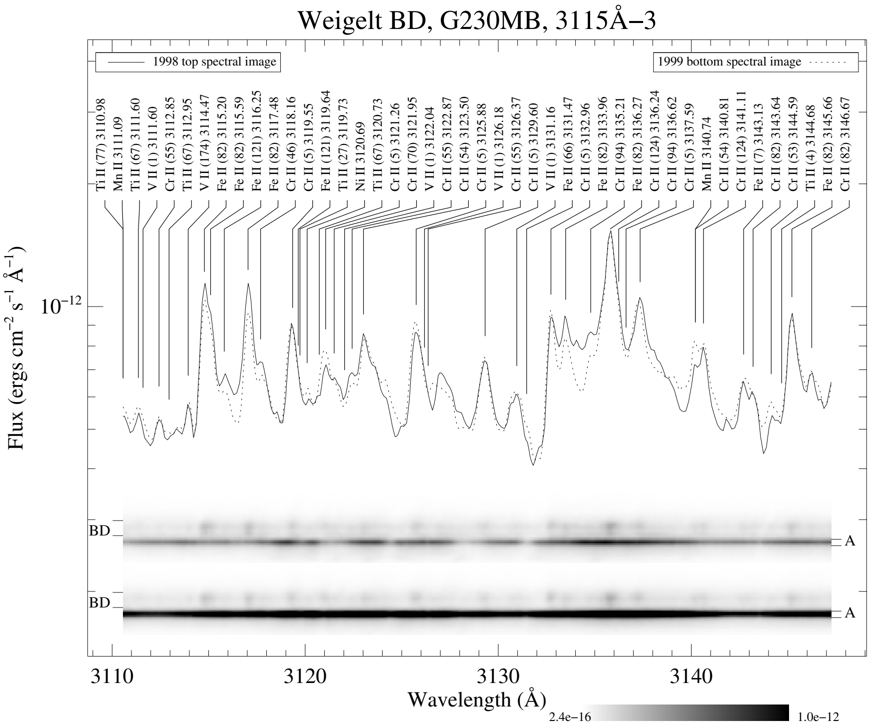


Fig. B.43. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

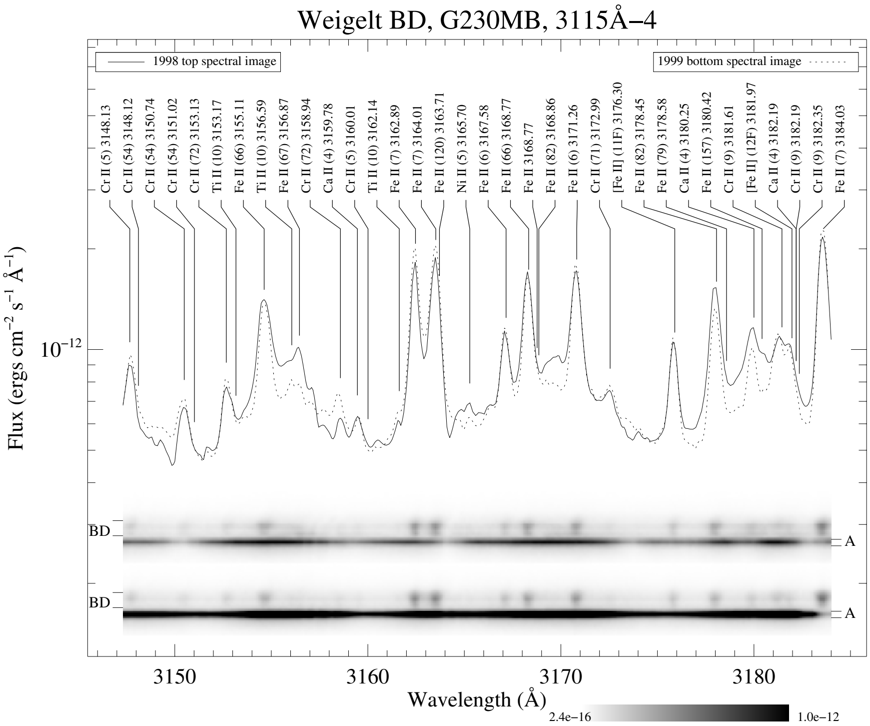


Fig. B.44. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

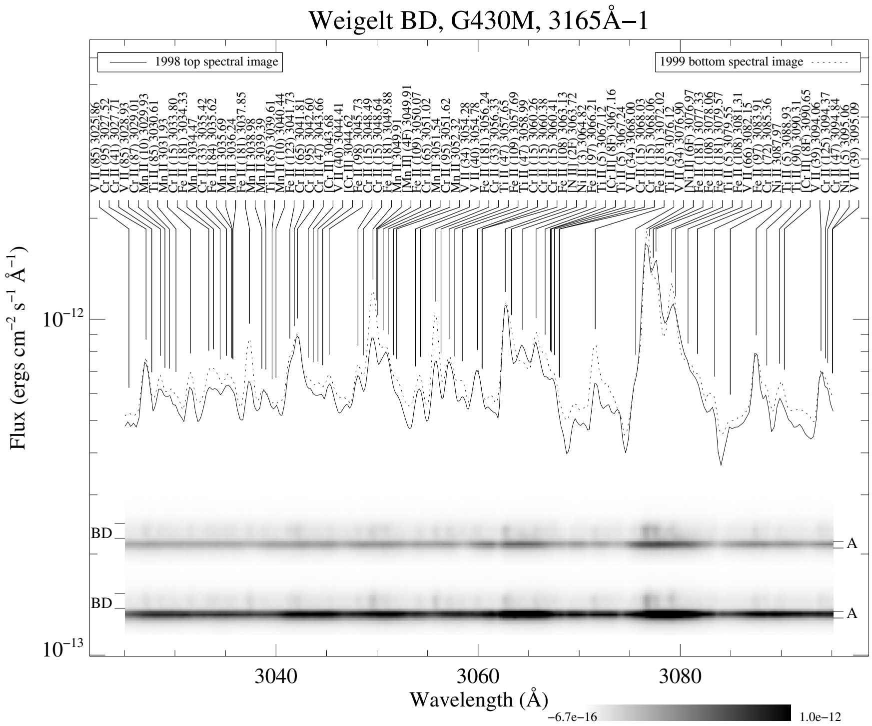


Fig. B.45. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

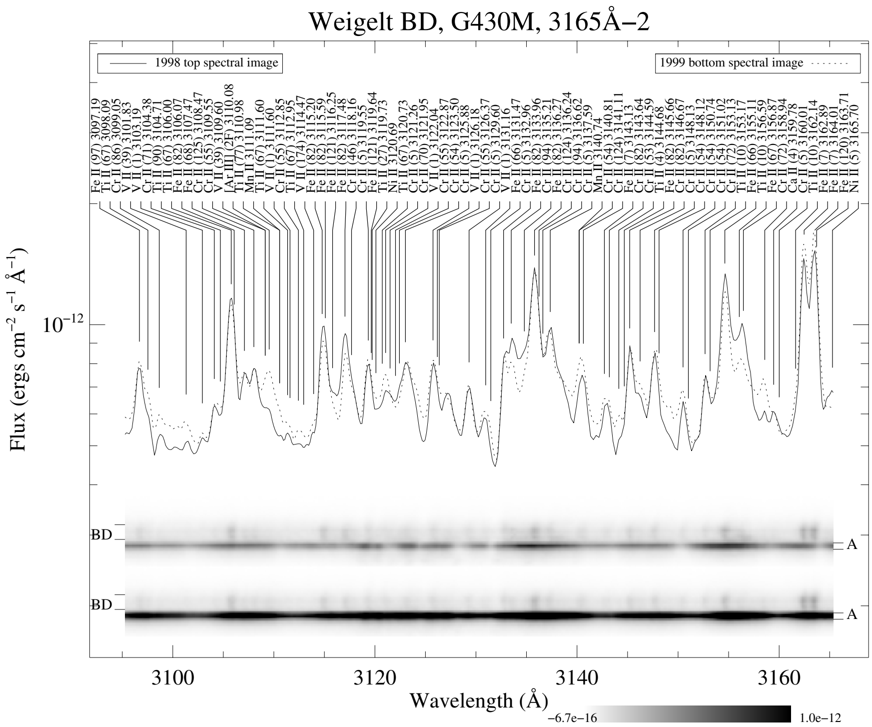


Fig. B.46. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

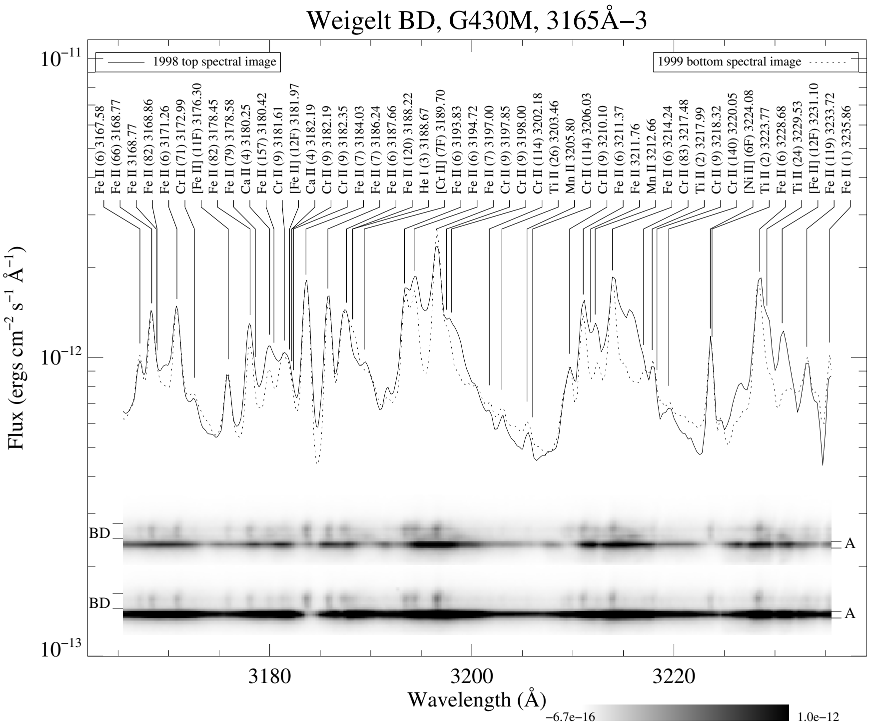


Fig. B.47. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

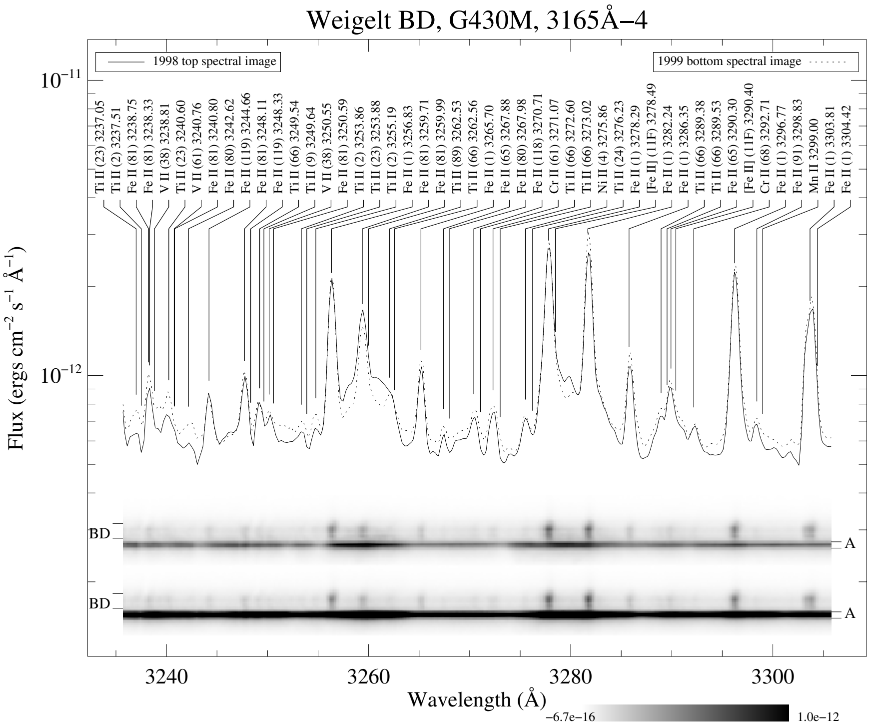


Fig. B.48. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

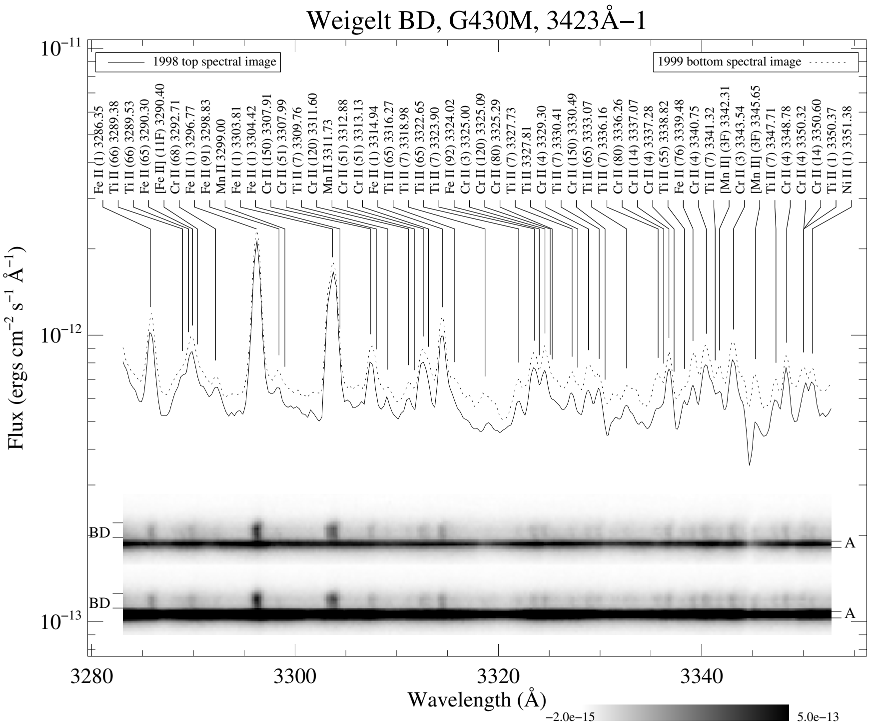


Fig. B.49. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

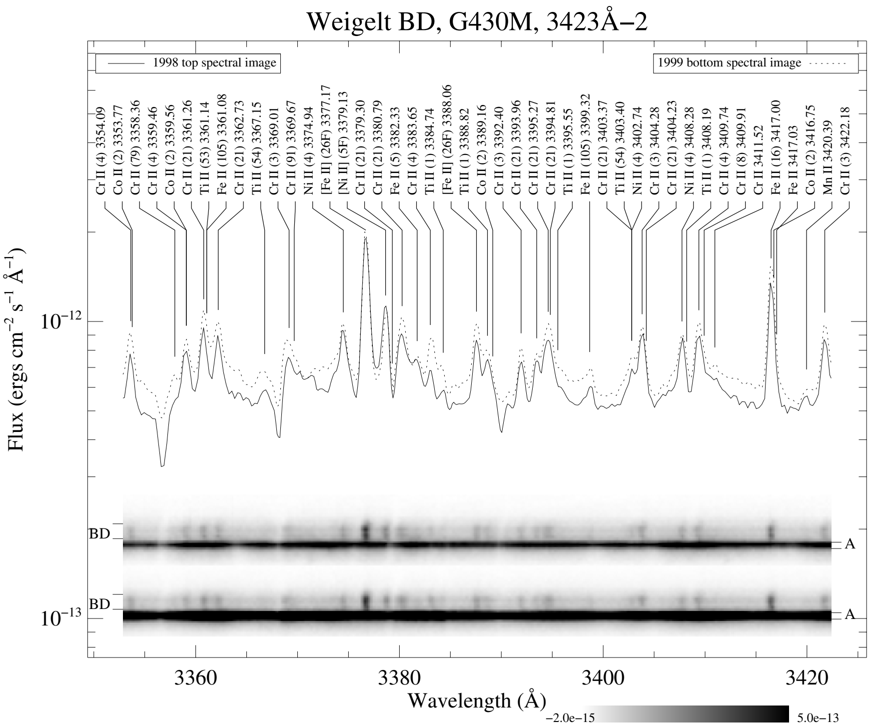


Fig. B.50. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

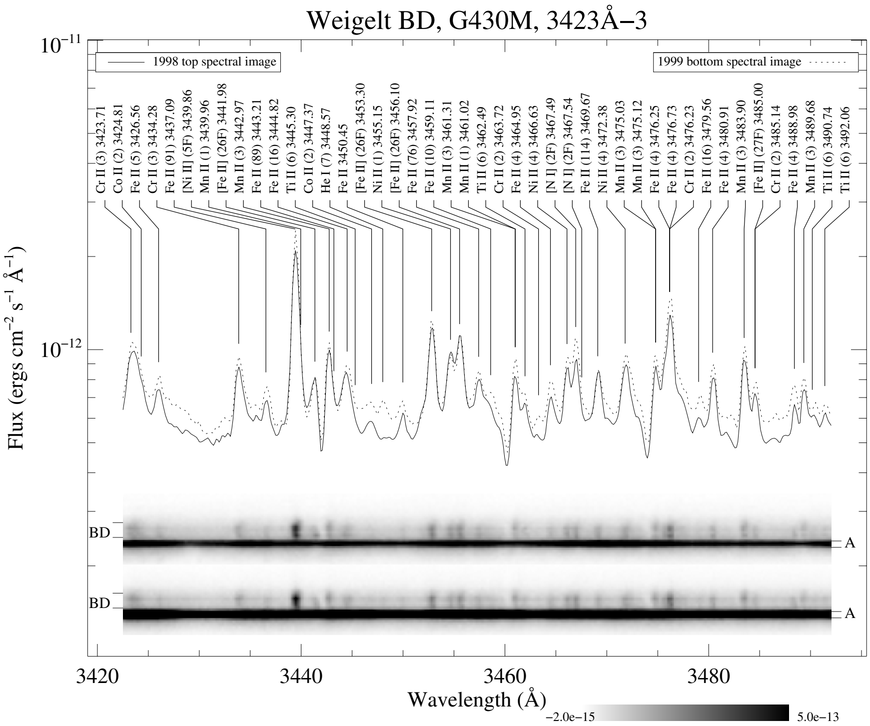
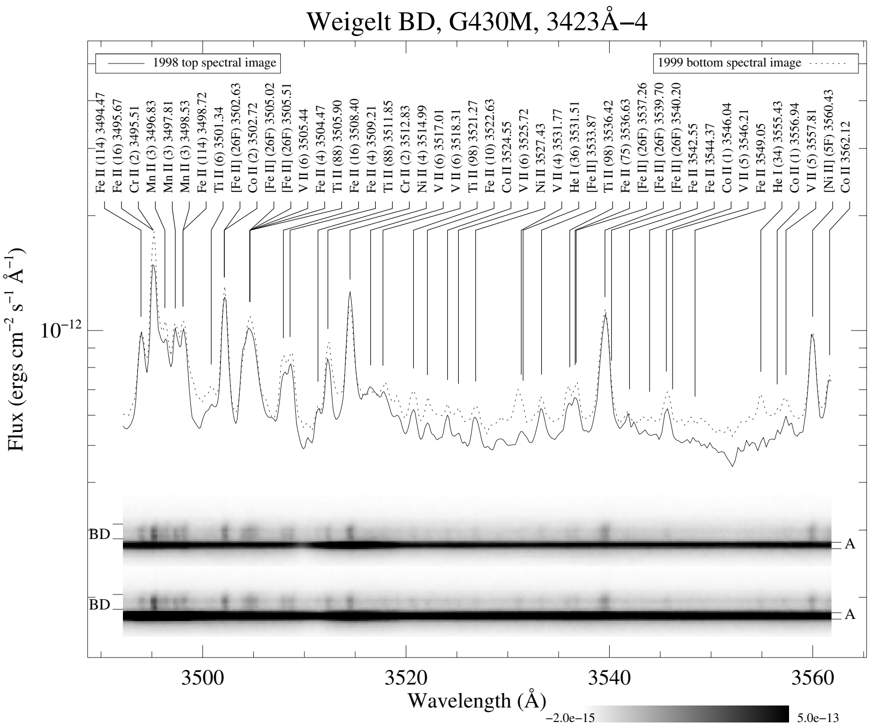


Fig. B.51. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.



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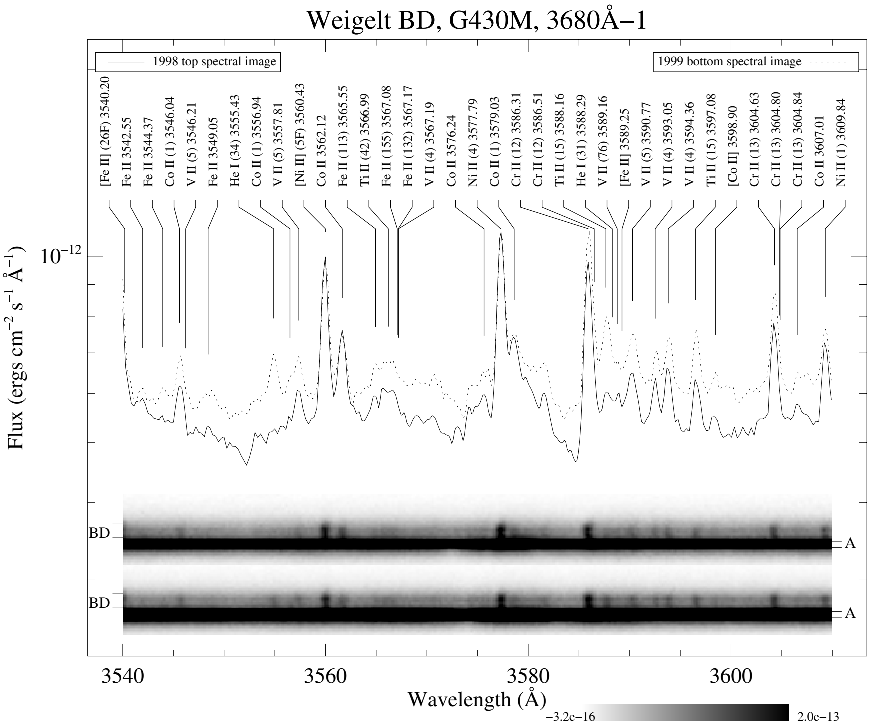

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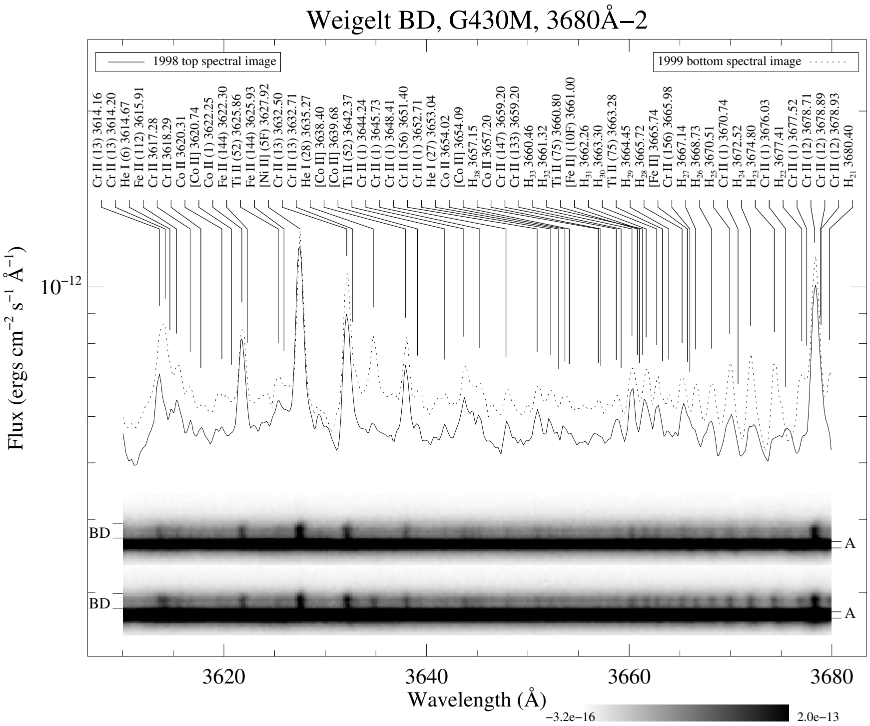
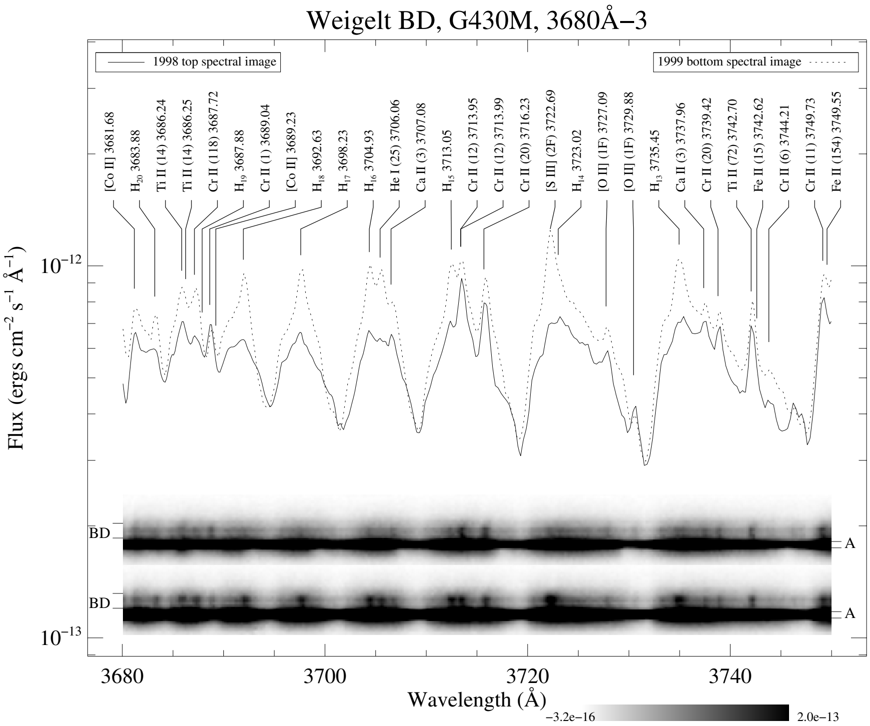


Fig. B.54. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.



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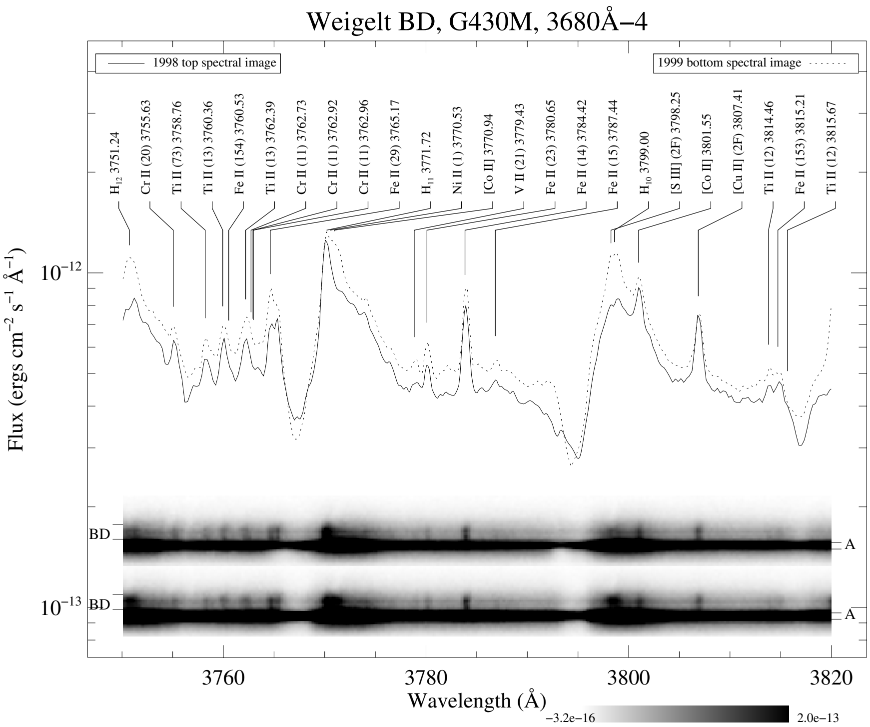


Fig. B.56. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

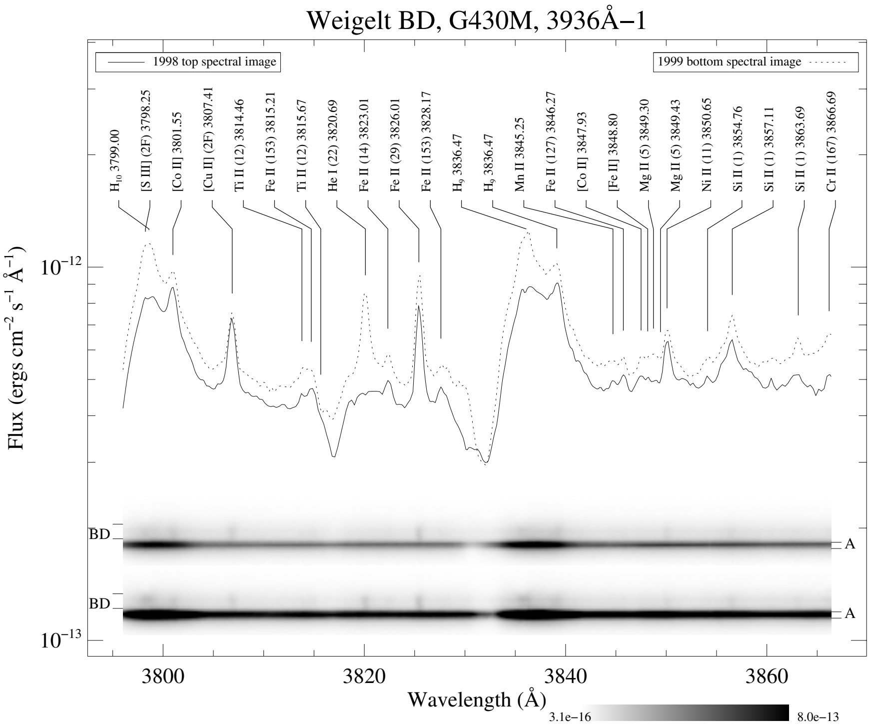


Fig. B.57. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

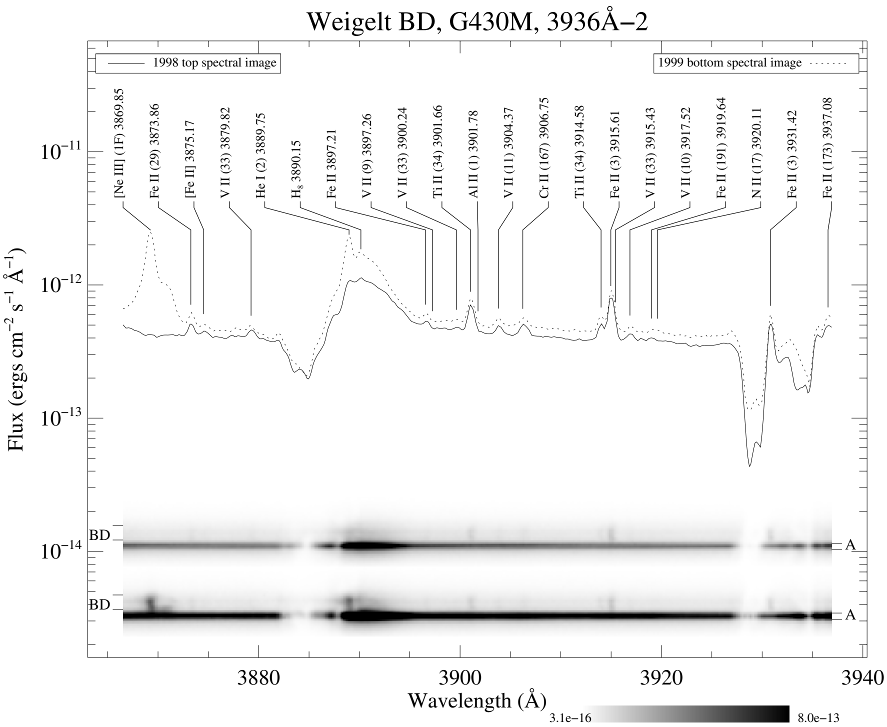


Fig. B.58. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

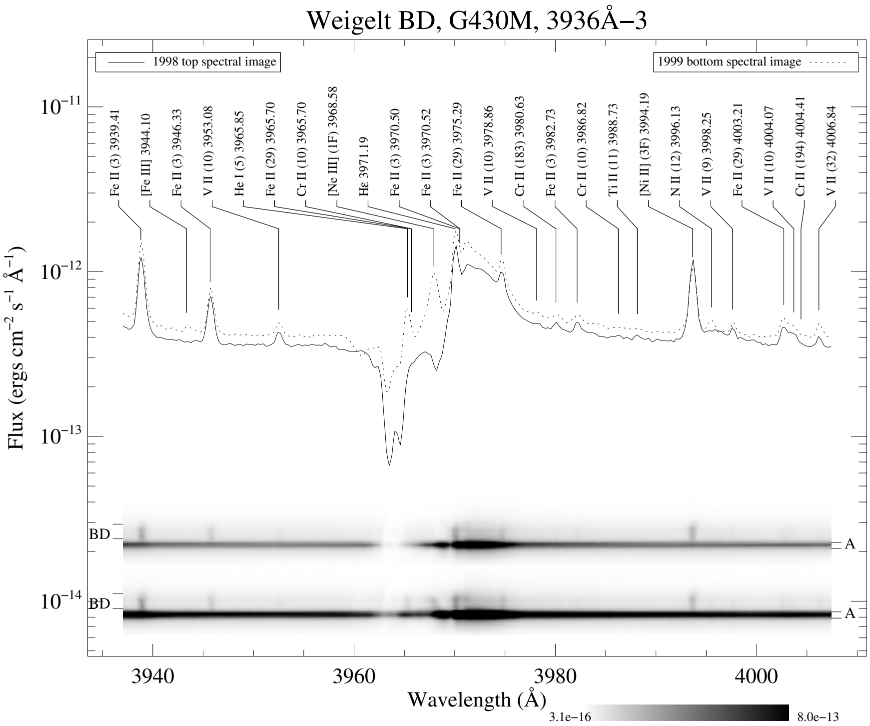


Fig. B.59. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

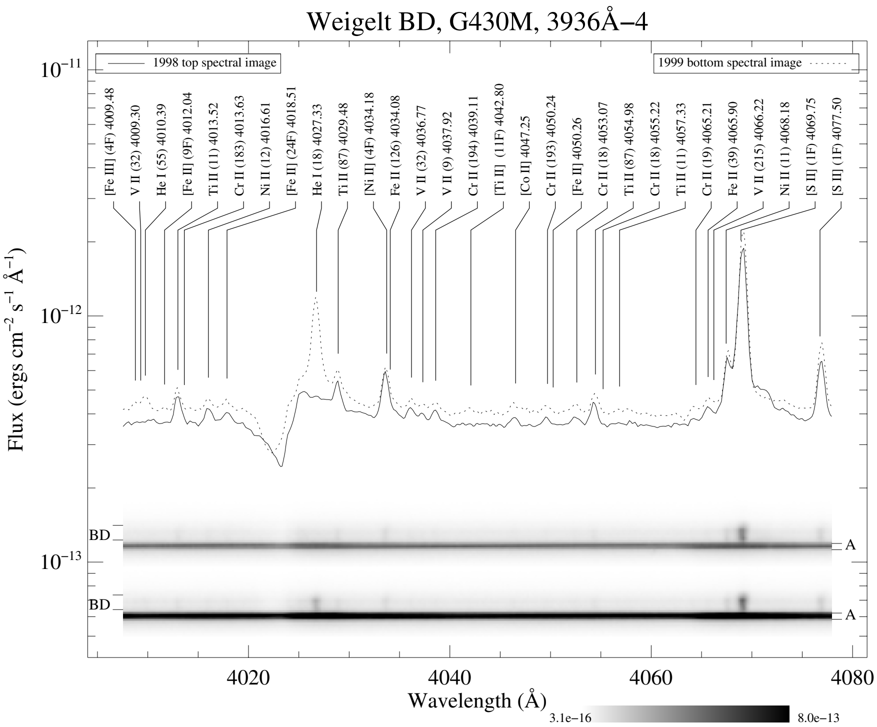


Fig. B.60. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

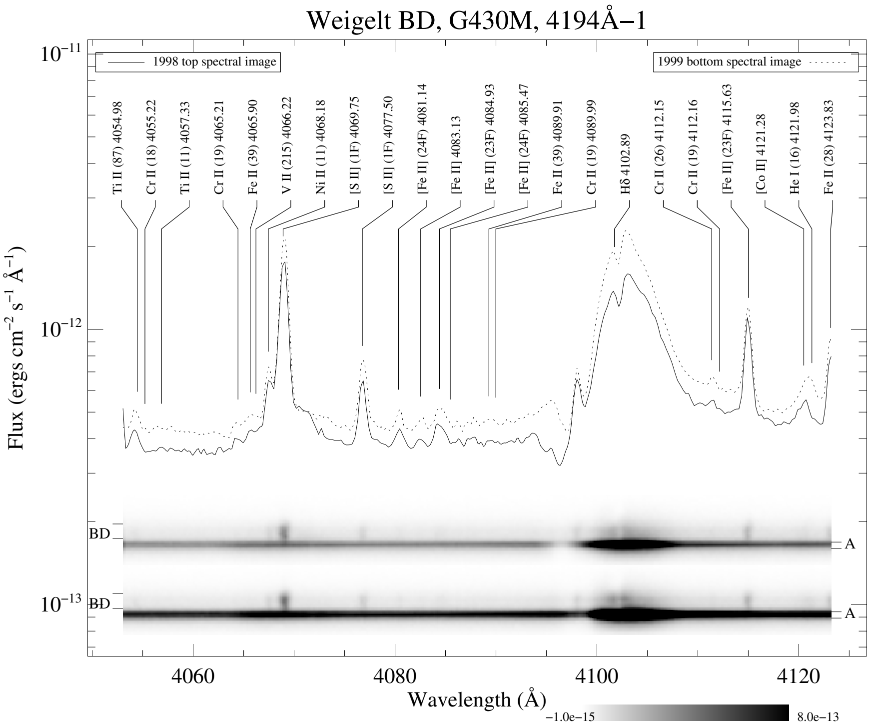


Fig. B.61. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

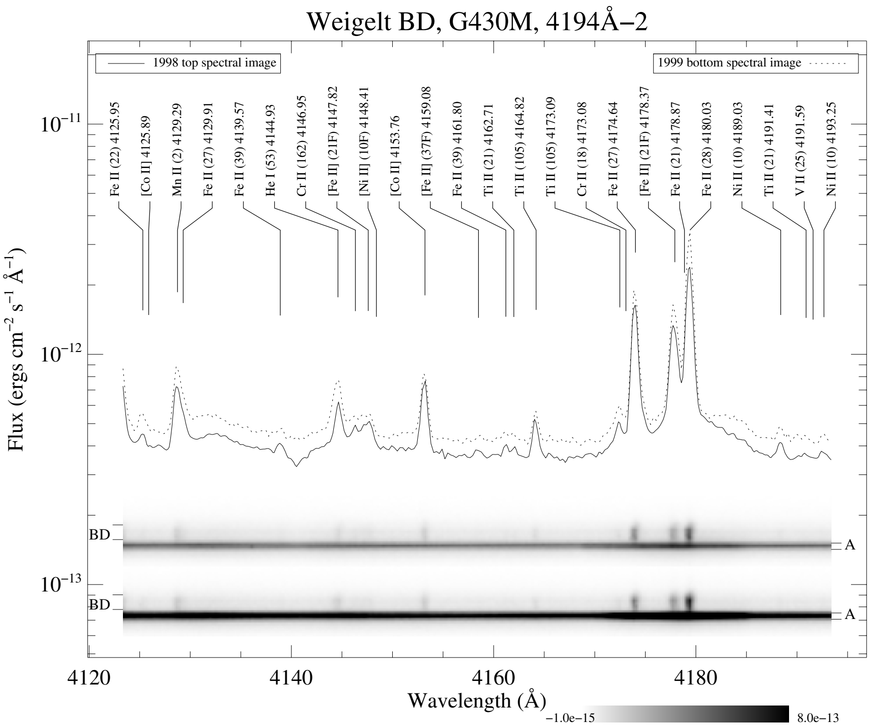
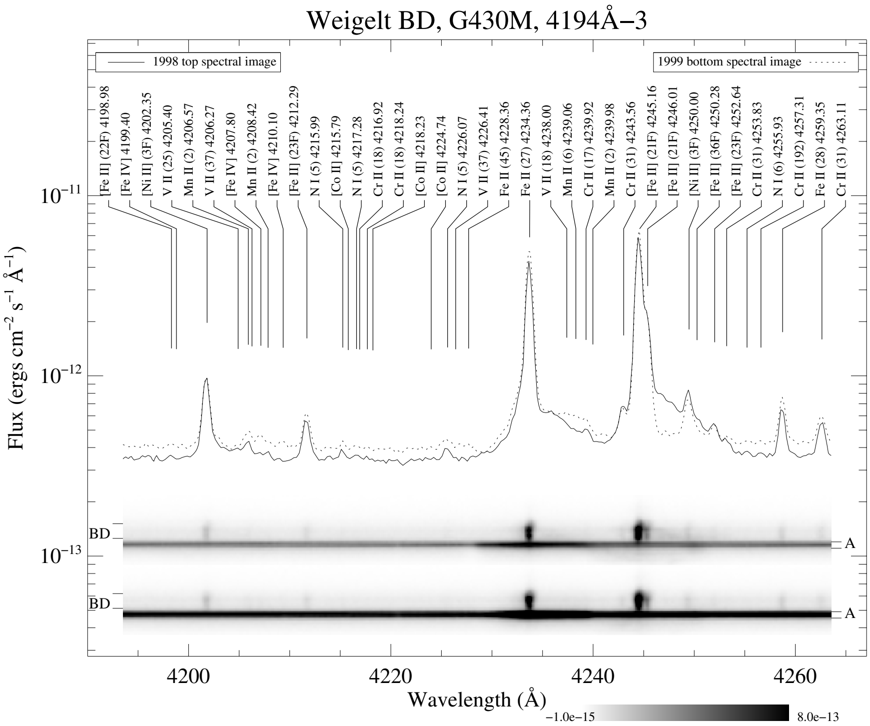


Fig. B.62. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.



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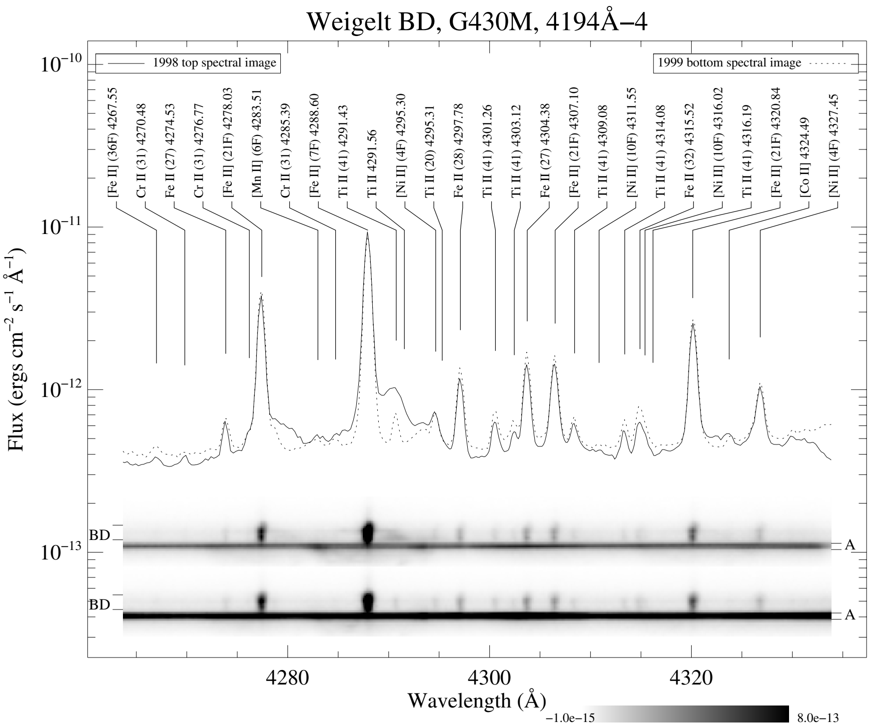
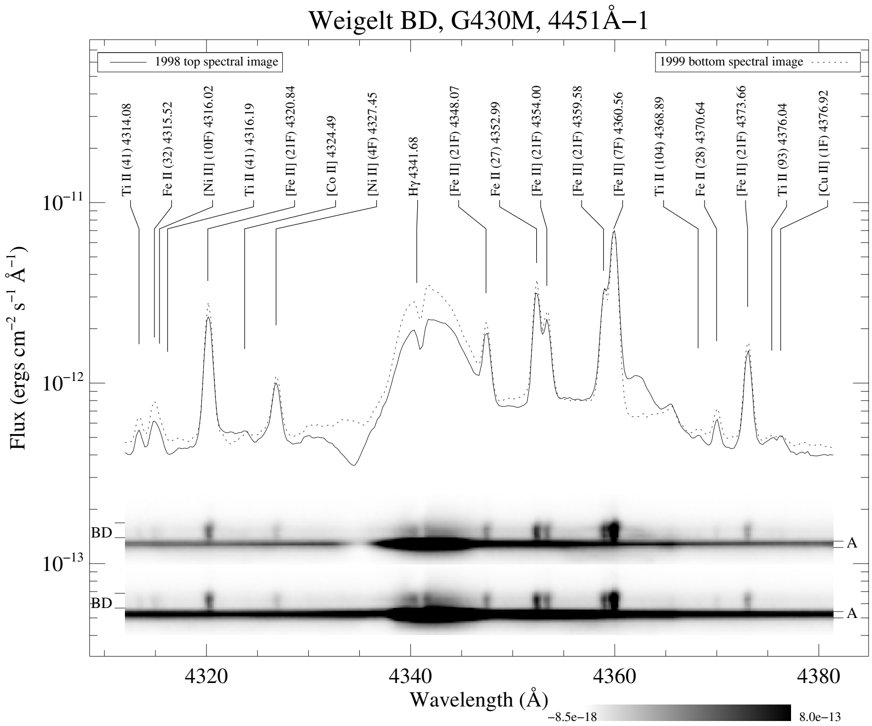


Fig. B.64. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.



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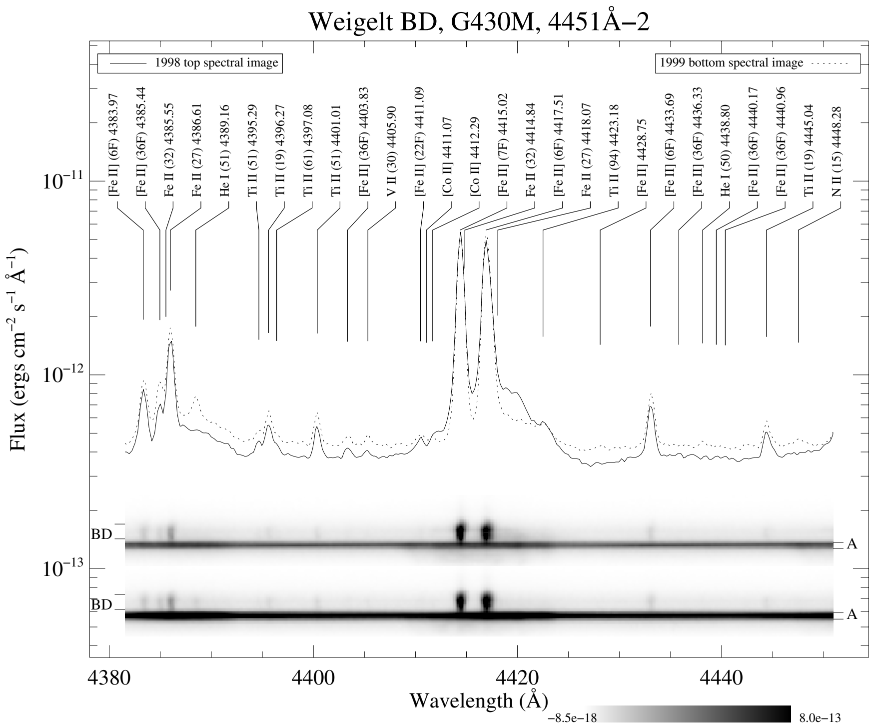


Fig. B.66. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

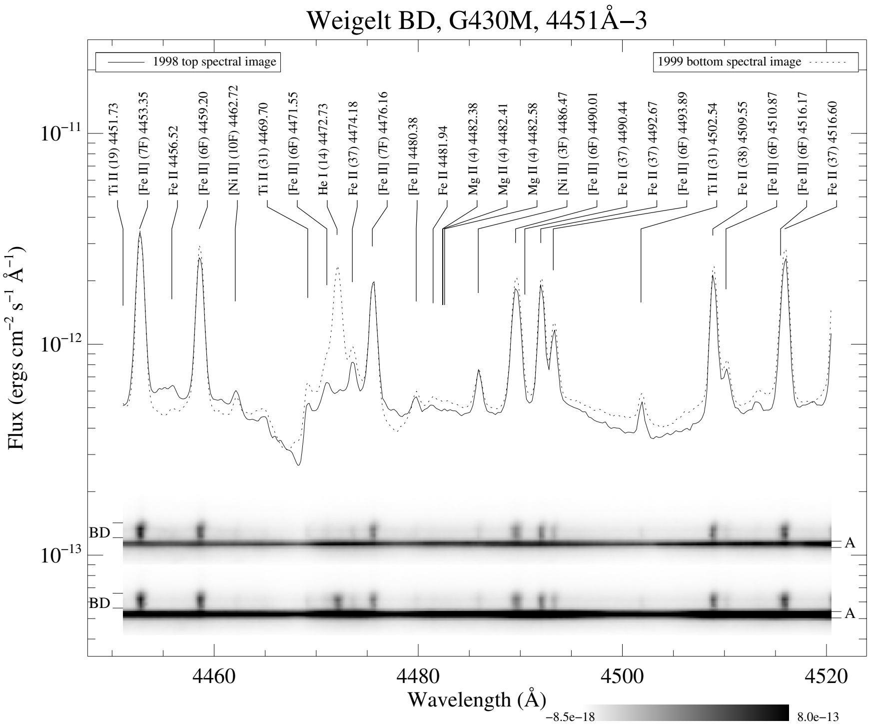
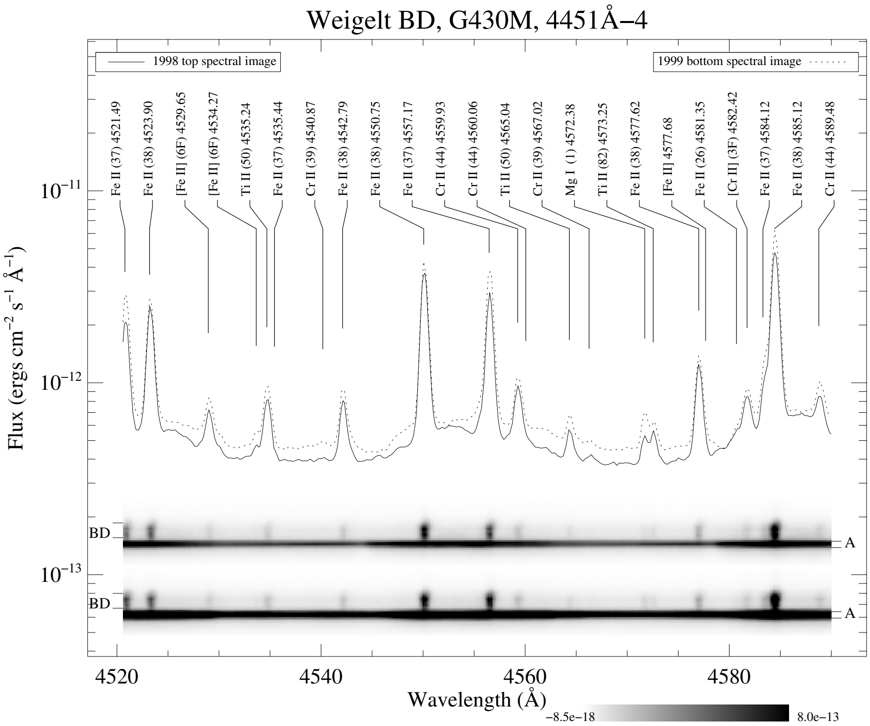


Fig. B.67. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.



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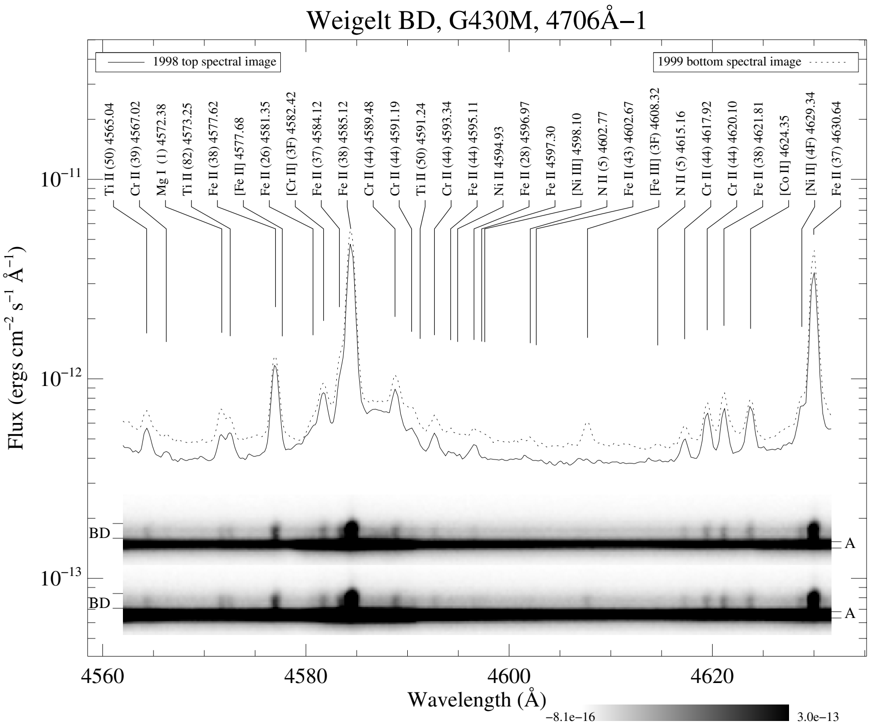
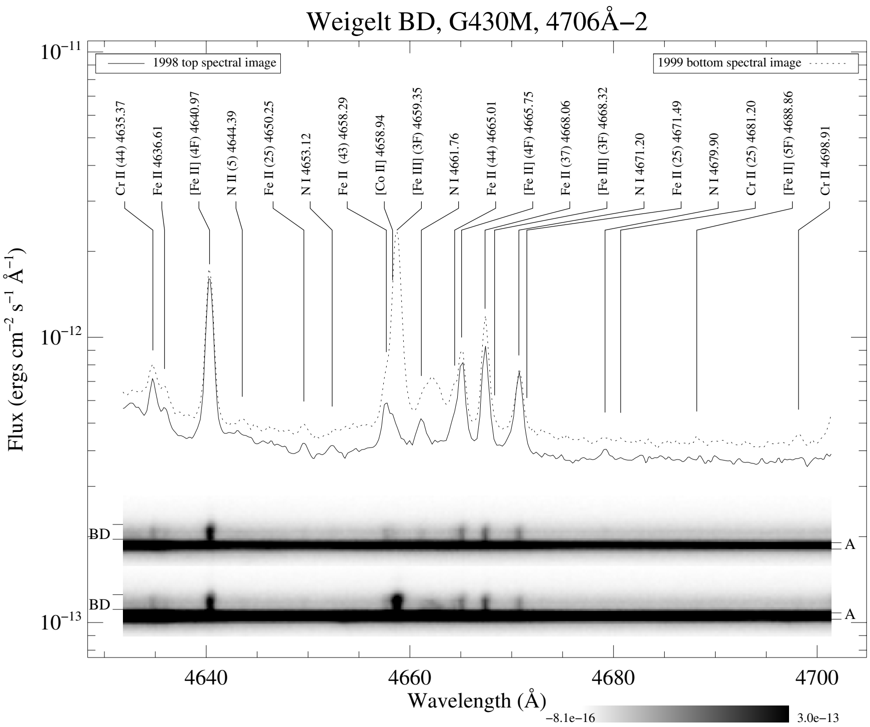


Fig. B.69. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.



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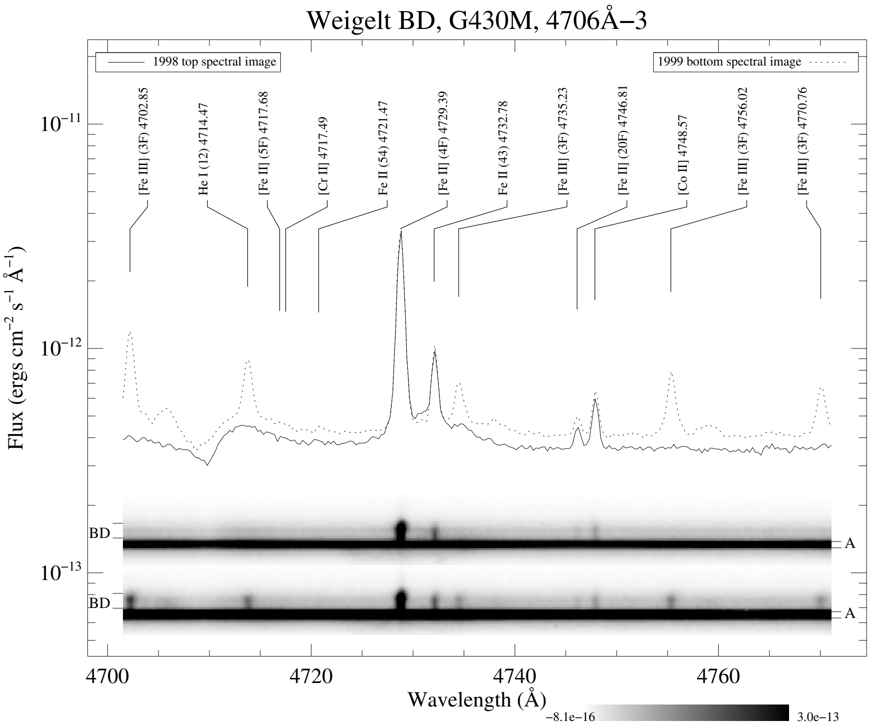

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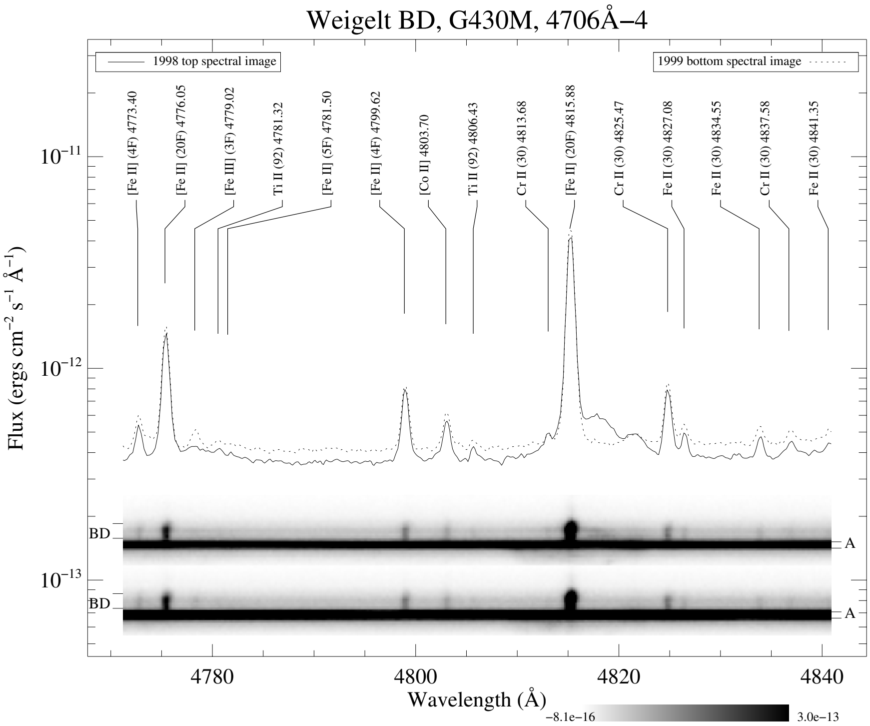


Fig. B.72. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

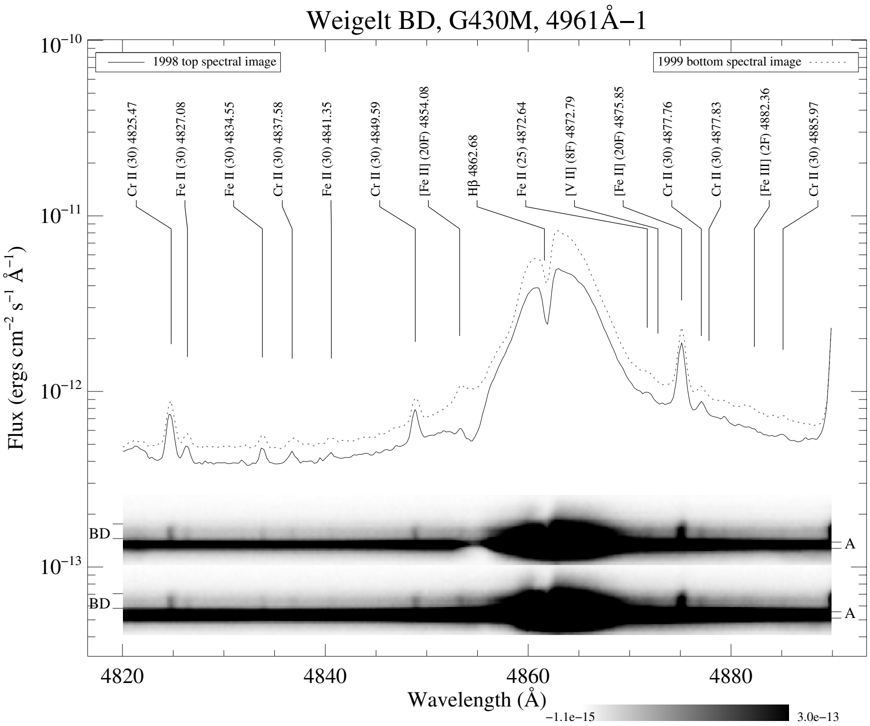


Fig. B.73. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

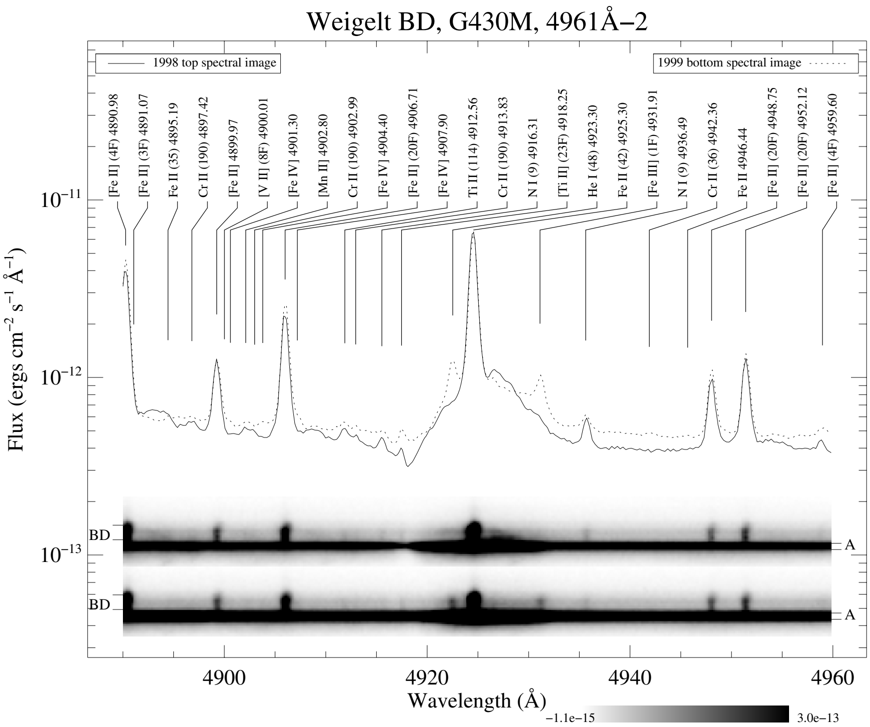


Fig. B.74. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

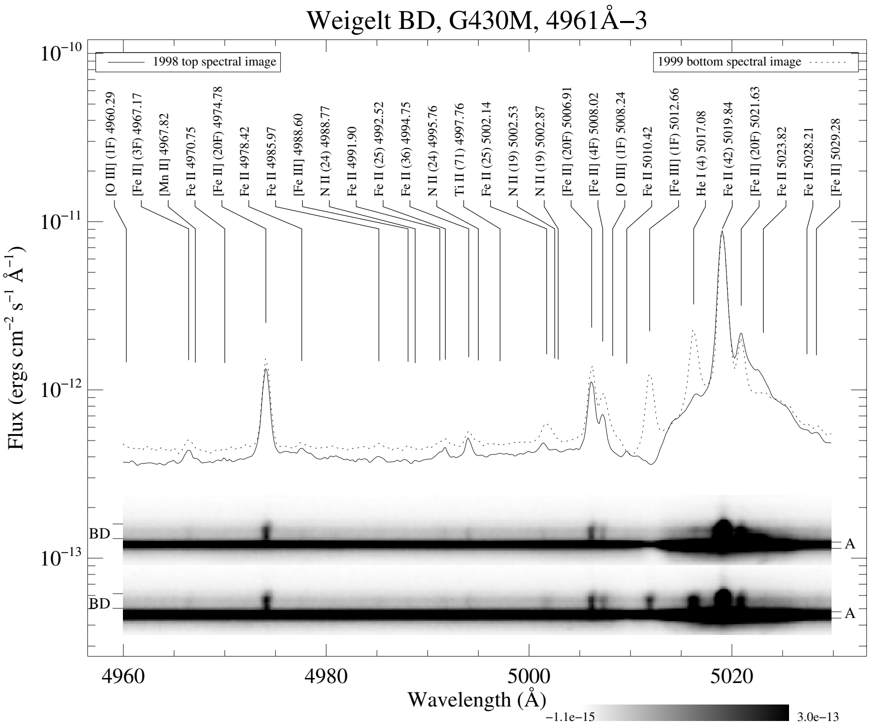
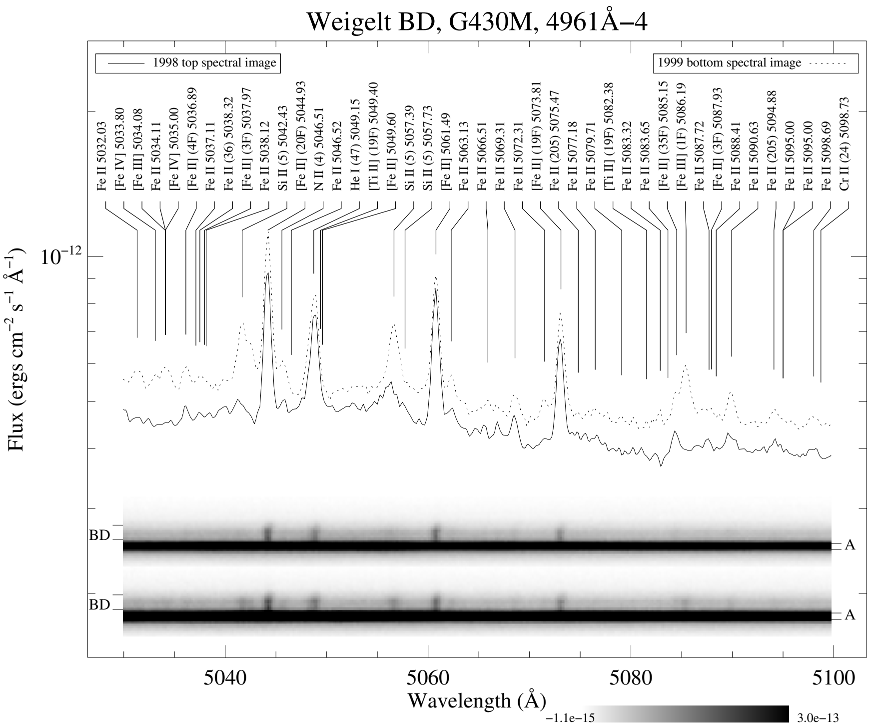


Fig. B.75. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.



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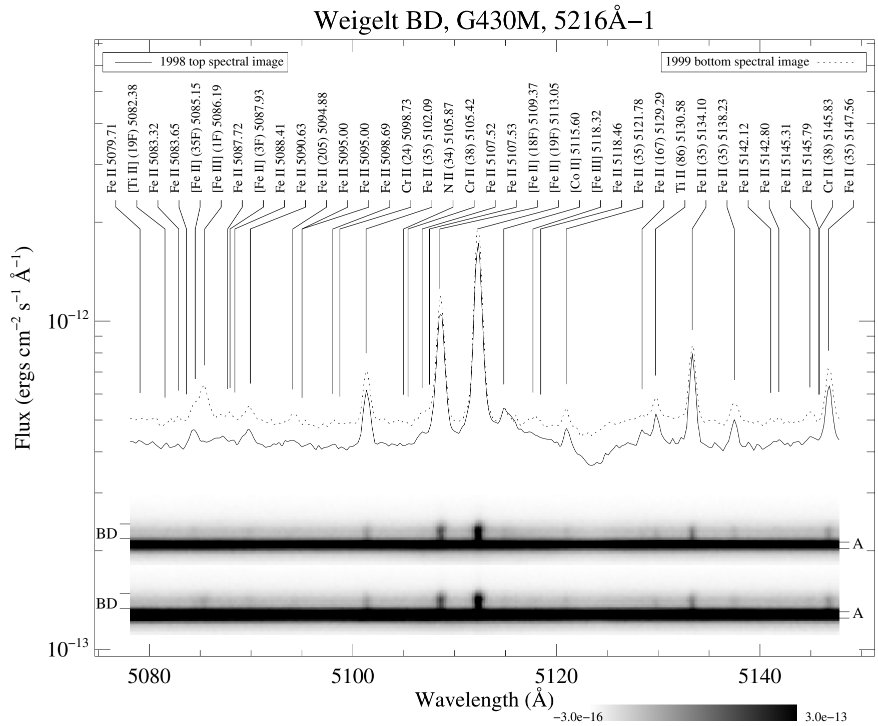

Fig. B.77. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

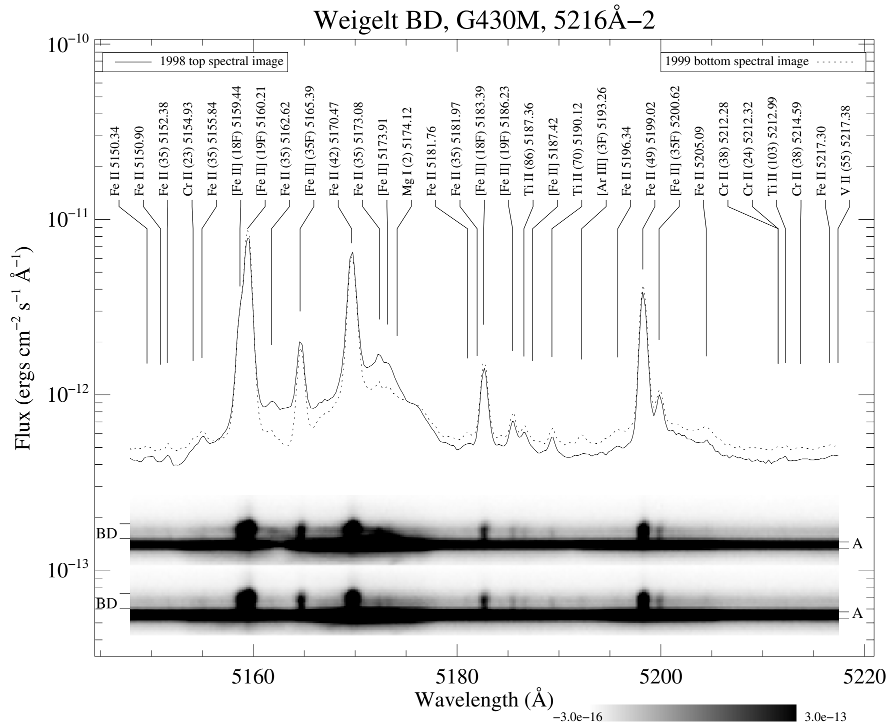

Fig. B.78. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

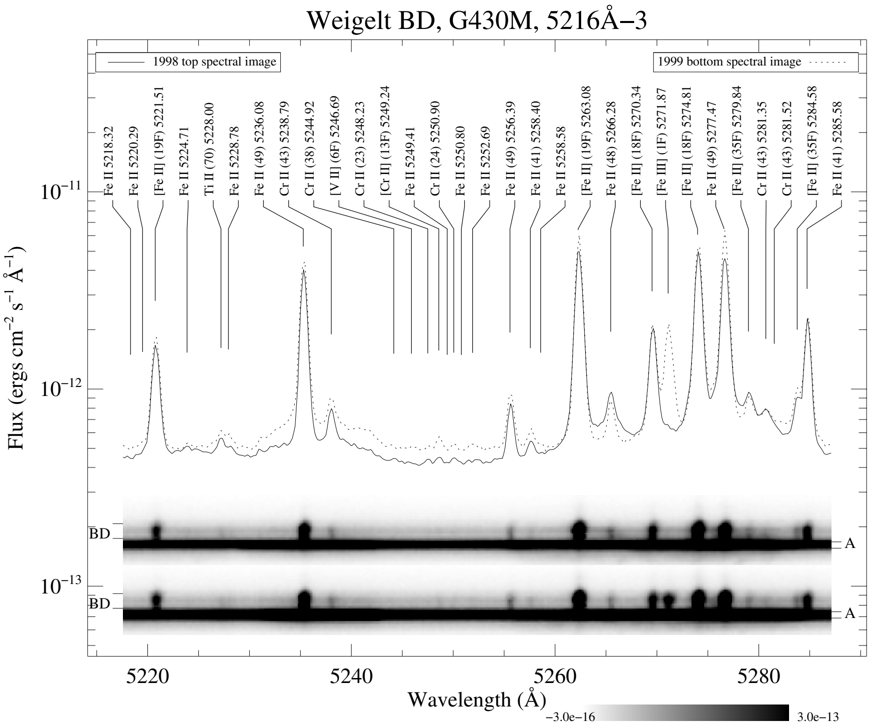

Fig. B.79. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

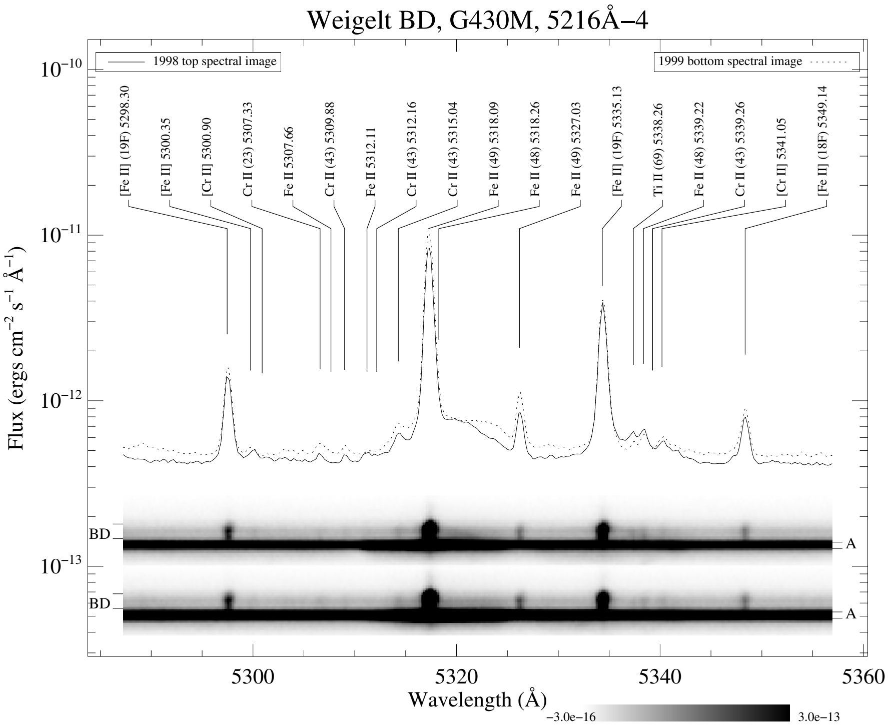

Fig. B.80. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

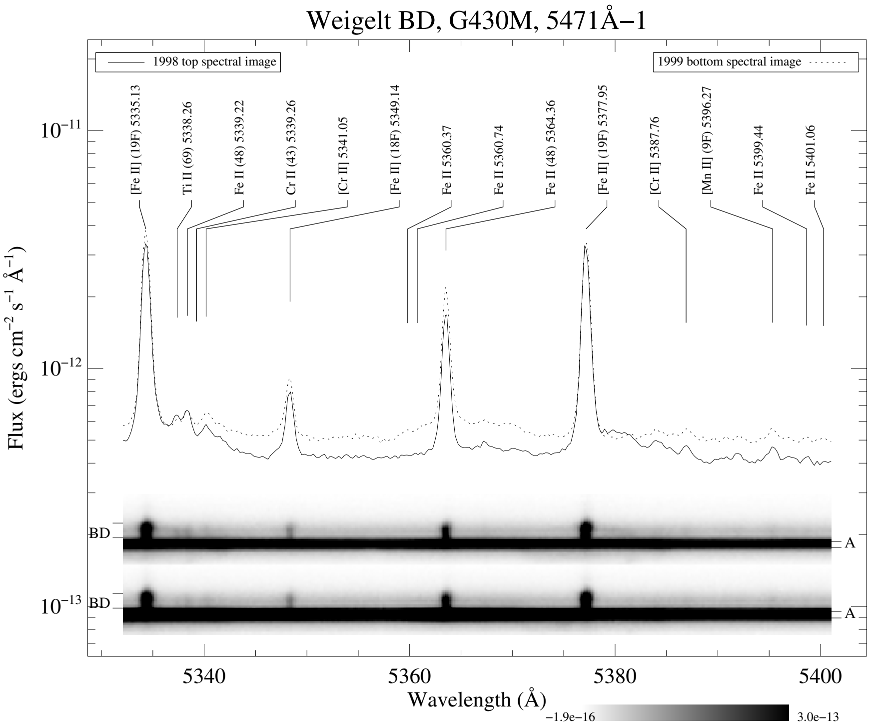

Fig. B.81. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

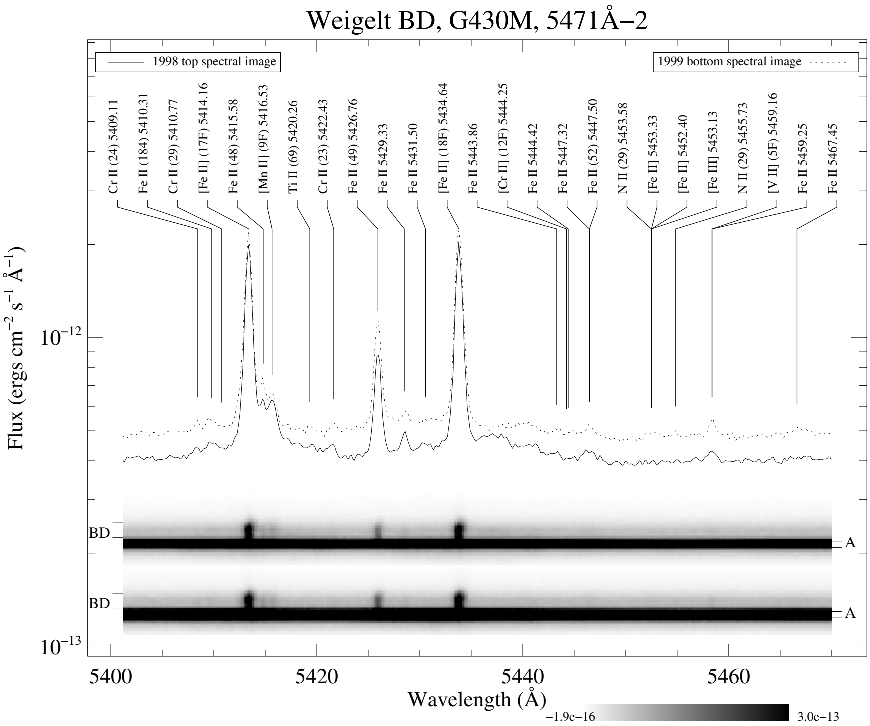

Fig. B.82. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

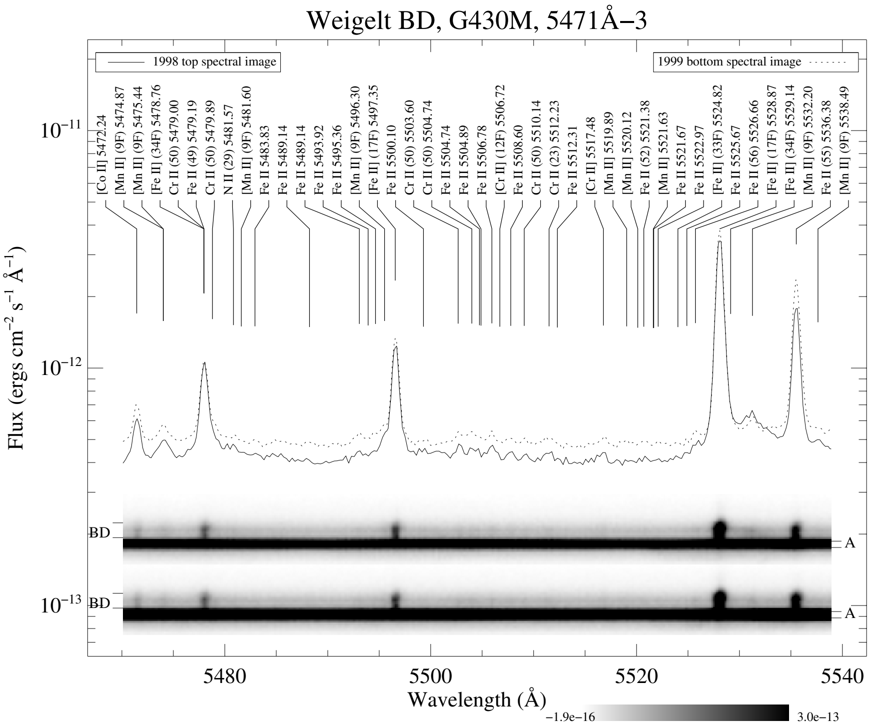

Fig. B.83. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

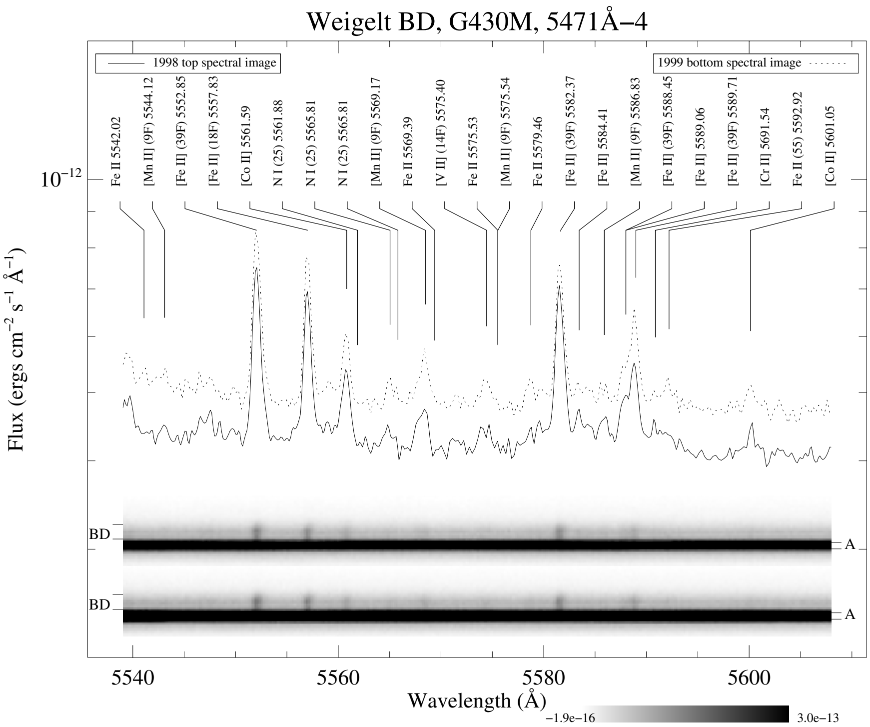

Fig. B.84. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

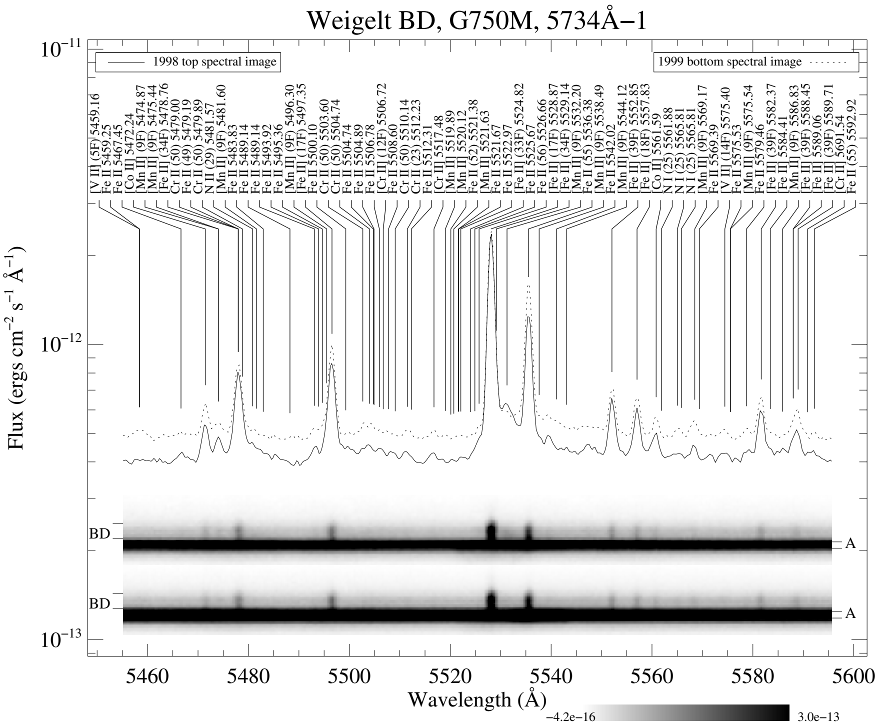

Fig. B.85. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

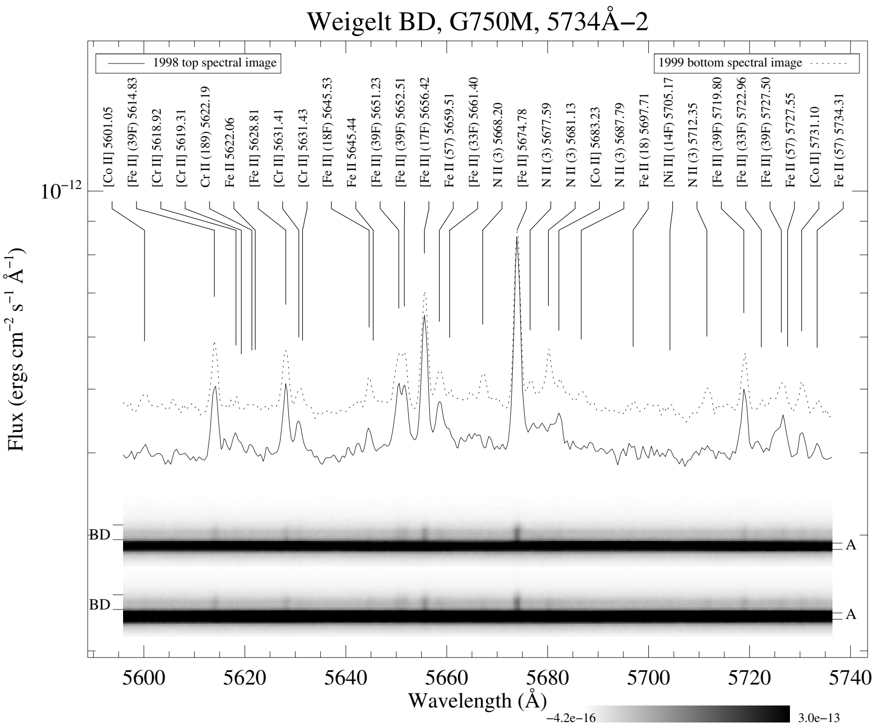

Fig. B.86. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

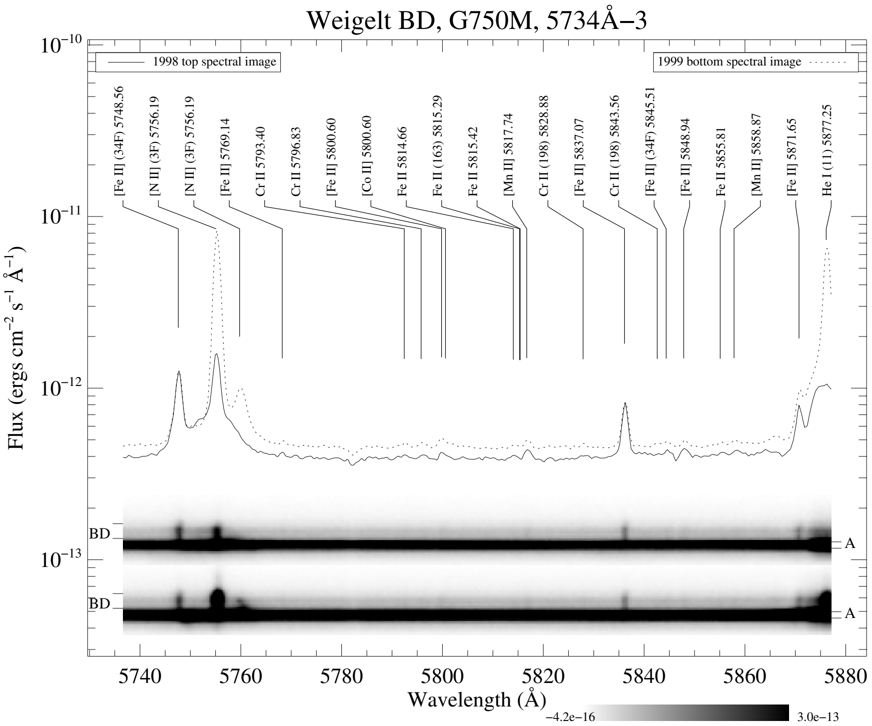

Fig. B.87. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

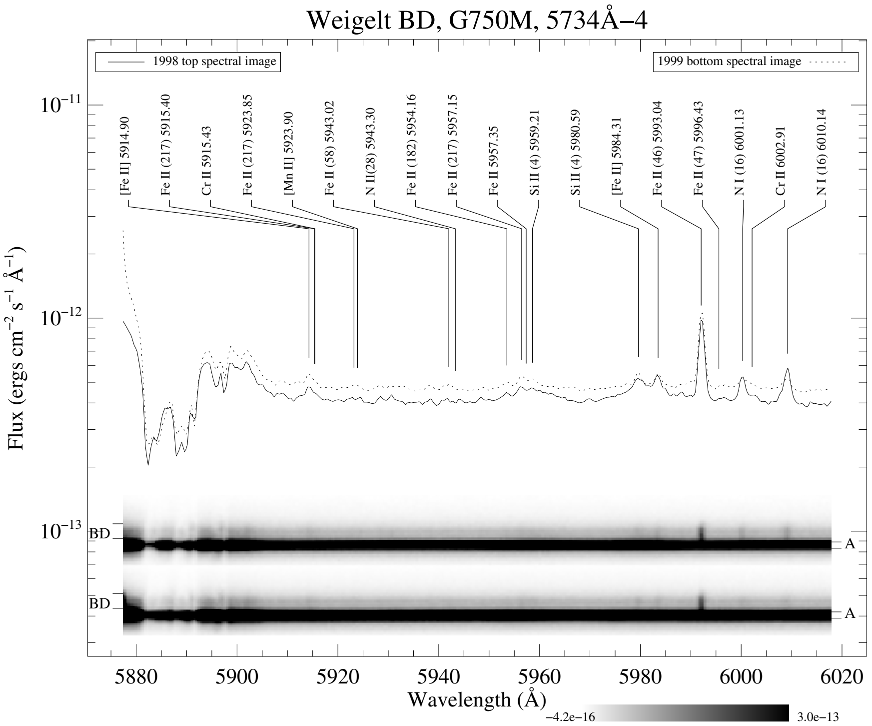

Fig. B.88. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

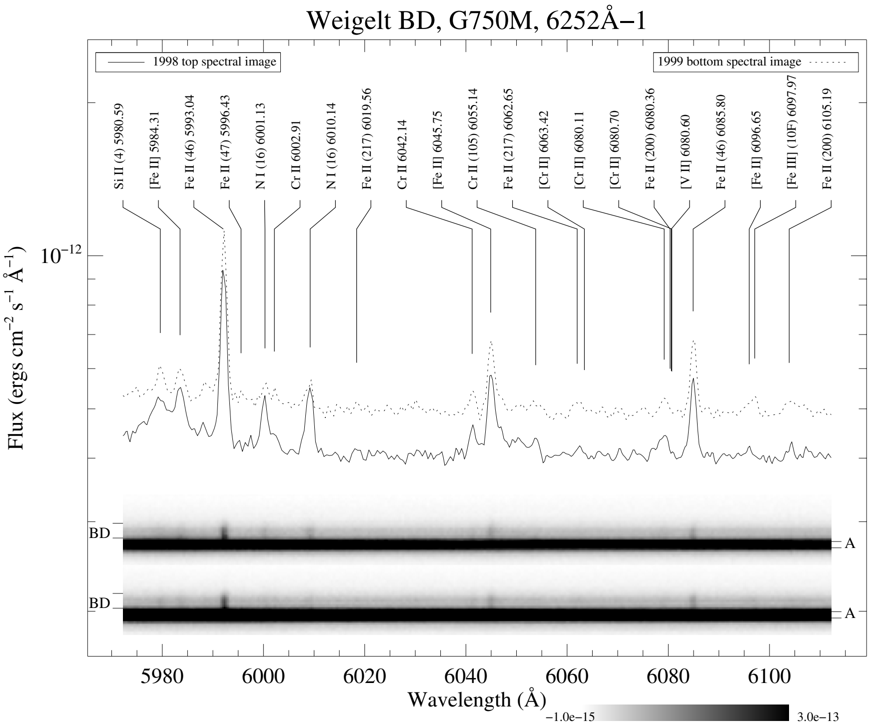

Fig. B.89. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

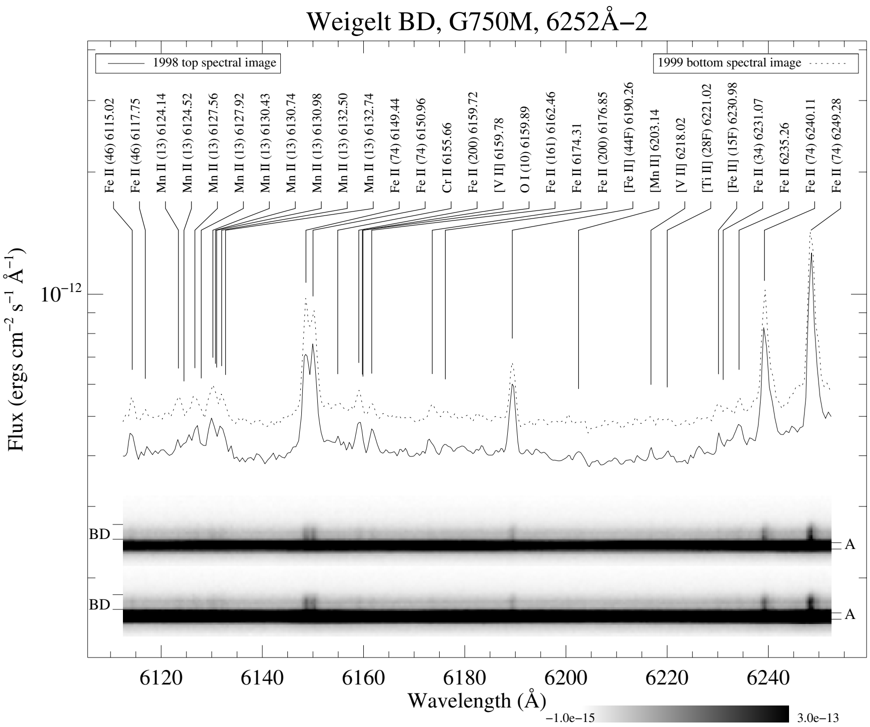

Fig. B.90. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

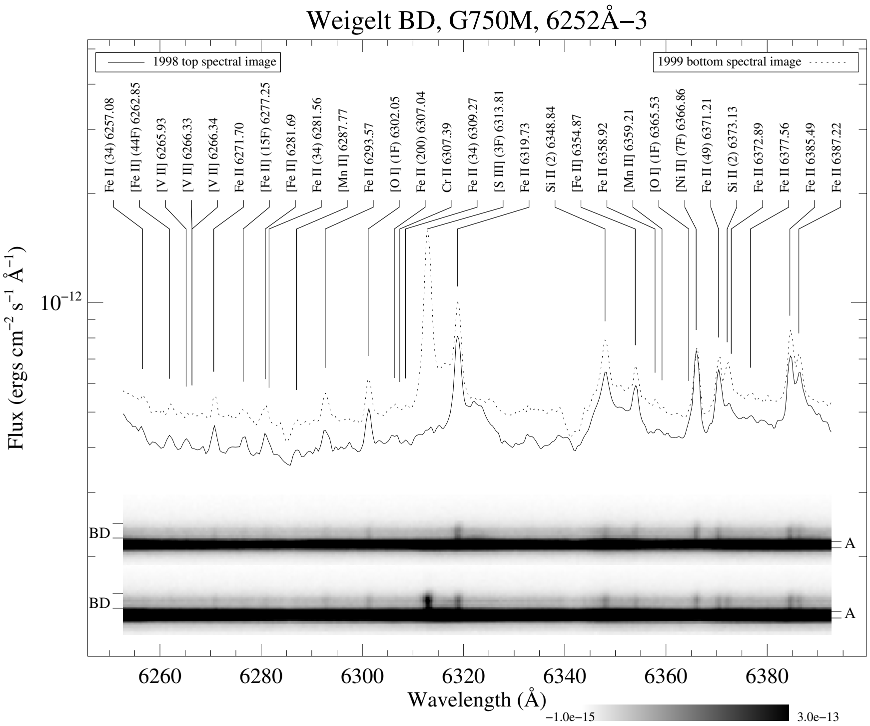

Fig. B.91. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

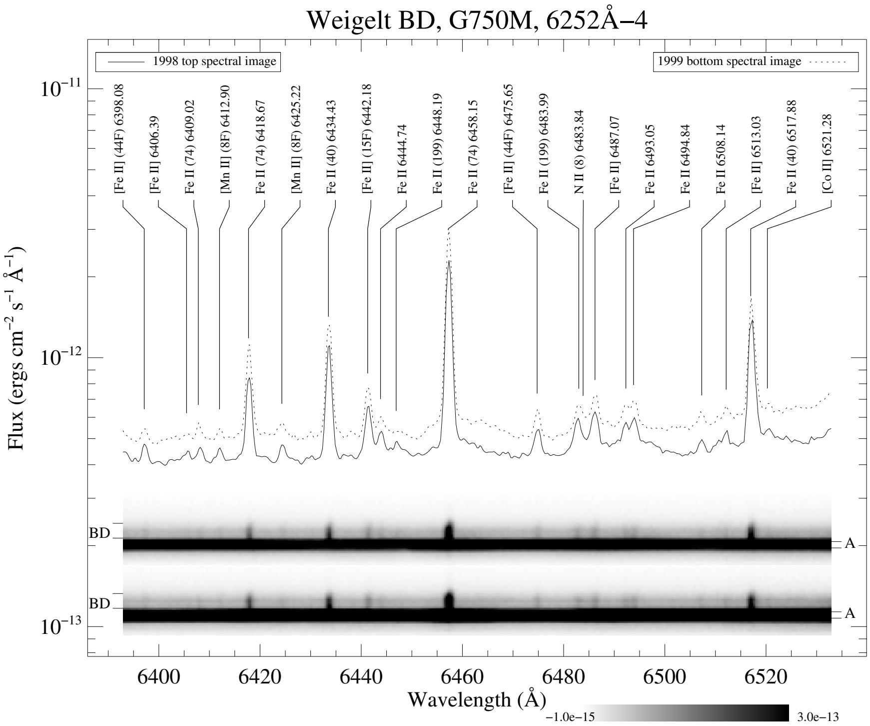

Fig. B.92. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

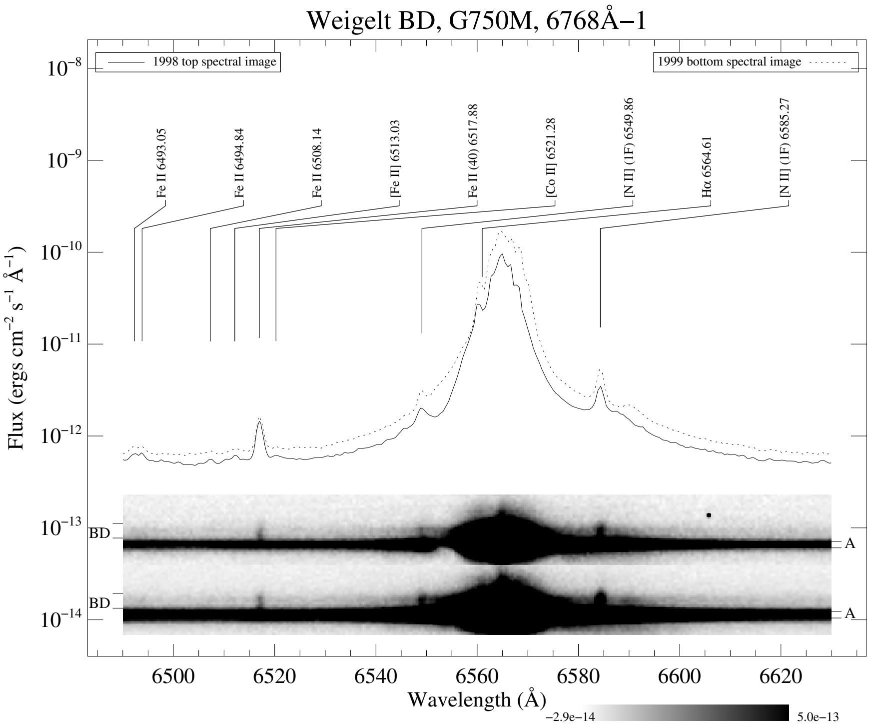

Fig. B.93. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

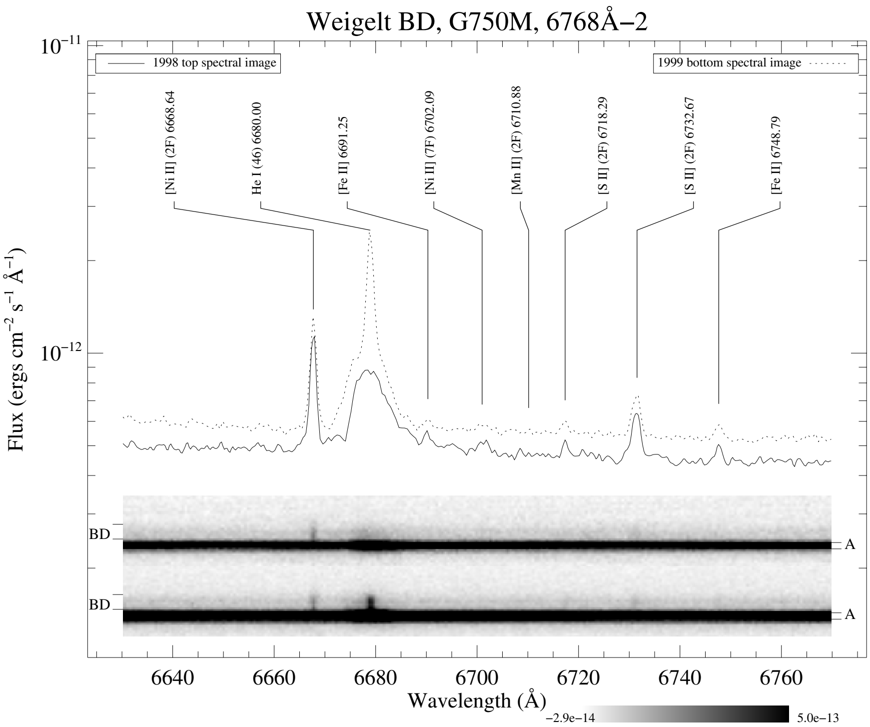

Fig. B.94. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

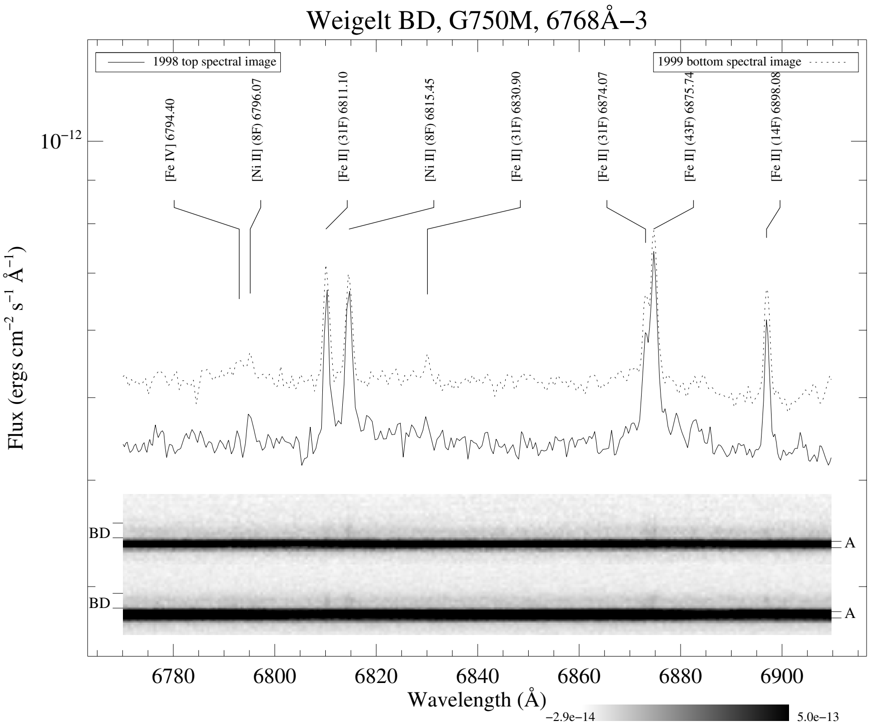

Fig. B.95. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

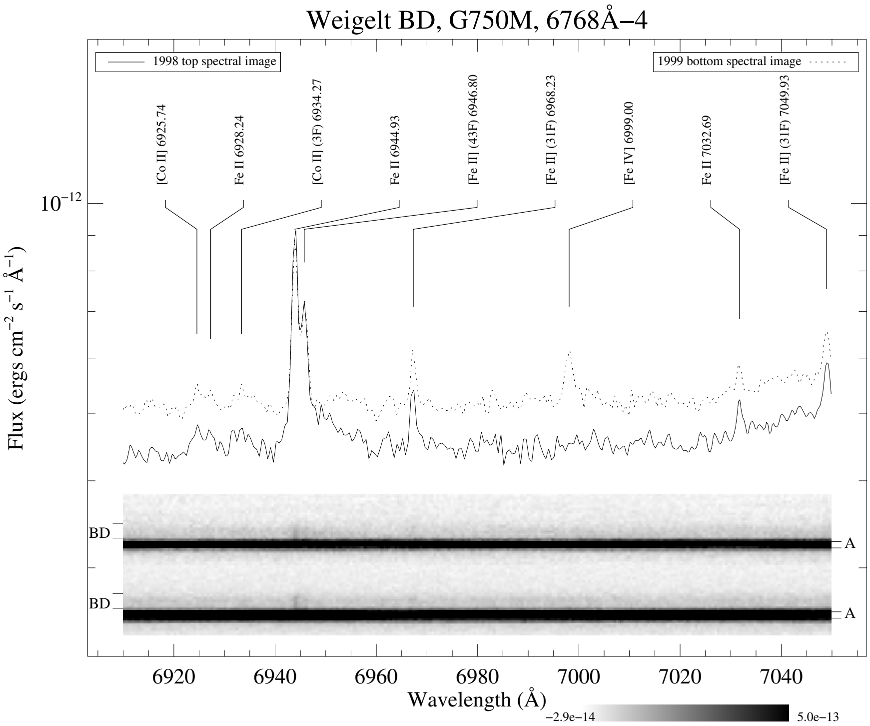

Fig. B.96. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

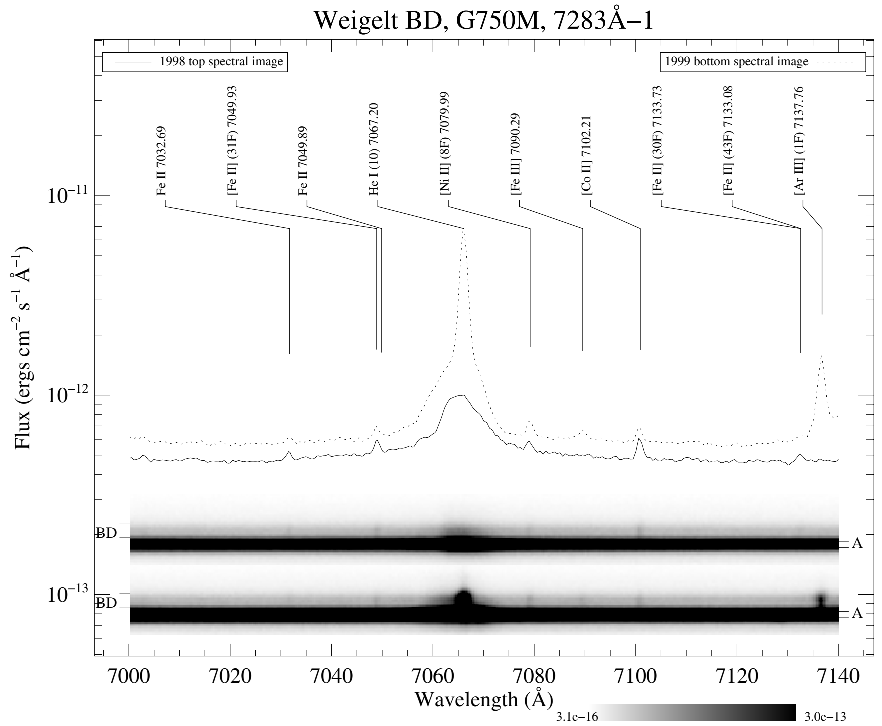

Fig. B.97. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

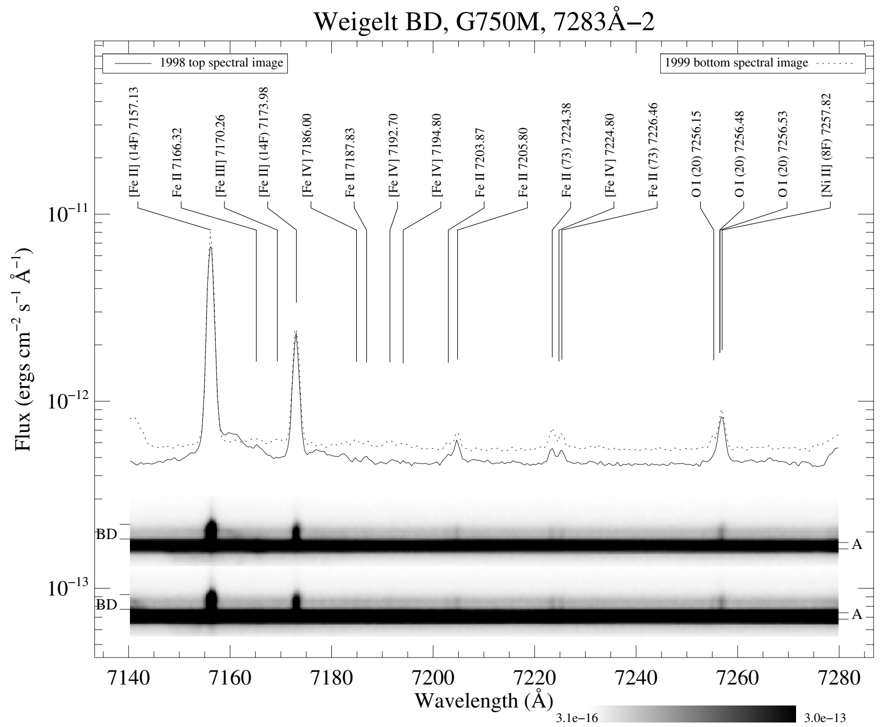

Fig. B.98. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

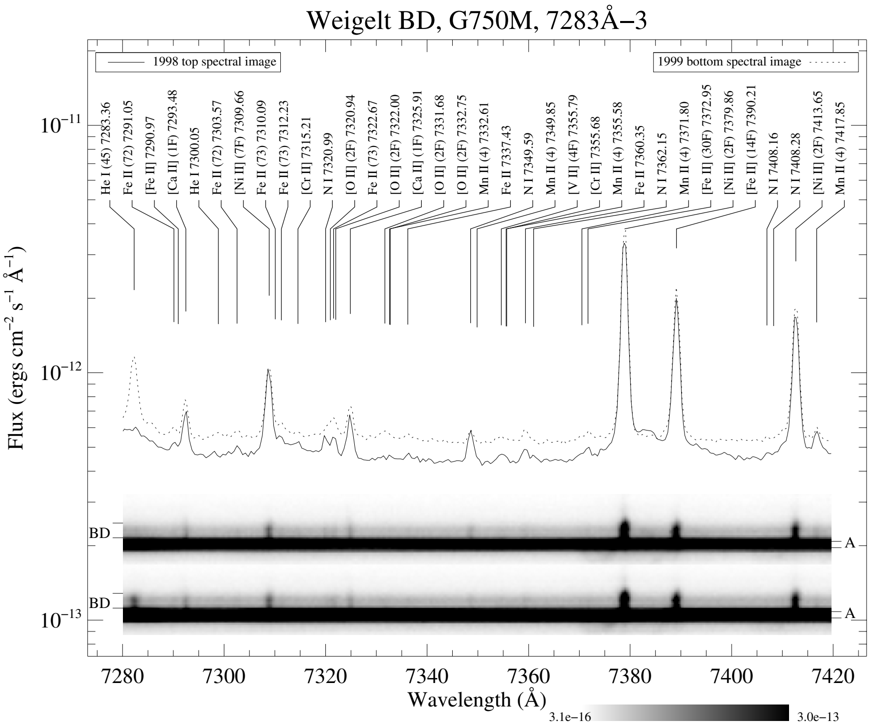

Fig. B.99. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

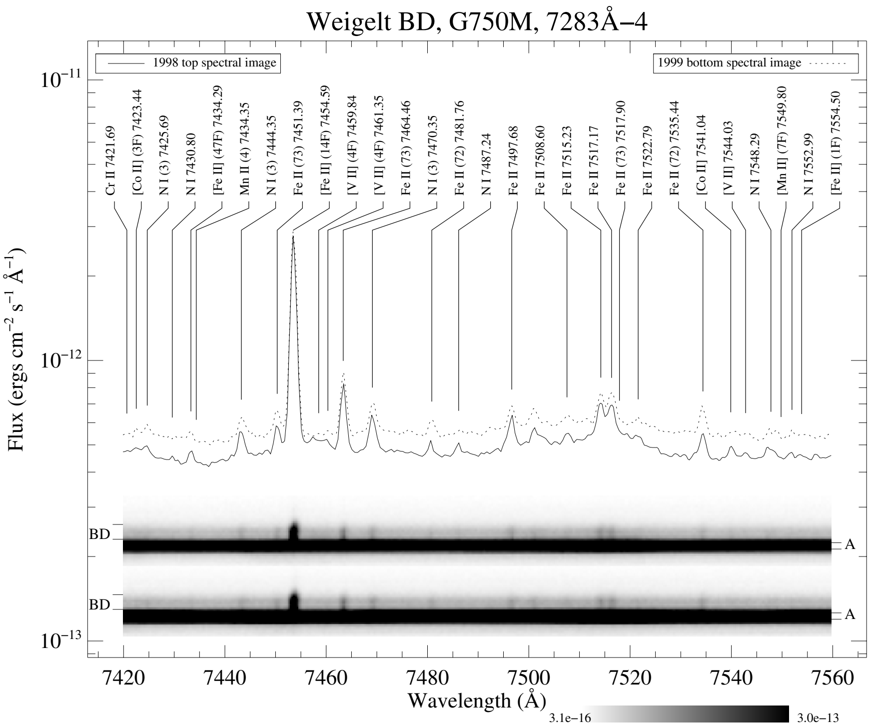

Fig. B.100. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

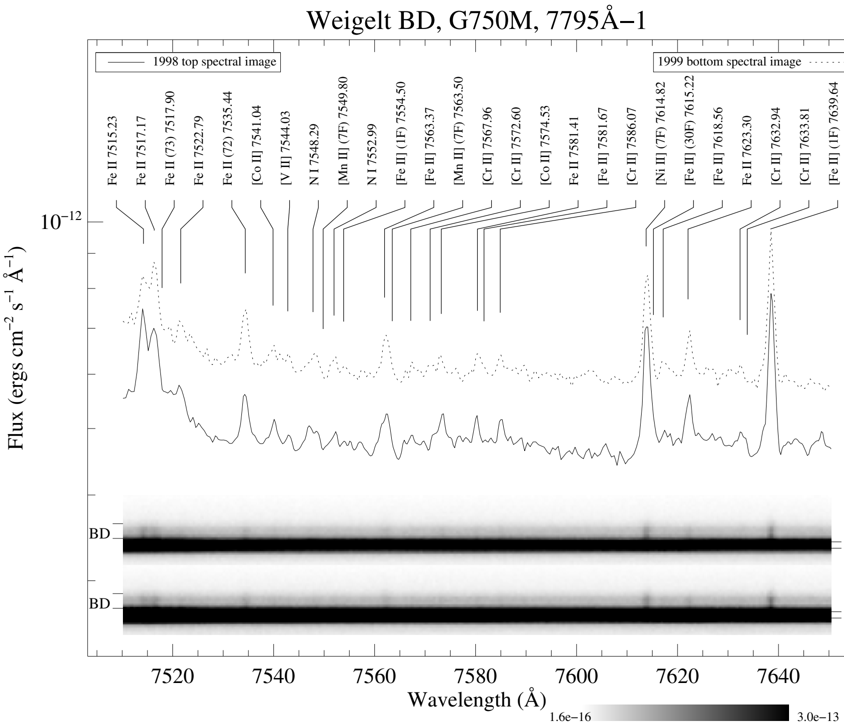

Fig. B.101. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

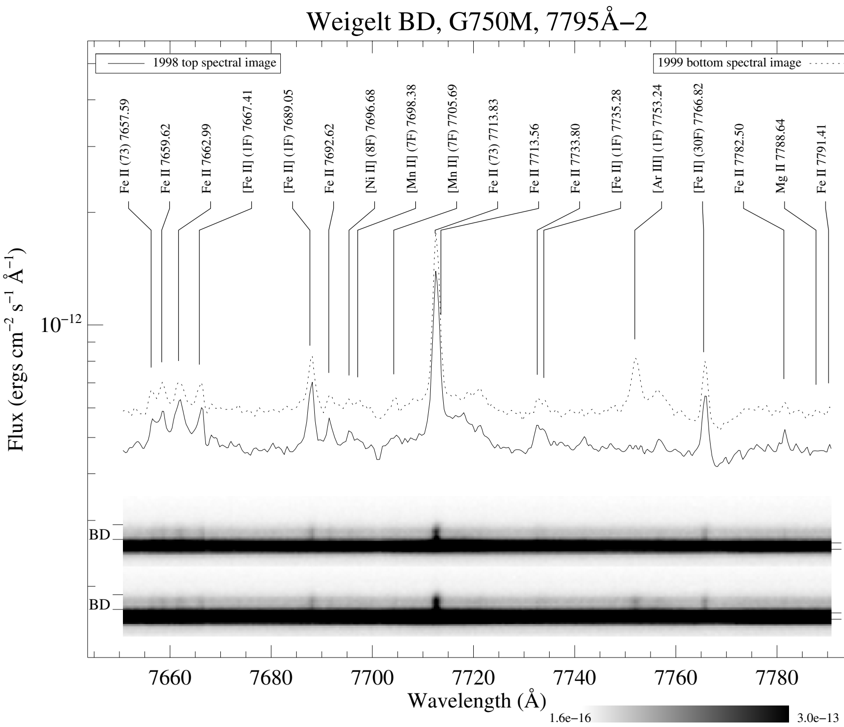

Fig. B.102. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

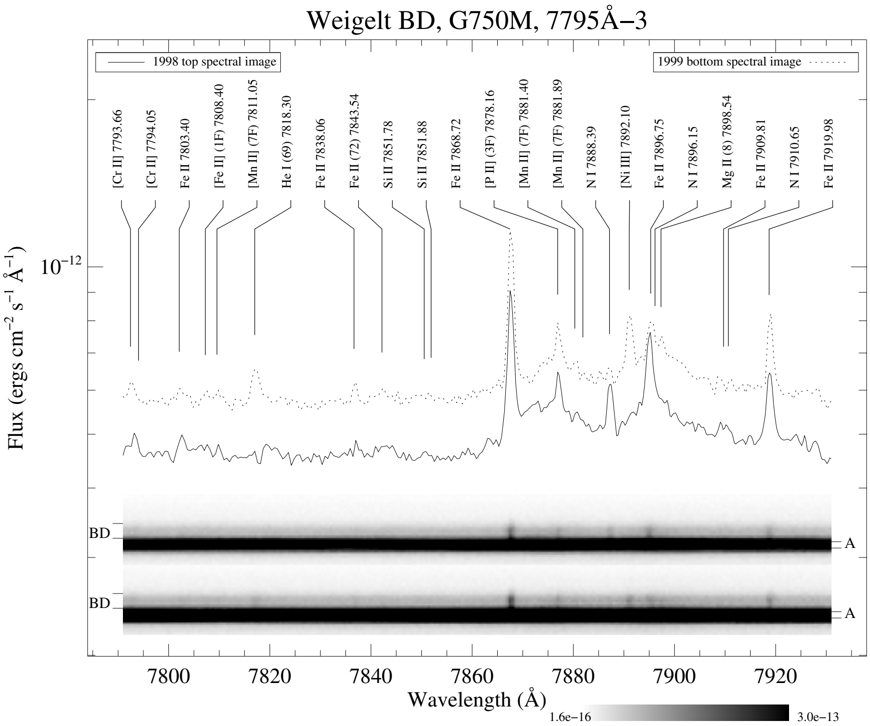

Fig. B.103. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

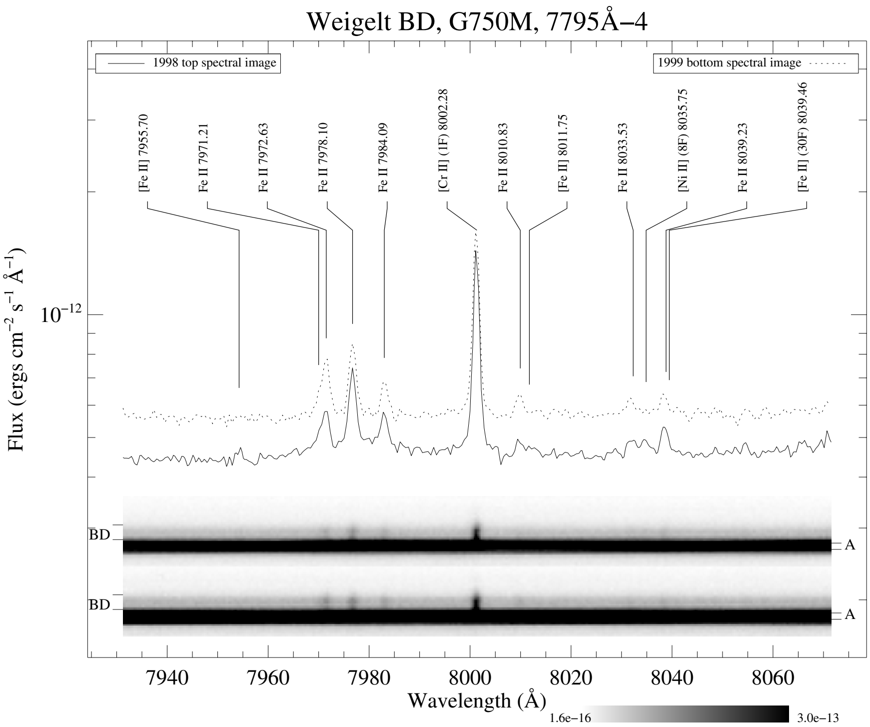

Fig. B.104. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

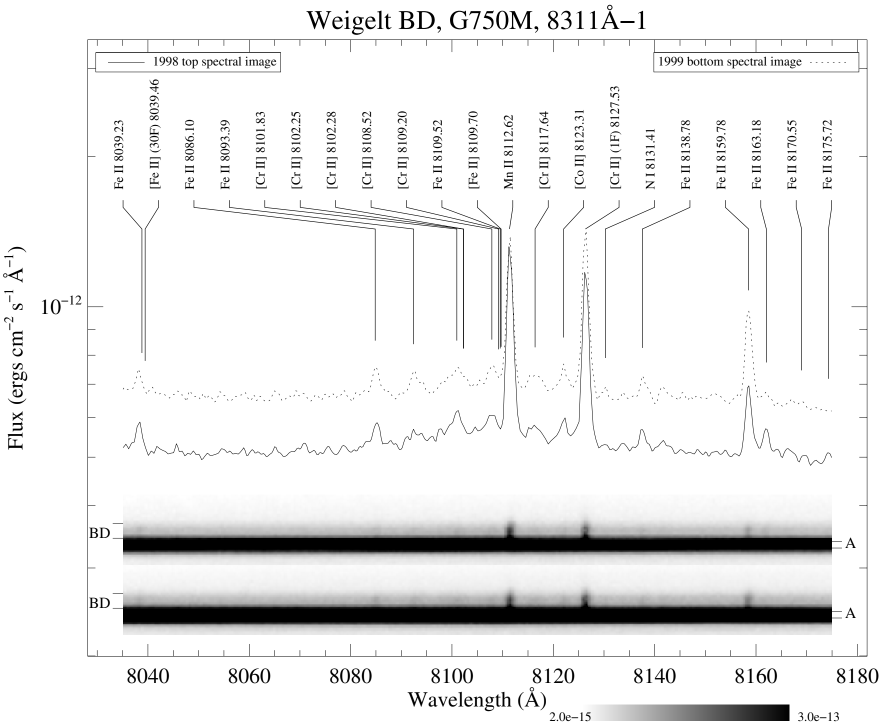

Fig. B.105. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

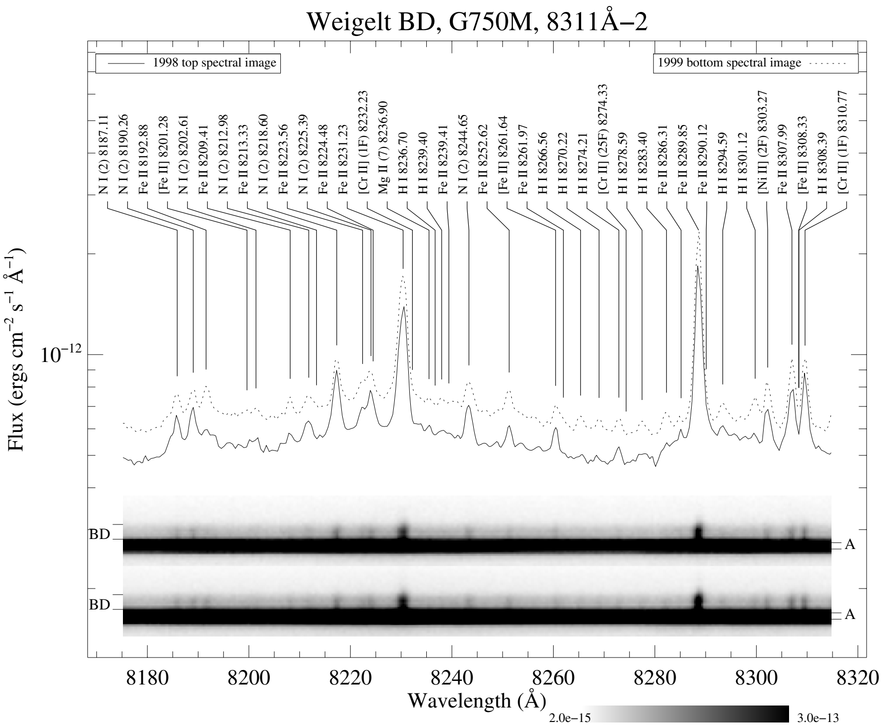

Fig. B.106. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

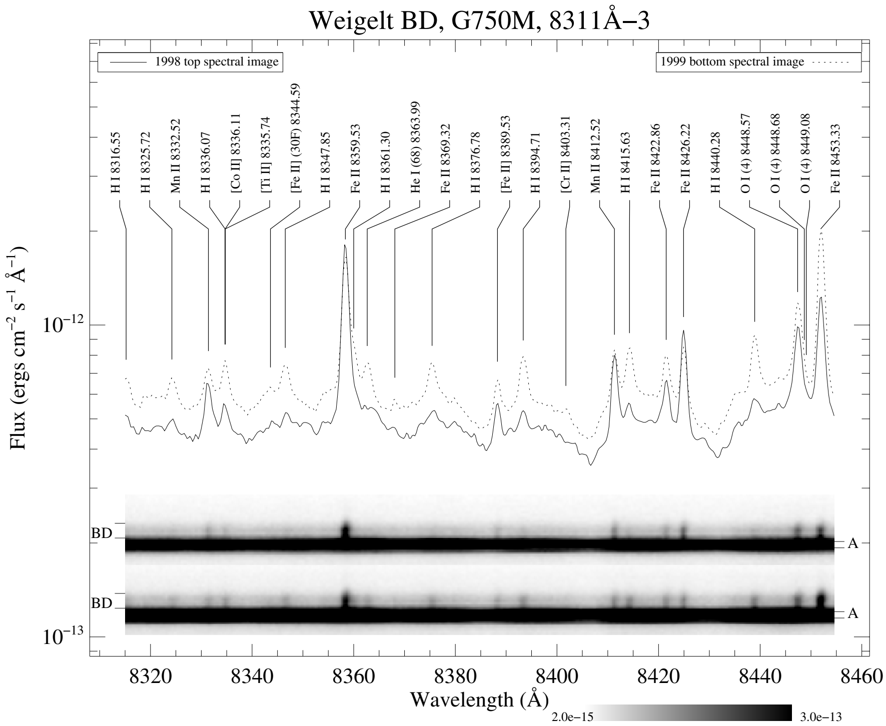

Fig. B.107. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

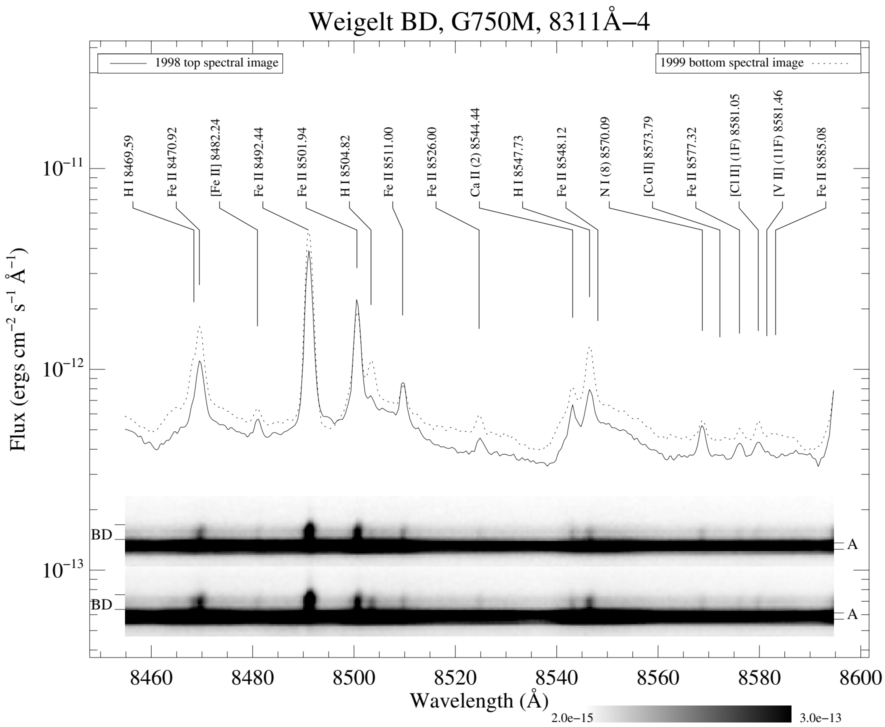

Fig. B.108. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

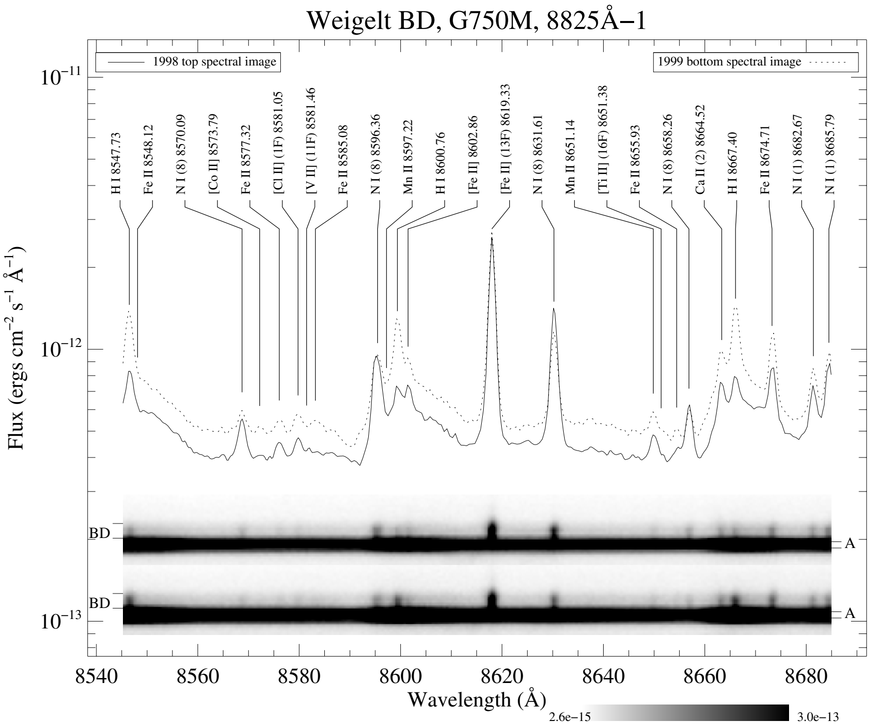

Fig. B.109. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

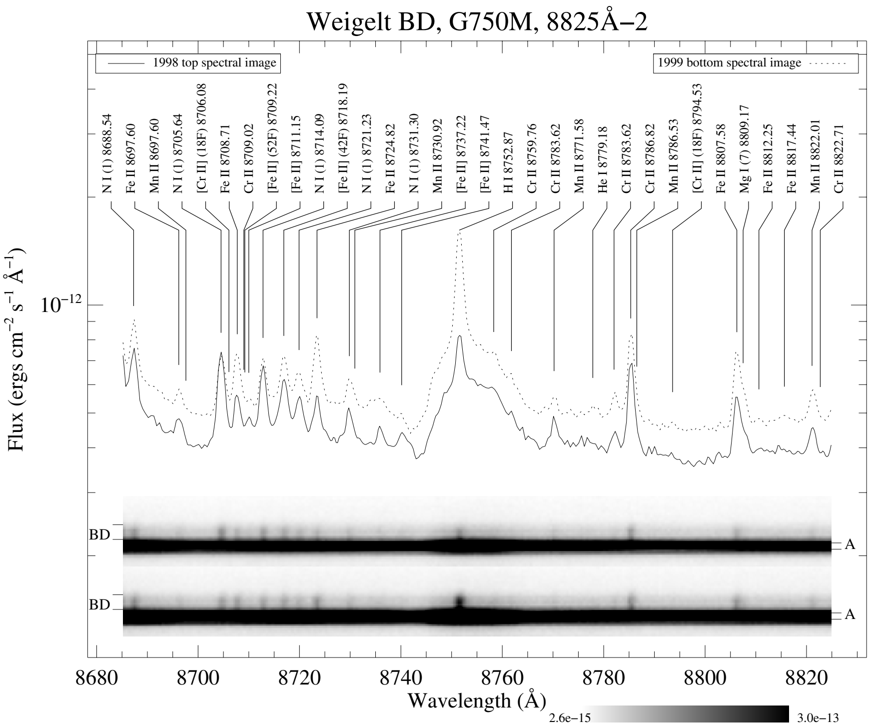

Fig. B.110. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

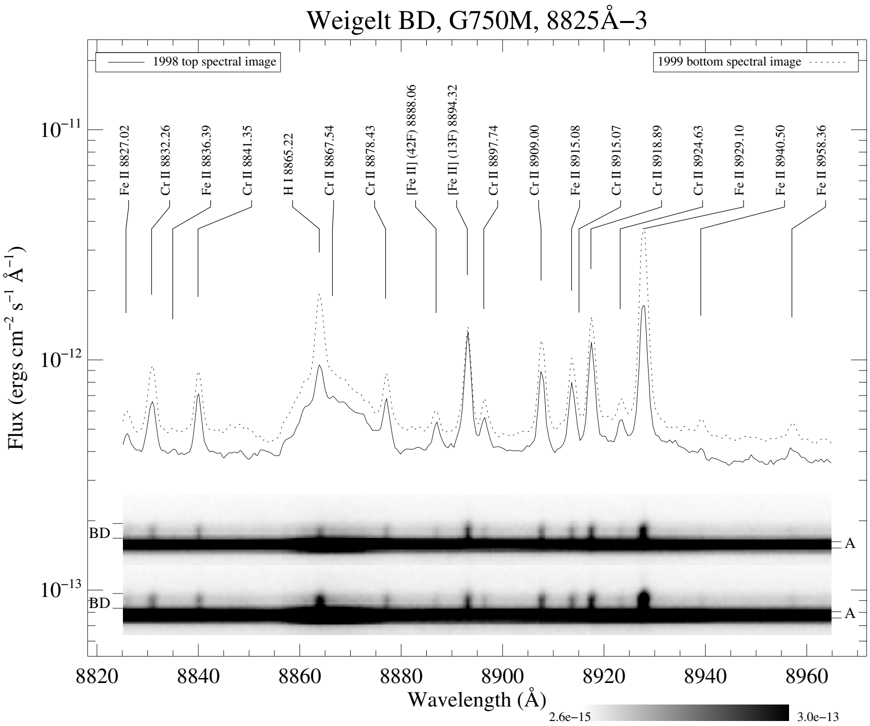

Fig. B.111. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

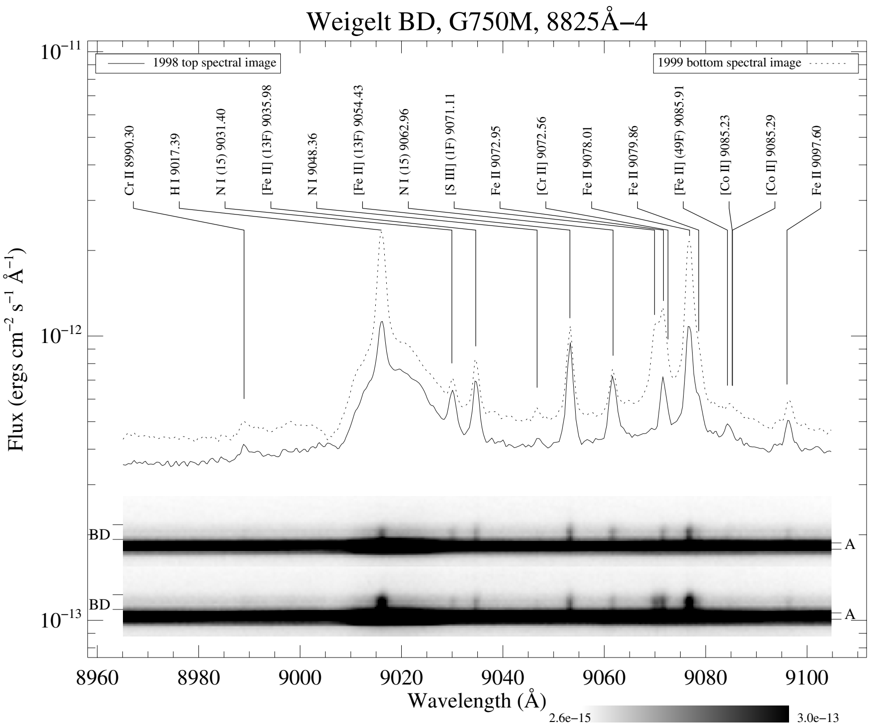

Fig. B.112. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

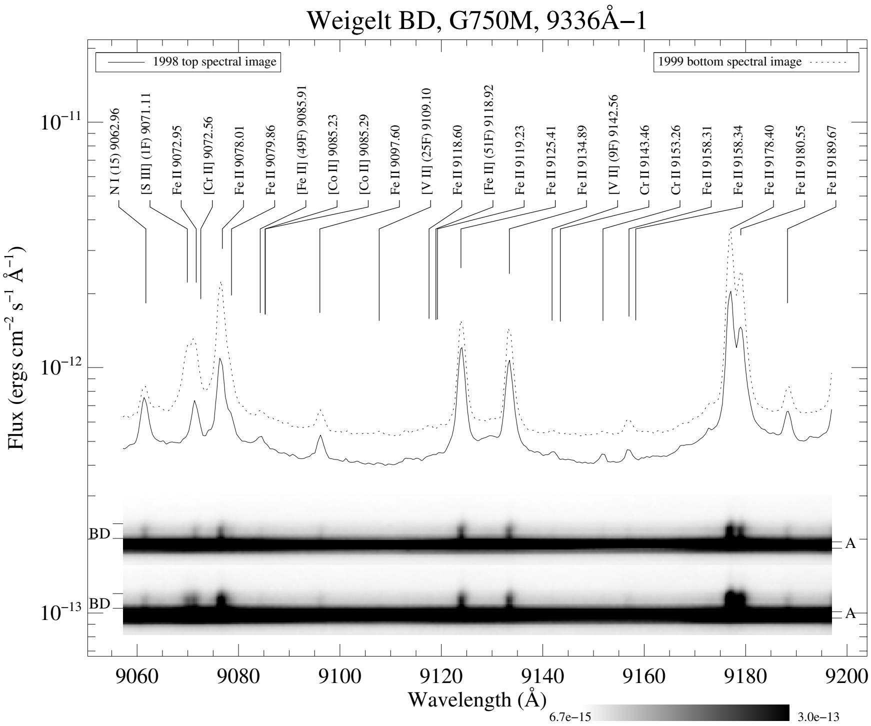

Fig. B.113. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

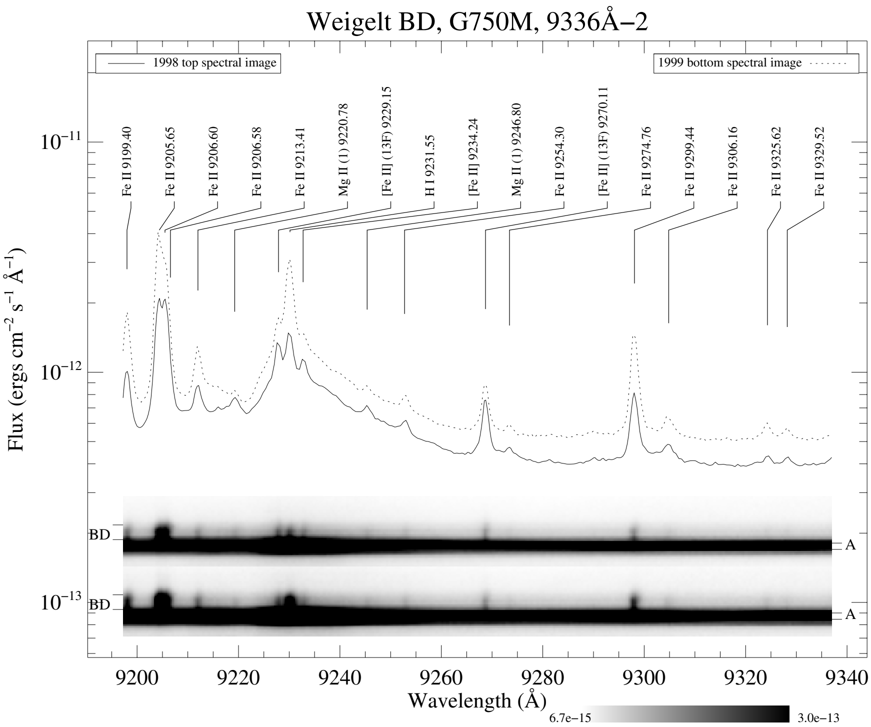

Fig. B.114. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

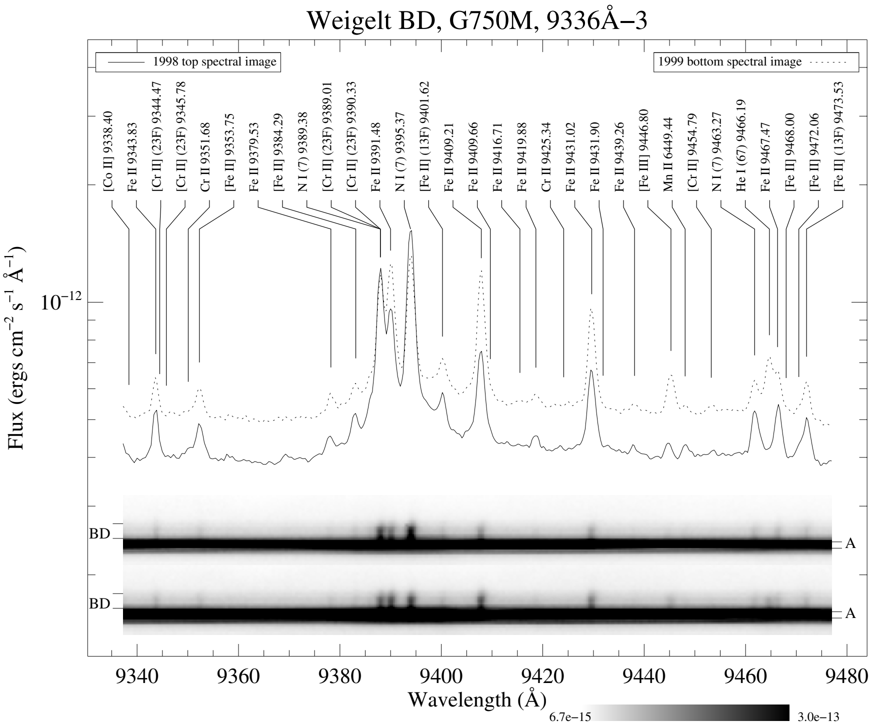

Fig. B.115. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

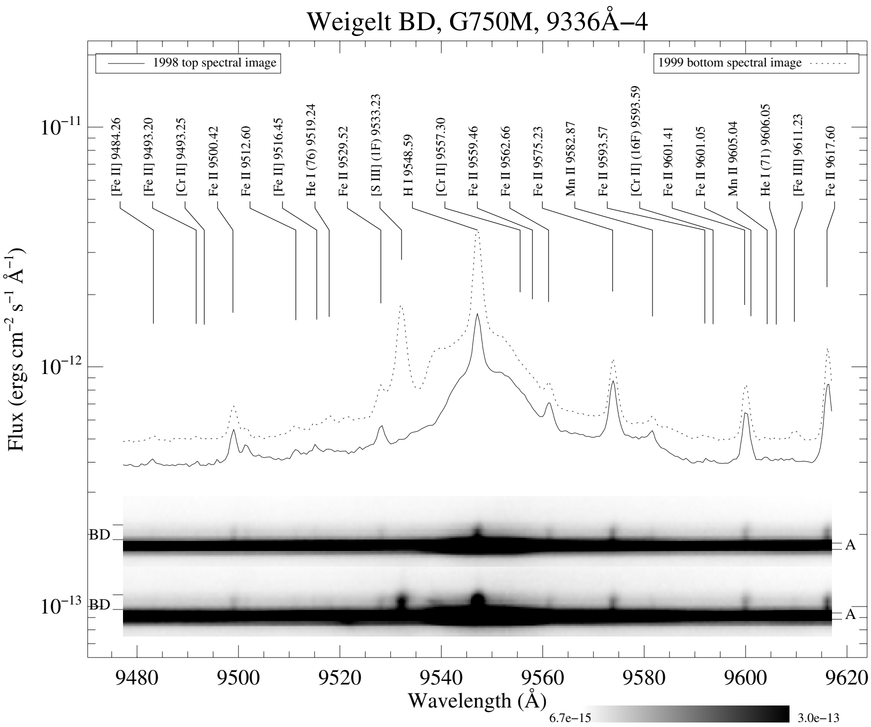

Fig. B.116. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

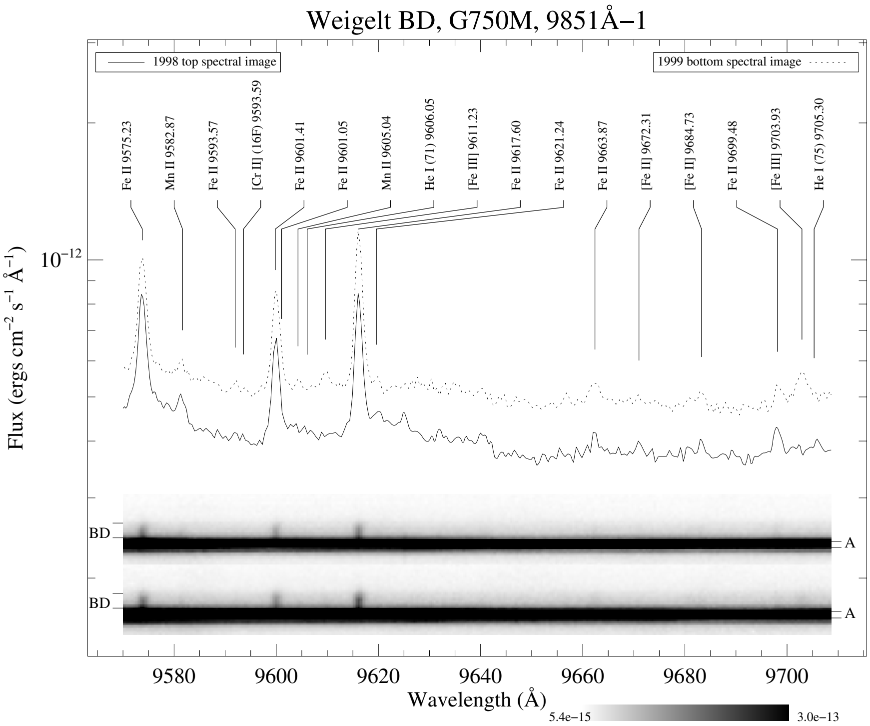

Fig. B.117. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

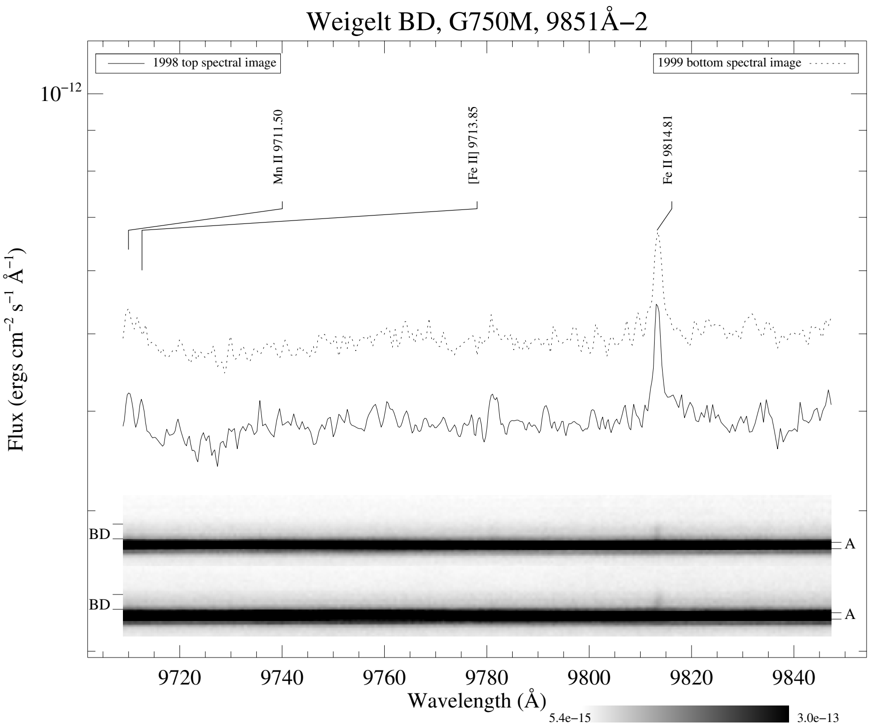

Fig. B.118. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

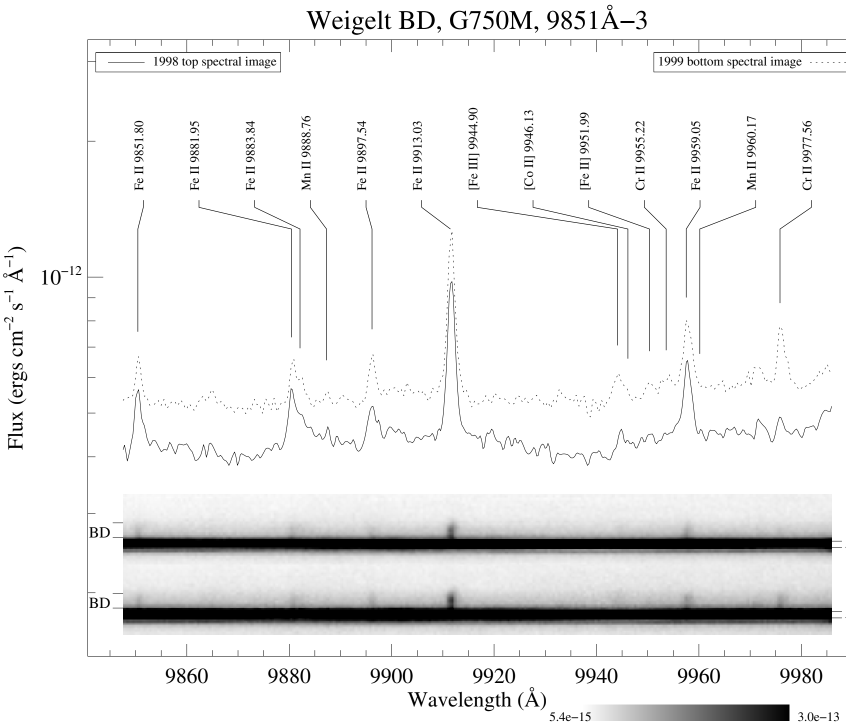

Fig. B.119. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

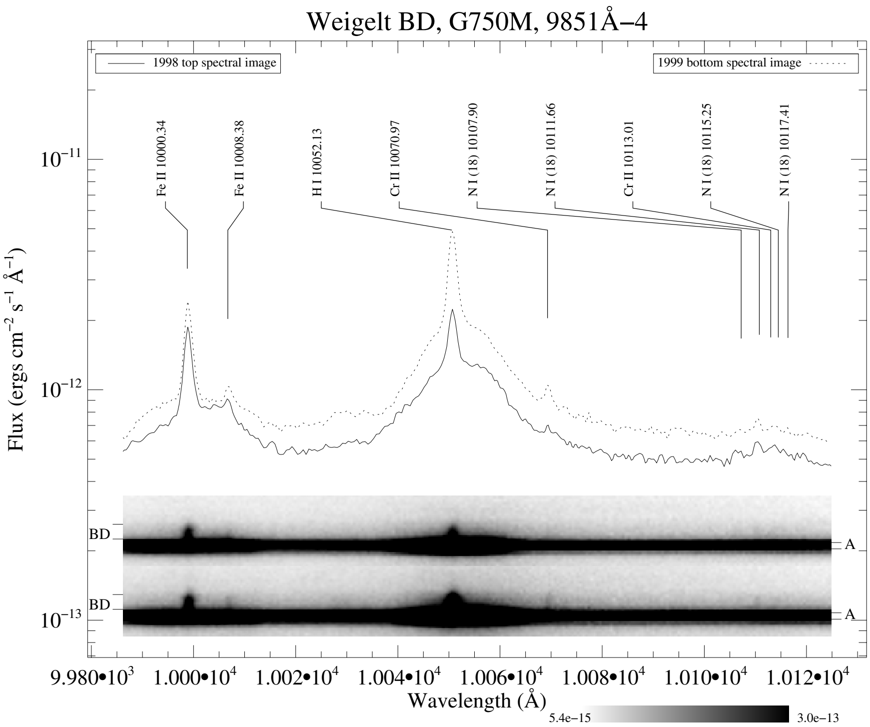

Fig. B.120. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

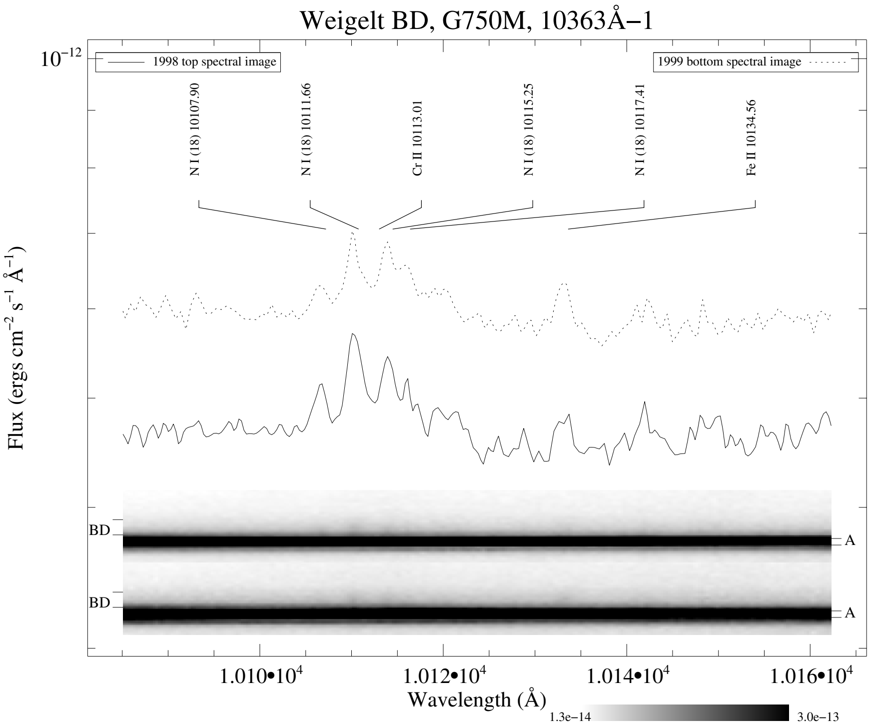

Fig. B.121. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

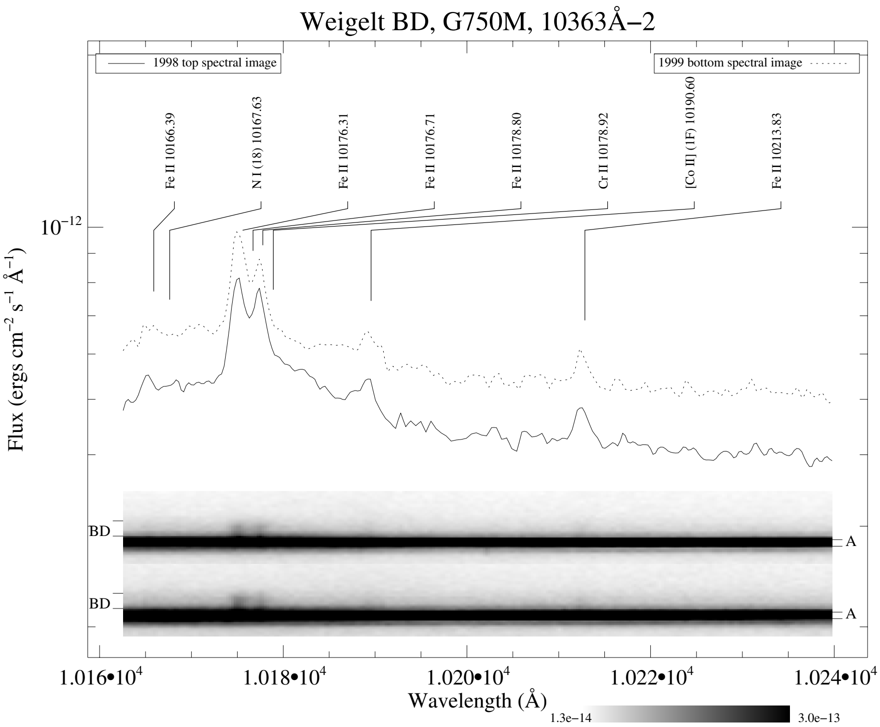

Fig. B.122. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

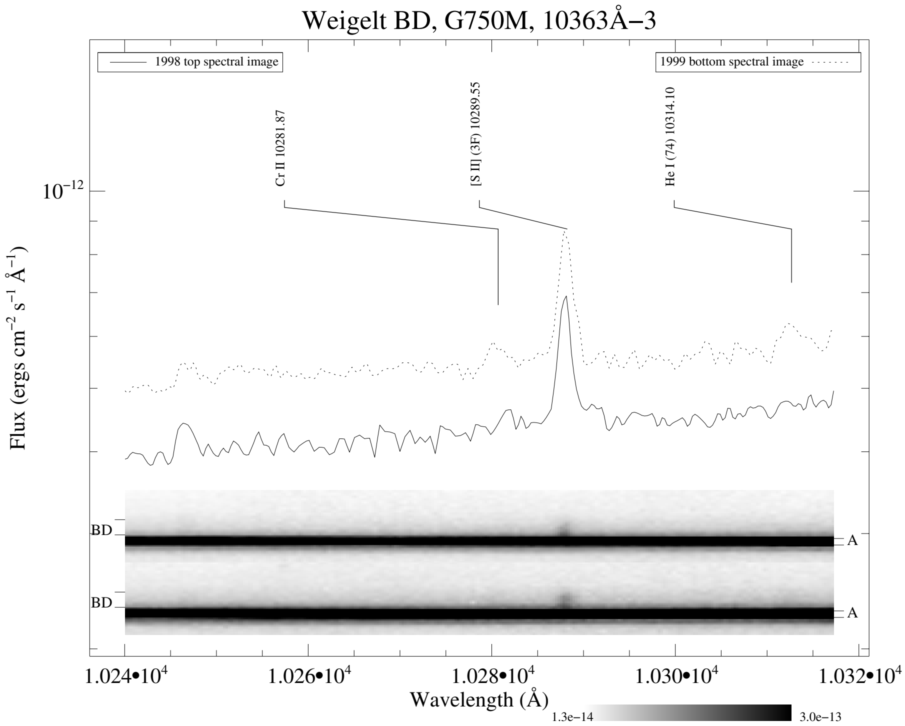

Fig. B.123. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

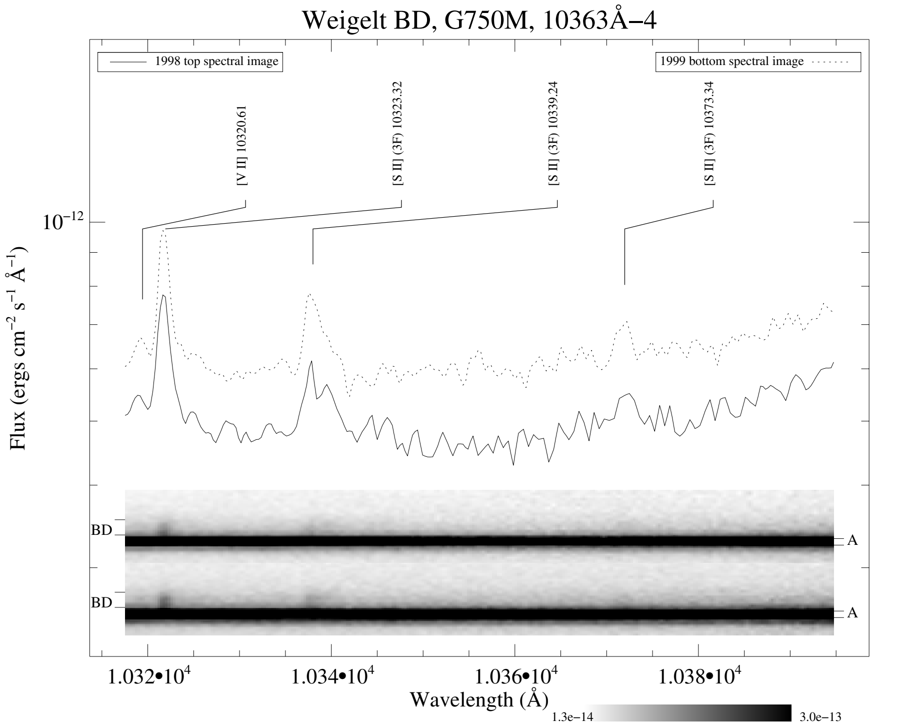

Fig. B.124. Spatially-resolved spectra of η Carinae, Weigelt B and Weigelt D. See Fig. 3 and text for detailed information.

Appendix C: Linelist

Table C.1. Identifications of 2500 emission lines in the wavelength region 1700–10 400 Å from the STIS spectra of the Weigelt blobs recorded in March 1998 and February 1999.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
1742.51		N I (UV 9)	$2p^3\ ^2P_{1/2} - 3s\ ^2P_{3/2}$	1742.72	
		N I (UV 9)	$2p^3\ ^2P_{3/2} - 3s\ ^2P_{3/2}$	1742.73	
1744.93		N I (UV 9)	$2p^3\ ^2P_{1/2} - 3s\ ^2P_{1/2}$	1745.25	
		N I (UV 9)	$2p^3\ ^2P_{3/2} - 3s\ ^2P_{1/2}$	1745.26	
1748.31		N III]	$2p\ ^2P_{1/2} - 2p^2\ ^4P_{1/2}$	1748.65	Not in 98
1751.89		N III]	$2p\ ^2P_{3/2} - 2p^2\ ^4P_{3/2}$	1752.16	Not in 98
1753.58		N III]	$2p\ ^2P_{3/2} - 2p^2\ ^4P_{1/2}$	1754.00	Not in 98
1785.05		Fe II (UV 191)	$a^6S_{5/2} - x^6P_{7/2}$	1785.27	
1786.52		Fe II (UV 191)	$a^6S_{5/2} - x^6P_{5/2}$	1786.75	
1835.28		N I (UV 8)	$2p^3\ ^2P_{3/2} - 3s\ ^4P_{3/2}$	1835.59	
1836.49		N I (UV 8)	$2p^3\ ^2P_{1/2} - 3s\ ^4P_{1/2}$	1836.71	
1839.54		Unidentified			
1869.27		Fe II	$b^4G_{11/2} - (^2F)sp\ ^4G_{11/2}$	1869.56	Lyα
1872.31		Fe II	$b^4G_{9/2} - (^2F)sp\ ^4G_{9/2}$	1872.64	Lyα
1877.64		Unidentified			
1891.65		Si III]	$3s^2\ ^1S_0 - 3s3p\ ^3P_1$	1892.03	Not in 98
1908.37		C III]	$2s^2\ ^1S_0 - 2s2p\ ^3P_1$	1908.73	Not in 98
1913.72		Fe III (UV 34)	$a^7S_3 - z^7P_3$	1914.06	Lyα, Not in 98
		Mn II (UV 10)	$a^5D_4 - z^5F_5$	1915.10	
1927.1		Fe III (UV 34)	$a^7S_3 - z^7P_2$	1926.96	
1953.24		Ni II (UV 43)	$a^4P_{5/2} - z^4S_{3/2}$	1953.40	
1982.72		Unidentified			
1986.16		Fe II	$b^2P_{3/2} - x^2P_{3/2}$	1986.42	
1991.30		Unidentified			
2068.55		Fe III (UV 48)	$a^5S_2 - z^5P_2$	2068.91	Not in 98
2079.40		Ni II (UV 16)	$a^4F_{7/2} - z^2D_{5/2}$	2079.43	
		Fe III (UV 48)	$a^5S_2 - z^5P_3$	2079.65	
2090.54		Ni II (UV 15)	$a^4F_{3/2} - z^2F_{5/2}$	2090.77	
2098.4		Fe II (UV 80)	$a^4P_{3/2} - y^4P_{3/2}$	2098.21	
2109.49		Fe II (UV 227)	$b^2P_{3/2} - y^2P_{3/2}$	2109.64	
		Ni II (UV 60)	$a^2G_{7/2} - y^2G_{9/2}$	2109.69	
		Fe II (UV 227)	$b^2P_{3/2} - y^2P_{1/2}$	2109.72	
2114.02		Ni II (UV 16)	$a^4F_{5/2} - z^2D_{5/2}$	2113.96	
		Ni II (UV 60)	$a^2G_{7/2} - y^2G_{7/2}$	2114.19	
2117.34		Fe II (UV 213)	$a^4G_{11/2} - w^4F_{9/2}$	2117.66	
2118.67		Fe II (UV 120)	$a^2H_{9/2} - y^2H_{9/2}$	2118.87	
2119.42		Fe II (UV 120)	$a^2H_{11/2} - y^2H_{11/2}$	2119.72	
2125.35		Ni II (UV 14)	$a^4F_{7/2} - z^2G_{7/2}$	2125.76	
2128.09		Ni II (UV 41)	$a^4P_{3/2} - x^2D_{5/2}$	2128.45	
2130.88		Cr II (UV 14)	$a^4D_{5/2} - y^4P_{5/2}$	2130.88	
		Fe II (UV 80)	$a^4P_{5/2} - y^4P_{5/2}$	2130.93	
2139.33		N II]	$2p^2\ ^3P_1 - 2p^3\ ^5S_2$	2139.68	Not in 98
2143.05		N II]	$2p^2\ ^3P_2 - 2p^3\ ^5S_2$	2143.45	Not in 98
2148.05		Cr II (UV 14)	$a^4D_{5/2} - y^4P_{3/2}$	2147.91	
		Fe II (UV 213)	$a^4G_{9/2} - w^4F_{7/2}$	2148.38	
2161.68		Fe II (UV 213)	$a^4G_{7/2} - w^4F_{5/2}$	2161.84	
		Ni II (UV 14)	$a^4F_{5/2} - z^2G_{7/2}$	2161.89	
2180.8		Ni II (UV 39)	$a^4P_{5/2} - z^2P_{3/2}$	2179.99	
		Ni II (UV 40)	$a^4P_{3/2} - y^4D_{5/2}$	2181.16	
2192.80		Ni II (UV 31)	$b^2D_{5/2} - y^4D_{5/2}$	2193.03	
2202.07		Ni II (UV 13)	$a^4F_{3/2} - z^4F_{5/2}$	2202.09	
2207.37		Ni II (UV 13)	$a^4F_{5/2} - z^4F_{7/2}$	2207.40	
2254.37		Ni II (UV 29)	$b^2D_{3/2} - y^2D_{3/2}$	2254.38	
		Ni II (UV 12)	$a^4F_{3/2} - z^4G_{5/2}$	2254.55	
2255.47		Fe II	$b^4F_{5/2} - y^2D_{3/2}$	2255.59	

Notes. The identifications for the region 2424–2706 Å are improved using the line list by Nielsen et al. (2007b) based on high resolution HST/STIS spectra. The identifications and laboratory wavelengths are retrieved from the Kurucz database (Kurucz 2001). The laboratory wavelengths for parity forbidden lines are Ritz wavelengths derived from energy levels in the NIST Atomic Spectra Database (2006). All wavelengths are given in vacuum. Abreviations for the comments are explained at the end of the table.

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
		Fe II	$a^4H_{13/2} - x^4G_{11/2}$	2255.89	
2256.64		Fe II (UV 4)	$a^6D_{1/2} - z^4F_{3/2}$	2256.69	
		Ni II (UV 51)	$a^2P_{1/2} - y^2P_{1/2}$	2256.84	
2270.93		Ni II (UV 12)	$a^4F_{7/2} - z^4G_{9/2}$	2270.91	
2275.15?		Ni II (UV 38)	$a^4P_{3/2} - y^2D_{5/2}$	2275.43	
2280.66		Fe II (UV 4)	$a^6D_{7/2} - z^4F_{9/2}$	2280.62	
2287.68		Ni II (UV 22)	$a^2F_{5/2} - z^2D_{3/2}$	2287.79	
2288.08		Ni II (UV 29)	$b^2D_{5/2} - y^2D_{5/2}$	2288.35	
2294.12		Co II (UV 9)	$a^5F_3 - z^5G_3$	2294.09	
		Fe II (UV 184)	$b^4F_{5/2} - x^4F_{5/2}$	2294.48	
		Fe II (UV 184)	$b^4F_{3/2} - x^4F_{3/2}$	2294.56	
2298.97		Ni II (UV 21)	$a^2F_{5/2} - z^2F_{5/2}$	2298.98	
		Ni II (UV 39)	$a^4P_{3/2} - z^2P_{1/2}$	2299.20	
2299.69		Mn II (UV 2)	$a^7S_3 - z^5P_2$	2299.66	
2304.25		Ni II (UV 59)	$a^2G_{7/2} - x^2F_{7/2}$	2304.46	
		Ni II (UV 51)	$a^2P_{1/2} - y^2P_{3/2}$	2304.56	
2309.10		Ni II (UV 50)	$a^2P_{3/2} - x^2D_{3/2}$	2309.23	
2317.67		Fe II (UV 183)	$b^4F_{5/2} - x^4G_{5/2}$	2318.09	
2318.92		Fe II (UV 183)	$b^4F_{7/2} - x^4G_{7/2}$	2319.06	
		Ni II (UV 29)	$b^2D_{5/2} - y^2D_{3/2}$	2319.22	
		Fe II (UV 132)	$a^2D_{3/2} - z^2F_{5/2}$	2319.25	
2322.09		Fe II (UV 183)	$b^4F_{9/2} - x^4G_{9/2}$	2322.40	
2325.92		Fe II (UV 183)	$b^4F_{5/2} - x^4G_{7/2}$	2326.01	
2333.8		Fe II (UV 3)	$a^6D_{5/2} - z^6P_{2/2}$	2333.52	
2337.02?		Co II (UV 8)	$a^5F_1 - z^5D_0$	2336.94	
		Ni II (UV 27)	$b^2D_{3/2} - z^4P_{3/2}$	2337.35	
		Ni II (UV 50)	$a^2P_{1/2} - x^2D_{3/2}$	2337.43	
2338.81		Fe II (UV 3)	$a^6D_{3/2} - z^6P_{3/2}$	2338.72	
2351.0		Ni II (UV 19)	$a^2F_{7/2} - z^2F_{5/2}$	2351.57	
		Fe II (UV 36)	$a^4F_{9/2} - z^4D_{7/2}$	2348.83	
		Fe II (UV 3)	$a^6D_{5/2} - z^6P_{5/2}$	2349.02	
2355.60		Fe II (UV 35)	$a^4F_{5/2} - z^4F_{3/2}$	2355.61	
		Fe II (UV 165)	$a^4H_{11/2} - y^4G_{11/2}$	2355.94	
2361.10		Fe II (UV 35)	$a^4F_{9/2} - z^4F_{9/2}$	2360.72	
		Fe II (UV 36)	$a^4F_{7/2} - z^4D_{5/2}$	2361.01	
2369.65		Fe II (UV 36)	$a^4F_{5/2} - z^4D_{3/2}$	2369.32	
		Ni II (UV 36)	$a^4P_{1/2} - z^4P_{1/2}$	2369.94	
2390.3		Fe II (UV 2)	$a^6D_{7/2} - z^6F_{7/2}$	2389.36	
2400.9		Fe II (UV 36)	$a^4F_{3/2} - z^4D_{5/2}$	2399.96	
		Fe II (UV 2)	$a^6D_{5/2} - z^6F_{5/2}$	2399.97	
2414.72		Co II (UV 7)	$a^5F_3 - z^5F_3$	2414.80	
		Fe II (UV 164)	$a^4H_{13/2} - z^2I_{11/2}$	2414.84	
		Fe II (UV 180)	$b^4F_{9/2} - y^4G_{7/2}$	2415.24	
2415.54		Fe II	$c^4P_{3/2} - 5p\ ^4P_{5/2}$	2415.80	Lyα
		Fe II (UV 180)	$b^4F_{3/2} - z^2F_{5/2}$	2415.80	
		Fe II	$c^4P_{3/2} - (b^3P)4p\ ^4P_{3/2}$	2415.93	Lyα
2416.81		Ni II (UV 20)	$a^2F_{5/2} - z^2G_{7/2}$	2416.87	
2419.04		Fe II	$c^4P_{3/2} - (b^3P)4p\ ^4P_{1/2}$	2419.40	Lyα
		Fe III (UV 47)	$a^5S_2 - z^7P_3$	2419.31	Lyα
2423.46		Fe II (UV 301)	$b^4D_{5/2} - w^4D_{7/2}$	2423.42	
		Fe II (UV 115)	$a^2H_{9/2} - y^4F_{7/2}$	2423.67	
		Fe II (UV 301)	$b^4D_{3/2} - w^4D_{5/2}$	2423.95	
2424.99		Fe II	$b^4F_{7/2} - y^4G_{7/2}$	2425.39	
2425.70		Fe II	$a^4G_{5/2} - y^2D_{3/2}$	2426.10	
2426.02		Fe II	$b^2P_{3/2} - y^2D_{5/2}$	2426.42	
2426.25		Fe II	$a^2D2_{5/2} - y^4D_{7/2}$	2426.65	
2427.53		Fe II	$a^2H_{11/2} - z^4I_{13/2}$	2427.93	
2429.13		Fe II	$a^4G_{11/2} - y^4H_{9/2}$	2429.53	
2429.14		Fe II	$b^4D_{3/2} - w^4D_{3/2}$	2429.54	
2429.42		Ni II	$^2P_{1/2} - y^4D_{1/2}$	2429.82	
2429.85		Fe II	$b^4F_{5/2} - y^4G_{5/2}$	2430.25	
2430.76		Fe II	$c^4F_{3/2} - {}^4F_{3/2}$	2431.14	Lyα
2430.82		Fe II	$c^4P_{3/2} - {}^4D_{5/2}$	2431.20	Lyα
2431.35		Fe II	$c^4P_{3/2} - {}^4S_{3/2}$	2431.73	Lyα

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
2431.90		Ni II	$^2P_{1/2} - {}^4D_{3/2}$	2432.30	
2433.04		Fe II	$a^2I_{13/2} - y^2I_{11/2}$	2433.44	
2433.89		Fe II	$a^4H_{9/2} - z^2I_{11/2}$	2434.24	
2433.92		Fe II	$c^2D_{5/2} - w^2P_{3/2}$	2434.32	
2436.15		Fe II	$a^4H_{13/2} - z^2I_{13/2}$	2436.55	
2436.56		Fe II	$a^4H_{11/2} - y^4H_{11/2}$	2436.96	
2436.89		Fe II	$c^2D_{3/2} - w^2P_{3/2}$	2437.29	
2437.50		Fe II	$a^4G_{7/2} - y^2D_{5/2}$	2437.90	
2437.61		Fe II	$b^4P_{3/2} - y^4D_{1/2}$	2438.01	
2438.63		[Fe III]	$^5D_4 - {}^5S_2$	2439.03	
2438.88		Fe II	$c^4P_{5/2} - {}^4F_{3/2}$	2439.26	Lyα
2438.96		Fe II	$c^4F_{3/2} - {}^4F_{5/2}$	2439.34	Lyα
2440.29		Fe II	$c^4F_{3/2} - {}^4D_{3/2}$	2440.67	Lyα
2440.45		Fe II	$d^2G_{7/2} - {}^2G_{7/2}$	2440.85	
2441.47		Fe II	$z^4F_{9/2} - e^4G_{9/2}$	2441.87	
2442.95		Fe II	$^4F_{5/2} - {}^4F_{5/2}$	2443.33	Lyα
2444.11		Co II	$b^3F_2 - z^3D_2$	2444.51	
2444.26		Fe II	$c^4F_{5/2} - {}^4D_{3/2}$	2444.66	
2447.14		Fe II	$c^4P_{5/2} - {}^4F_{5/2}$	2447.52	Lyα
2448.47		Fe II	$c^4P_{5/2} - {}^4D_{3/2}$	2448.85	Lyα
2453.27		Fe II	$b^4D_{7/2} - w^4F_{5/2}$	2453.67	
2454.32		Fe II	$z^4D_{7/2} - e^4G_{9/2}$	2454.72	
2454.53		Fe II	$b^2P_{3/2} - x^4F_{5/2}$	2454.91	Si III]
2454.92		Fe II	$a^2I_{13/2} - w^2H_{11/2}$	2455.32	
2455.86		Ni II	$^2F_{7/2} - {}^4G_{7/2}$	2456.26	
2457.32		Fe II	$c^4P_{5/2} - {}^4P_{5/2}$	2457.71	Lyα
2457.45		Fe II	$c^4P_{5/2} - {}^4P_{3/2}$	2457.84	Lyα
2457.91		Fe II	$b^4D_{3/2} - {}^4P_{3/2}$	2458.30	Lyα
2459.45		Fe II	$b^2F_{7/2} - w^4D_{7/2}$	2459.85	
2459.46		Fe II	$a^4H_{11/2} - z^2G_{9/2}$	2459.86	
2460.78		Fe II	$z^4F_{9/2} - e^4G_{11/2}$	2461.18	
2460.99		Fe II	$c^2D_{3/2} - w^2P_{1/2}$	2461.39	
2463.10		Fe II	$c^4F_{7/2} - {}^4F_{7/2}$	2463.49	Lyα
2464.86		[Fe III]	$^5D_3 - {}^5S_2$	2465.26	
2464.92		Fe II	$c^4F_{3/2} - {}^4D_{5/2}$	2465.31	Lyα
2466.27		Fe II	$a^4G_{7/2} - x^4F_{5/2}$	2466.66	Si III]
2469.72		Fe II	$a^4H_{9/2} - z^4H_{7/2}$	2470.12	
2470.57		[O II]	$^4S_{3/2} - {}^2P_{1/2}$	2470.97	
2470.69		[O II]	$^4S_{3/2} - {}^2P_{3/2}$	2471.09	
2470.76		Fe II	$a^4G_{5/2} - x^4F_{5/2}$	2471.16	
2472.95		Fe II	$z^4F_{7/2} - e^4G_{9/2}$	2473.35	
2473.27		Fe II	$c^4P_{5/2} - {}^4D_{5/2}$	2473.66	Lyα
2473.81		Fe II	$c^4P_{5/2} - {}^4S_{3/2}$	2474.20	Lyα
2475.47		Fe II	$z^4F_{3/2} - e^4G_{5/2}$	2475.87	
2475.89		Fe II	$z^4F_{5/2} - e^4G_{7/2}$	2476.29	
2477.84		Fe II	$a^2H_{9/2} - z^4H_{7/2}$	2478.25	
2478.79		Fe II	$a^4H_{13/2} - z^4I_{11/2}$	2479.20	
2479.63		Fe II	$a^4G_{5/2} - x^4F_{7/2}$	2480.04	
2481.91		Fe II	$c^2G_{9/2} - w^2H_{9/2}$	2482.32	
2483.19		[Fe III]	$^5D_2 - {}^5S_2$	2483.79	
2484.71		Fe II	$b^2F_{7/2} - w^4F_{5/2}$	2485.12	
2484.87		Fe II	$b^4P_{3/2} - y^6P_{5/2}$	2485.28	
2485.69		Co II	$b^3F_4 - z^3G_3$	2486.10	
2488.66		Fe II	$d^2F_{5/2} - {}^2F_{5/2}$	2489.07	Lyα
2488.69		Fe II	$d^2F_{7/2} - {}^2F_{7/2}$	2489.08	Lyα
2489.43		Ni II	$^4G_{9/2} - {}^2F_{7/2}$	2489.84	
2491.68		V II	$a^5P_3 - w^3D_2$	2492.09	
2495.38		[Fe III]	$^5D_1 - {}^5S_2$	2495.79	
2496.24		Ni II	$^4D_{5/2} - {}^2F_{7/2}$	2496.65	
2497.65		Fe II	$a^4G_{7/2} - x^4F_{9/2}$	2498.06	
2498.71		Fe II	$a^4H_{7/2} - y^4D_{7/2}$	2499.12	
2501.27		Fe II	$c^2D_{5/2} - v^2F_{7/2}$	2501.68	
2503.92		Fe II	$b^4F_{3/2} - y^4D_{3/2}$	2504.33	
2504.22		Fe II	$b^2G_{9/2} - x^2G_{9/2}$	2504.63	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
2505.26		Fe II	$c^4F_{9/2} - {}^6F_{9/2}$	2505.65	Lyα
2506.19		Ni II	${}^2P_{3/2} - {}^2P_{3/2}$	2506.60	
2507.16		Fe II	$c^4F_{7/2} - {}^6F_{9/2}$	2507.55	Lyα
2508.05		Fe II	$z^6D_{7/2} - e^6D_{5/2}$	2508.44	Lyα sec
2508.71		Fe II	$c^4F_{7/2} - {}^4G_{9/2}$	2509.10	Lyα
2510.23		Fe II	$z^6D_{3/2} - e^6D_{1/2}$	2510.62	Lyα sec
2513.08		Fe II	$a^2D2_{3/2} - z^2D_{5/2}$	2513.49	
2513.52		Fe II	$z^6D_{9/2} - e^6D_{7/2}$	2513.91	Lyα sec
2515.28		Fe II	$b^4F_{5/2} - y^4D_{5/2}$	2515.69	
2515.48		Fe II	$c^4F_{5/2} - {}^4G_{7/2}$	2515.88	Lyα
2516.41		Fe II	$c^4F_{9/2} - {}^4G_{7/2}$	2516.80	Lyα
2517.48		Fe II	$b^4P_{1/2} - z^2D_{3/2}$	2517.89	
2517.79		Co II	$c^3P_1 - z^3P_1$	2518.20	
2519.76		Fe II	$b^2P_{1/2} - x^4F_{3/2}$	2520.17	
2519.92		Fe II	$c^4P_{5/2} - {}^4G_{7/2}$	2520.32	Lyα
2520.62		Fe II	$z^6D_{5/2} - e^6D_{5/2}$	2521.02	Lyα sec
2521.58		Fe II	$c^4F_{3/2} - {}^4G_{5/2}$	2521.98	Lyα
2521.84		Fe II	$d^2G_{9/2} - {}^2H_{11/2}$	2522.24	Lyα
2522.16		Fe II	$c^2G_{7/2} - w^2G_{7/2}$	2522.57	
2523.80		Fe II	$z^6D_{1/2} - e^6D_{3/2}$	2524.20	Lyα sec
2525.46		Fe II	$c^2G_{7/2} - w^2G_{9/2}$	2525.87	
2526.28		Fe II	$z^4D_{7/2} - e^6D_{7/2}$	2526.68	Lyα sec
2527.80		Fe II	$c^2G_{7/2} - x^2F_{5/2}$	2528.21	
2528.03		Fe II	$b^2G_{7/2} - x^2G_{9/2}$	2528.44	
2529.03		Fe II	$b^4F_{9/2} - y^6P_{7/2}$	2529.44	
2530.11		Ti II	$b^4F_{3/2} - y^4D_{3/2}$	2530.52	
2530.28		Fe II	$c^2G_{7/2} - {}^4D_{7/2}$	2530.69	
2534.23		Ti II	$d^2D1_{1.5} - {}^4F_{3/2}$	2534.64	
2535.71		Fe II	$c^2F_{5/2} - v^2D_{3/2}$	2536.12	
2537.50		Fe II	$z^6D_{9/2} - e^6D_{9/2}$	2537.90	Lyα sec
2539.44		Ni II	${}^2P_{1/2} - {}^2P_{3/2}$	2539.86	
2540.15		Fe II	$b^4F_{7/2} - y^6P_{7/2}$	2540.57	
2540.40		Fe II	$a^2F_{7/2} - y^4H_{7/2}$	2540.82	
2546.24		Ni II	${}^2F_{5/2} - {}^4G_{7/2}$	2546.66	
2546.40		Fe II	$c^2P_{1/2} - u^4F_{3/2}$	2546.80	N IV
2549.27		Fe II	$a^2I_{11/2} - x^2H_{9/2}$	2549.69	
2550.12		Fe II	$a^2F_{7/2} - x^4F_{5/2}$	2550.54	
2551.55		Fe II	$c^2G_{9/2} - w^4D_{7/2}$	2551.97	
2553.31		V II	$b^3F_4 - x^3D_3$	2553.73	
2554.09		Fe II	$a^2D2_{5/2} - z^4S_{3/2}$	2554.51	
2555.41		Fe II	$b^4F_{5/2} - y^4F_{7/2}$	2555.83	
2555.80		Fe II	$b^4F_{3/2} - y^4F_{5/2}$	2556.22	
2557.45		Fe II	$a^4H_{7/2} - z^4G_{9/2}$	2557.85	Si III]
2557.68		Co II	$a^3P_0 - z^3D_1$	2558.10	
2557.85		Fe II	$b^4F_{9/2} - y^4D_{7/2}$	2558.27	
2558.21		Ni II	${}^2P_{3/2} - {}^2D_{3/2}$	2558.63	
2558.69		Cr II	$a^2D_{5/2} - x^4G_{7/2}$	2559.11	
2559.21		Mn II	$a^5F_4 - x^5D_4$	2559.63	
2565.57		Mn II	$a^5G_5 - z^5F_5$	2565.99	
2565.71		Co II	$a^3P_2 - z^3D_2$	2566.13	
2568.76		Fe II	$b^4P_{1/2} - y^4P_{3/2}$	2569.18	
2568.87		Mn II	$b^3G_5 - y^3F_4$	2569.29	
2569.24		Fe II	$b^4F_{7/2} - y^4D_{7/2}$	2569.66	
2570.13		Fe II	$a^2S_{1/2} - x^2P_{3/2}$	2570.55	
2571.31		Mn II	$a^3F_3 - z^3G_4$	2571.73	
2571.39		Ti II	$a^2F_{7/2} - y^2G_{9/2}$	2571.81	
2571.90		Fe II	$b^4F_{9/2} - z^4I_{9/2}$	2572.32	
2581.47		Fe II	$a^6S_{5/2} - y^6P_{5/2}$	2581.89	
2589.15		Fe II	$a^2F_{7/2} - x^4G_{7/2}$	2589.57	
2633.56		Fe II	$c^2D_{5/2} - x^2P_{3/2}$	2633.99	
2635.76		Fe II	$b^2H_{9/2} - z^2F_{7/2}$	2636.19	
2636.42		Co II	$a^3D_3 - y^3P_2$	2636.85	
2637.11		Fe II	$b^4D_{5/2} - x^4P_{3/2}$	2637.54	
2639.92		Fe II	$b^2P_{1/2} - z^2P_{1/2}$	2640.35	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
2641.48		Fe II	$b^4P_{3/2} - z^4S_{3/2}$	2641.91	
2642.37		Fe II	$b^2F_{5/2} - y^2F_{5/2}$	2642.80	
2644.18		Mn II	$b^3F_3 - x^5D_3$	2644.61	
2645.44		Fe II	$a^2F_{7/2} - y^2G_{7/2}$	2645.87	
2645.44		Fe II	$b^2F_{5/2} - y^2F_{7/2}$	2645.87	
2645.58		Fe II	$c^2P_{3/2} - u^2D_{5/2}$	2645.99	He II
2645.71		Fe II	$d^2F_{7/2} - u^2D_{5/2}$	2646.12	He II
2646.57		Fe II	$b^2H_{11/2} - y^4G_{9/2}$	2647.00	
2648.46		Mn II	$a^3D_1 - y^3P_0$	2648.89	
2649.08		Ni II	$^2F_{5/2} - {}^4D_{5/2}$	2649.51	
2649.30		Mn II	$b^5D_4 - z^3G_5$	2649.73	
2649.84		Fe II	$^2F_{5/2} - u^2G_{7/2}$	2650.26	He II
2651.39		Mn II	$b^5D_4 - y^5F_4$	2651.82	
2651.66		Fe II	$b^2H_{11/2} - y^4G_{11/2}$	2652.09	
2652.04		Fe II	$c^2D_{3/2} - w^2F_{5/2}$	2652.47	
2653.01		V II	$a^3P_1 - y^3F_2$	2653.44	
2654.98		Mn II	$b^5D_2 - z^3G_3$	2655.41	
2658.28		Fe II	$b^2G_{9/2} - y^2H_{9/2}$	2658.71	
2658.61		Fe II	$b^2F_{7/2} - y^2F_{7/2}$	2659.04	
2662.07		Cr II	$a^6D_{5/2} - z^4P_{5/2}$	2662.51	
2664.03		Cr II	$a^6D_{1/2} - z^6D_{1/2}$	2664.47	
2664.55		Fe II	$b^2H_{9/2} - y^4G_{11/2}$	2664.99	
2665.53		Mn II	$a^3G_5 - y^5F_5$	2665.97	
2665.60		Ni II	$^2P_{3/2} - {}^4P_{3/2}$	2666.04	
2667.38		Mn II	$b^5D_2 - y^5F_3$	2667.82	
2667.41		Mn II	$b^3P_0 - z^3S_1$	2667.85	
2669.51		Al II]	$^1S_0 - {}^3P_1$	2669.95	
2670.42		Cr II	$b^4P_{5/2} - z^4S_{3/2}$	2670.86	
2670.57		Cr II	$a^2I_{13/2} - z^2I_{13/2}$	2671.01	
2670.67		Ni II	$^2P_{1/2} - {}^4P_{1/2}$	2671.11	
2670.73		Fe II	$c^2D_{5/2} - w^2F_{7/2}$	2671.17	
2672.52		Fe II	$d^2F_{5/2} - v^4F_{7/2}$	2672.94	Lyα
2674.79		Mn II	$a^3G_5 - z^3G_5$	2675.23	
2680.69		Mn II	$a^3G_4 - z^3G_4$	2681.13	
2681.40		Fe II	$c^4P_{1/2} - v^4D_{1/2}$	2681.84	
2682.85		Mn II	$a^3G_3 - z^3G_4$	2683.29	
2682.88		Fe II	$d^2F_{7/2} - u^2G_{9/2}$	2683.30	He II
2683.45		V II	$a^5D_0 - z^5D_1$	2683.89	
2685.32		Fe II	$a^4G_{11/2} - z^2I_{11/2}$	2685.76	
2686.46		Fe II	$a^4G_{5/2} - x^4D_{5/2}$	2686.90	
2686.75		Fe II	$a^2F_{5/2} - z^2P_{3/2}$	2687.19	
2687.58		Fe II	$z^6F_{7/2} - e^4D_{7/2}$	2688.00	Lyα sec
2688.65		Cr II	$a^4H_{7/2} - y^4G_{5/2}$	2689.09	
2689.57		Fe II	$b^2P_{3/2} - y^4D_{3/2}$	2690.01	
2692.10		Fe II	$a^4G_{9/2} - x^4D_{7/2}$	2692.54	
2692.10		Mn II	$a^3P_2 - z^5D_3$	2692.54	
2693.55		Mn II	$a^5P_3 - z^5D_3$	2693.99	
2693.89		Cr II	$a^4H_{9/2} - y^4G_{7/2}$	2694.33	
2694.22		Fe II	$a^2F_{7/2} - z^2F_{5/2}$	2694.66	
2695.04		Co II	$b^3F_3 - z^5G_4$	2695.48	
2695.10		V II	$a^5D_2 - z^3D_3$	2695.54	
2695.72		Mn II	$a^5P_2 - z^5D_3$	2696.16	
2697.69		Fe II	$b^2D_{3/2} - y^2P_{3/2}$	2698.13	
2697.82		Fe II	$b^2D_{3/2} - y^2P_{1/2}$	2698.26	
2698.09		Fe II	$c^2G_{9/2}f - x^2G_{7/2}$	2698.53	
2699.04		Cr II	$a^6D_{1/2} - z^4P_{3/2}$	2699.48	
2699.34		Mn II	$a^5P_3 - z^5S_2$	2699.78	
2704.66	322	Cr II (UV 7)	$a^6D_{3/2} - z^4P_{3/2}$	2704.65	
		Mn II (UV 18)	$a^5G_6 - z^5G_5$	2704.78	
		Fe II (UV 261)	$a^2F_{7/2} - z^2F_{7/2}$	2704.79	
2707.07	273	V II (UV 1)	$a^5D_3 - z^5F_4$	2706.97	
		Fe II (UV 341)	$b^2D_{5/2} - y^2P_{3/2}$	2707.37	
		Mn II (UV 18)	$a^5G_4 - z^5G_5$	2707.44	
2707.58	363	V II (UV 2)	$a^5D_2 - z^3D_2$	2707.50	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
		Fe II (UV 339)	$b^2D_{3/2} - x^2F$	2707.94	
		Mn II (UV 18)	$a^5G_5 - z^5G_4$	2708.35	
2709.63	569	Mn II (UV 18)	$a^5G_3 - z^5G_4$	2709.61	
		Fe II (UV 218)	$b^2P_{3/2} - y^4D_{5/2}$	2709.86	
		Cr II (UV 186)	$b^4G_{5/2} - x^4G_{5/2}$	2710.11	
2715.15	257	Fe II (UV 63)	$a^4D_{7/2} - z^4D_{5/2}$	2715.22	
		V II (UV 2)	$a^5D_3 - z^3D_2$	2715.01	
2716.97	363	Fe II (UV 261)	$a^2F_{5/2} - z^2F_{5/2}$	2717.02	
		Mn II (UV 33)	$a^5P_3 - z^5F_3$	2717.60	
2719.00	430	Fe II (UV 32)	$a^4F_{9/2} - z^6D_{7/2}$	2718.32	?wl
		Cr II (UV 102)	$a^4F_{3/2} - x^4D_{1/2}$	2719.13	?wl
2719.72	141	Mn II (UV 33)	$a^5P_2 - z^5F_3$	2719.81	?wl
		Fe II (UV 339)	$b^2D_{5/2} - x^2F_{7/2}$	2720.11	
2720.53	116	Mn II (UV 33)	$a^5P_3 - z^5F_4$	2720.81	
		Cr II (UV 102)	$a^4F_{5/2} - x^4D_{3/2}$	2720.88	
		Cr II (UV 102)	$a^4F_{5/2} - x^4D_{5/2}$	2721.06	
2722.47	149	Fe II (UV 199)	$a^4G_{11/2} - y^4F_{9/2}$	2722.62	
		Fe II (UV 260)	$a^2F_{7/2} - y^4G_{7/2}$	2722.87	
		Mn II (UV 34)	$a^5P_2 - z^5D_1$	2722.89	
		Mn II (UV 34)	$a^5P_1 - z^5D_2$	2722.91	
2723.40	143	Cr II (UV 7)	$a^6D_{3/2} - z^4P_{1/2}$	2723.55	
2725.59	264	Fe II (UV 62)	$a^4D_{5/2} - z^4F_{5/2}$	2725.69	
2728.33	181	Fe II (UV 63)	$a^4D_{5/2} - z^4D_{3/2}$	2728.35	
2729.40	178	V II (UV 1)	$a^5D_1 - z^5F_2$	2729.45	
		Fe II (UV 260)	$a^2F_{7/2} - y^4G_{9/2}$	2729.71	
2731.46	531	Fe II (UV 62)	$a^4D_{3/2} - z^4F_{3/2}$	2731.54	
2733.24	285	Fe II (UV 32)	$a^4F_{9/2} - z^6D_{9/2}$	2733.26	
2750.27	1082	Fe II (UV 63)	$a^4D_{3/2} - z^4D_{3/2}$	2749.99	
		Fe II (UV 62)	$a^4D_{5/2} - z^4F_{7/2}$	2750.13	
		Fe II (UV 63)	$a^4D_{1/2} - z^4D_{1/2}$	2750.30	
2751.51	1019	Cr II (UV 6)	$a^6D_{5/2} - z^6P_{5/2}$	2751.54	
		Fe II (UV 217)	$b^2P_{3/2} - z^2D_{3/2}$	2751.94	
2756.52	1682	Fe II (UV 62)	$a^4D_{7/2} - z^4F_{9/2}$	2756.55	
		Cr II (UV 101)	$a^4F_{5/2} - y^4F_{7/2}$	2756.64	
		Cr II (UV 99)	$a^4F_{5/2} - z^2D_{5/2}$	2757.12	
		Fe II (UV 200)	$a^4G_{5/2} - z^2G_{7/2}$	2757.33	
2758.32	535	Cr II (UV 6)	$a^6D_{5/2} - z^6P_{3/2}$	2758.53	
2760.2 ?	372	Fe II (UV 32)	$a^4F_{7/2} - z^6D_{7/2}$	2760.15	
2762.71	349	Fe II (UV 63)	$a^4D_{1/2} - z^4D_{3/2}$	2762.63	
		Fe II (UV 373)	$z^6F_{5/2} - e^6D_{5/2}$	2763.15	Lyα sec.
		Fe II (UV 199)	$a^4G_{5/2} - y^4F_{3/2}$	2763.26	
2763.23	168	Cr II (UV 6)	$a^6D_{7/2} - z^6P_{5/2}$	2763.41	
		Cr II (UV 100)	$a^4F_{7/2} - y^4G_{9/2}$	2763.60	
		Fe II (UV 199)	$a^4G_{7/2} - y^4F_{9/2}$	2764.23	
2764.32	274	Fe II (UV 32)	$a^4F_{5/2} - z^6D_{3/2}$	2764.32	
		Cr II (UV 101)	$a^4F_{9/2} - z^4F_{7/2}$	2764.40	
		He I	2s ^3S – 7p ^3P	2764.62	
		Fe II (UV 199)	$a^4G_{7/2} - y^4F_{5/2}$	2764.73	
2767.24	238	Cr II (UV 6)	$a^6D_{9/2} - z^6P_{7/2}$	2767.35	
		Cr II (UV 100)	$a^4F_{9/2} - y^4G_{9/2}$	2767.48	
2768.10	560	Fe II (UV 373)	$z^6F_{3/2} - e^6D_{5/2}$	2768.23	Lyα sec.
		Fe II (UV 235)	$b^2H_{11/2} - z^2I_{13/2}$	2768.32	
		Fe II (UV 373)	$z^6F_{9/2} - e^6D_{7/2}$	2768.33	Lyα
2769.92	525	Fe II (UV 63)	$a^4D_{3/2} - z^4D_{5/2}$	2769.75	
		Fe II (UV 200)	$a^4G_{7/2} - z^2G_{9/2}$	2769.97	
		Fe II (UV 198)	$a^4G_{11/2} - z^4I_{13/2}$	2770.17	
		Fe II (UV 199)	$a^4G_{5/2} - y^4F_{5/2}$	2770.38	
2770.95	264	Fe II (UV 198)	$a^4G_{11/2} - z^4I_{9/2}$	2771.32	
		Fe II (UV 199)	$a^4G_{7/2} - y^4F_{7/2}$	2771.32	
2771.76	252	Fe II (UV 282)	$b^2G_{9/2} - y^4H_{11/2}$	2772.00	
2775.1	258	Fe II (UV 32)	$a^4F_{7/2} - z^6D_{9/2}$	2775.55	
		Fe II (UV 218)	$b^2P_{1/2} - y^4D_{3/2}$	2775.51	
2777.25	281	Fe II (UV 373)	$z^6F_{7/2} - e^6D_{7/2}$	2777.73	Lyα sec.
2778.39	335	Fe II (UV 233)	$b^2H_{11/2} - y^4F_{9/2}$	2778.71	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
		Cr II (UV 101)	$a^4F_{3/2} - y^4F_{3/2}$	2778.74	
2779.81	482	Fe II (UV 234)	$b^2H_{9/2} - z^2G_{7/2}$	2780.12	
		Fe II (UV 348)	$a^2S_{1/2} - y^2P_{1/2}$	2780.73	
2784.29	336	Fe II (UV 234)	$b^2H_{11/2} - z^2G_{9/2}$	2784.51	
		Fe II (UV 295)	$b^4D_{3/2} - y^2D_{3/2}$	2784.79	
2785.6	499	Cr II (UV 101)	$a^4F_{5/2} - y^4F_{5/2}$	2785.93	
		Fe II (UV 373)	$z^6F_{11/2} - e^6D_{9/2}$	2786.01	Lyα sec.
2787.57	546	Cr II (UV 307)	$z^6F_{1/2} - e^6D_{1/2}$	2787.95	
		Fe II (UV 380)	$z^6P_{7/2} - e^6D_{5/2}$	2788.06	Lyα sec.
2789.63	161	Cr II (UV 101)	$a^4F_{7/2} - y^4F_{5/2}$	2789.90	
		Cr II (UV 307)	$z^6F_{5/2} - e^6D_{5/2}$	2790.11	Lyα sec.
2810.27	453	Fe II (UV 380)	$z^6P_{7/2} - e^6D_{7/2}$	2810.61	Lyα sec.
		Cr II (UV 307)	$z^6F_{9/2} - e^6D_{7/2}$	2810.82	Lyα sec.
2811.6	113	Fe II (UV 196)	$a^4G_{11/2} - z^4H_{9/2}$	2812.10	
2812.89	185	Fe II (UV 215)	$b^2P_{3/2} - y^4P_{3/2}$	2813.32	
		Mn II (UV 71)	$a^3D_2 - y^3D_2$	2813.09	
		Mn II (UV 71)	$a^3D_2 - y^3D_3$	2813.16	
		Mn II (UV 71)	$a^3D_3 - y^3D_2$	2813.35	
		Mn II (UV 71)	$a^3D_3 - y^3D_3$	2813.42	
2813.99	135	Fe II (UV 198)	$a^4G_{7/2} - z^4I_{9/2}$	2814.44	
2815.45	70	Mn II (UV 66)	$b^3G_3 - z^3G_3$	2815.85	
2817.38	332	Cr II (UV 307)	$z^6F_{11/2} - e^6D_{9/2}$	2817.79	Lyα sec.
		Fe II (UV 380)	$z^6P_{5/2} - e^6D_{3/2}$	2817.92	Lyα sec.
2818.8	106	Cr II (UV 182)	$b^4G_{7/2} - y^4H_{9/2}$	2819.18	
2819.7	60	Fe II (UV 196)	$a^4G_{11/2} - z^4H_{11/2}$	2820.17	
2822.81	273	Cr II (UV 82)	$a^4H_{13/2} - z^4I_{15/2}$	2823.21	
		Fe II (UV 231)	$b^2H_{11/2} - z^4I_{11/2}$	2823.50	
2823.71	157	Fe II (UV 196)	$a^4G_{11/2} - z^4H_{13/2}$	2824.16	
		Fe I (UV 44)	$a^5F_3 - y^5G_3$	2824.11	Mg II
2824.97	36	Fe II (UV 399)	$z^4D_{5/2} - e^4D_{3/2}$	2825.40	Lyα sec.
2825.65	100	Ni II	$a^4P_{5/2} - z^2F_{5/2}$	2826.06	
2826.37	396	Fe II (UV 195)	$a^4G_{11/2} - z^4G_{9/2}$	2826.58	
		Fe II (UV 255)	$a^2F_{7/2} - y^4D_{5/2}$	2826.86	
2827.81	205	Fe II (UV 231)	$b^2H_{11/2} - z^4I_{13/2}$	2828.26	
2828.3 ?	88	Fe II (UV 196)	$a^4G_{9/2} - z^4H_{7/2}$	2828.73	
2829.07	269	Fe II (UV 231)	$b^2H_{11/2} - z^4I_{9/2}$	2829.46	
		Fe II (UV 255)	$a^2F_{5/2} - y^4D_{3/2}$	2829.51	
2829.53	279	He I (UV 12)	2s ^{3}S – 6p ^{3}P	2829.91	Not in 98
2831.21	212	Unidentified			
2832.09	346	Fe II (UV 217)	$b^2P_{3/2} - z^2D_{5/2}$	2832.40	
		Fe II (UV 399)	$z^4D_{3/2} - e^4D_{1/2}$	2832.71	Lyα sec.
2833.44	407	Fe II (UV 380)	$z^6P_{5/2} - e^6D_{5/2}$	2833.92	Lyα sec.
2836.46	563	Cr II (UV 5)	$a^6D_{9/2} - z^6F_{11/2}$	2836.46	
2837.67	226	Fe II (UV 231)	$b^2H_{9/2} - z^4I_{11/2}$	2838.13	
2838.53	32	Fe II (UV 61)	$a^4D_{5/2} - z^6P_{3/2}$	2838.57	
		Fe II (UV 380)	$z^6P_{3/2} - e^6D_{1/2}$	2839.05	Lyα sec.
2839.88	1521	Fe II (UV 391)	$z^4F_{9/2} - e^4D_{7/2}$	2840.35	Lyα sec.
		Fe II (UV 380)	$z^6P_{7/2} - e^6D_{9/2}$	2840.63	Lyα sec.
2840.78	461	Fe II (UV 195)	$a^4G_{11/2} - z^4G_{11/2}$	2841.18	
2843.91	483	Cr II (UV 5)	$a^6D_{7/2} - z^6F_{9/2}$	2844.08	
2844.4	198	Fe I (UV 44)	$a^5F_2 - y^5G_3$	2844.83	Mg II
2845.4	506	Fe II (UV 399)	$z^4D_{1/2} - e^4D_{1/2}$	2845.79	Lyα sec.
2845.92	2325	Fe II (UV 391)	$z^4F_{7/2} - e^4D_{5/2}$	2846.43	Lyα sec.
		Fe II (UV 399)	$z^4D_{3/2} - e^4D_{3/2}$	2846.26	Lyα sec.
2847.59	82	Fe II (UV 197)	$a^4G_{7/2} - z^2D_{5/2}$	2848.05	
2848.73	617	Fe II (UV 391)	$z^4F_{5/2} - e^4D_{3/2}$	2849.16	Lyα sec.
2850.56	342	Cr II (UV 5)	$a^6D_{5/2} - z^6F_{7/2}$	2850.68	
2852.00	352	Fe II (UV 391)	$z^4F_{3/2} - e^4D_{1/2}$	2852.56	Lyα sec.
2853.44?	198	Fe II (UV 197)	$a^4G_{5/2} - z^2D_{5/2}$	2854.04	
		Cr II (UV 81)	$a^4H_{9/2} - z^4G_{7/2}$	2854.04	
2856.65	584	Fe II (UV 195)	$a^4G_{9/2} - z^4G_{9/2}$	2856.99	
		Fe II (UV 380)	$z^6P_{5/2} - e^6D_{7/2}$	2857.22	Lyα sec.
2857.33	1150	Fe II (UV 399)	$z^4D_{7/2} - e^4D_{7/2}$	2857.75	Lyα sec.
		Cr II (UV 11)	$a^4D_{3/2} - z^4D_{5/2}$	2857.60	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
2858.74	146	Fe II (UV 195)	$a^4G_{7/2} - z^4G_{7/2}$	2859.17	
		Fe II (UV 279)	$b^2G_{9/2} - z^2H_{11/2}$	2859.18	
2859.43	221	Cr II (UV 11)	$a^4D_{1/2} - z^4D_{3/2}$	2859.49	
		Cr II (UV 5)	$a^6D_{9/2} - z^6F_{9/2}$	2859.75	
2861.47	153	Cr II (UV 5)	$a^6D_{1/2} - z^6F_{3/2}$	2861.77	
		Fe II (UV 61)	$a^4D_{3/2} - z^6P_{3/2}$	2862.01	
2863.14	129	Cr II (UV 5)	$a^6D_{7/2} - z^6F_{7/2}$	2863.41	
2864.12	283	Ni II (UV 26)	$b^2D_{3/2} - z^2D_{3/2}$	2864.53	
2864.4	197	Fe II (UV 380)	$z^6P_{3/2} - e^6D_{5/2}$	2864.96	Lyα sec.
2865.82	321	Cr II (UV 5)	$a^6D_{5/2} - z^6F_{5/2}$	2865.94	
		Cr II (UV 11)	$a^4D_{1/2} - z^4D_{1/2}$	2866.17	
		Fe II (UV 391)	$z^4F_{3/2} - e^4D_{3/2}$	2866.30	Lyα sec.
2868.21	119	Cr II (UV 5)	$a^6D_{1/2} - z^6F_{1/2}$	2868.49	
		Cr II (UV 213)	$b^2F_{5/2} - x^4G_{7/2}$	2868.79	
2869.68	540	Fe II (UV 61)	$a^4D_{5/2} - z^6P_{5/2}$	2869.72	
		Fe II (UV 257)	$a^2F_{7/2} - y^4F_{9/2}$	2870.00	
		Fe II (UV 399)	$z^4D_{3/2} - e^4D_{5/2}$	2870.15	Lyα sec.
2871.43	522	Cr II (UV 11)	$a^4D_{5/2} - z^4D_{5/2}$	2871.28	
		Fe II (UV 195)	$a^4G_{7/2} - z^4G_{9/2}$	2871.45	
		Fe II (UV 195)	$a^4G_{9/2} - z^4G_{11/2}$	2871.90	
		Fe II (UV 230)	$b^2H_{11/2} - z^4H_{9/2}$	2871.97	
2872.75	292	Fe II (UV 391)	$z^4F_{5/2} - e^4D_{5/2}$	2873.10	Lyα sec.
		Fe II (UV 230)	$b^2H_{9/2} - z^4H_{7/2}$	2873.23	
2874.0	208	Fe II (UV 279)	$b^2G_{7/2} - z^2H_{9/2}$	2874.24	
		Cr II (UV 5)	$a^6D_{3/2} - z^6F_{1/2}$	2874.32	
		Cr II (UV 11)	$a^4D_{3/2} - z^4D_{1/2}$	2874.65	
2875.64	125	Fe II (UV 61)	$a^4D_{1/2} - z^6P_{3/2}$	2875.70	
		Fe II (UV 258)	$a^2F_{7/2} - z^2G_{9/2}$	2876.19	
2877.12	441	Cr II (UV 5)	$a^6D_{5/2} - z^6F_{3/2}$	2877.09	
		Fe II (UV 257)	$a^2F_{7/2} - y^4F_{7/2}$	2877.65	
2878.38	117	Cr II (UV 5)	$a^6D_{7/2} - z^6F_{5/2}$	2878.82	
2878.79	150	Cr II (UV 5)	$a^6D_{9/2} - z^6F_{7/2}$	2879.29	
2879.8 ?	198	Cr II (UV 56)	$b^4P_{3/2} - z^2S_{1/2}$	2880.02	
		Fe II (UV 278)	$b^2G_{9/2} - y^2G_{7/2}$	2880.09	
		Mn II (UV 61)	$a^3G_5 - z^3F_4$	2880.34	
2881.46	72	Fe II (UV 61)	$a^4D_{7/2} - z^6P_{7/2}$	2881.60	
		Fe II (UV 258)	$a^2F_{5/2} - z^2G_{7/2}$	2881.68	
		Cr II (UV 11)	$a^4D_{5/2} - z^4D_{3/2}$	2881.71	
		Ni II (UV 25)	$b^2D_{3/2} - z^2F_{5/2}$	2882.09	
2882.31	91	Cr II	$a^2P_{1/2} - (a^3P)4p\ ^2D_{3/2}$	2882.77	
		Fe II (UV 391)	$z^4F_{7/2} - e^4D_{7/2}$	2883.03	Lyα sec.
2884.11	262	Fe II (UV 230)	$a^2H_{11/2} - z^4H_{13/2}$	2884.56	
2885.12	279	Fe II (UV 399)	$z^4D_{5/2} - e^4D_{7/2}$	2885.61	Lyα sec.
2886.44	148	Fe II (UV 317)	$a^2I_{13/2} - y^2H_{11/2}$	2886.78	
2888.48	322	Fe II (UV 215)	$b^2P_{3/2} - y^4P_{5/2}$	2888.94	
2889.0 ?	171	Cr II (UV 315)	$z^6P_{7/2} - e^6D_{9/2}$	2889.48	Lyα sec.
2890.27	150	Fe II (UV 391)	$z^4F_{3/2} - e^4D_{5/2}$	2890.53	Lyα sec.
		Cr II (UV 160)	$b^4F_{9/2} - y^4F_{9/2}$	2890.65	
2893.83	179	Fe II (UV 61)	$a^4D_{3/2} - z^6P_{5/2}$	2893.67	
		V II (UV 12)	$a^5F_4 - z^5D_3$	2894.16	
2895.1 ?	94	Fe II (UV 230)	$b^2H_{9/2} - z^4H_{11/2}$	2895.63	
2895.55	251	Fe II (UV 257)	$a^2F_{5/2} - y^4F_{5/2}$	2895.94	
		Fe II (UV 294)	$b^4D_{7/2} - x^4F_{9/2}$	2896.07	
2897.68	286	Fe II (UV 254)	$a^2F_{5/2} - z^2D_{3/2}$	2898.11	
2902.76	164	Fe II (UV 257)	$a^2F_{5/2} - y^4F_{7/2}$	2903.17	
		Fe II (UV 278)	$b^2G_{9/2} - y^2G_{9/2}$	2903.31	
2905.76	48	Fe II (UV 255)	$a^2F_{7/2} - y^4D_{7/2}$	2906.03	
2906.58	74	Cr II (UV 227)	$b^2H_{11/2} - y^2G_{9/2}$	2906.96	
		Fe II (UV 215)	$b^2P_{1/2} - y^4P_{3/2}$	2906.97	
2907.40	16	Cr II (UV 315)	$z^6P_{5/2} - e^6D_{5/2}$	2907.82	Lyα sec.
2908.29	254	Fe II (UV 60)	$a^4D_{7/2} - z^6F_{5/2}$	2908.71	
2909.51	82	Cr II (UV 315)	$z^6P_{3/2} - e^6D_{3/2}$	2909.95	Lyα sec.
		V II (UV 12)	$a^5F_5 - z^5D_4$	2909.66	
2911.01	85	Fe II	$a^4G_{5/2} - y^4P_{5/2}$	2911.47	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
		Cr II (UV 211)	$b^2F_{7/2} - y^2D_{5/2}$	2911.50	
2912.12	72	Cr II (UV 212)	$b^2F_{5/2} - y^2G_{7/2}$	2912.54	
2913.96	142	Ni II (UV 35)	$a^4P_{5/2} - z^2D_{5/2}$	2914.44	
2915.56	99	Cr II (UV 227)	$b^2H_{9/2} - y^2G_{7/2}$	2916.03	
		Cr II (UV 315)	$z^6P_{3/2} - e^6D_{1/2}$	2916.04	Lyα sec.
		Cr II (UV 239)	$a^2G_{7/2} - y^2H_{9/2}$	2916.08	
2916.52	366	Fe II (UV 60)	$a^4D_{7/2} - z^6F_{7/2}$	2917.00	
2917.42	41	Fe II	$b^2H_{9/2} - z^4G_{11/2}$	2917.78	
		Cr II (UV 315)	$z^6P_{5/2} - e^6D_{3/2}$	2917.78	Lyα sec.
2922.36	149	Cr II (UV 95)	$a^4F_{7/2} - z^4G_{9/2}$	2922.67	
		Fe II (UV 293)	$b^4D_{7/2} - x^4G_{9/2}$	2922.88	
2927.16	1148	Fe II (UV 60)	$a^4D_{7/2} - z^6F_{9/2}$	2927.44	
2928.63	233	Cr II (UV 55)	$b^4P_{3/2} - y^4D_{5/2}$	2929.00	
		Cr II (UV 256)	$b^2G_{7/2} - x^2G_{7/2}$	2929.15	
		Cr II (UV 95)	$a^4F_{5/2} - z^4G_{7/2}$	2929.16	
2931.28	109	V II (UV 10)	$a^5F_3 - z^5F_3$	2931.65	
		Cr II (UV 55)	$b^4P_{1/2} - y^4D_{3/2}$	2931.70	
2934.82	155	V II (UV 10)	$a^5F_1 - z^5F_2$	2935.25	
2936.95	140	Mg II (UV 2)	$3p\ ^2P_{3/2} - 4s\ ^2S_{1/2}$	2937.37	
2940.03	402	Mn II (UV 5)	$a^5S_2 - z^5P_2$	2940.17	
		Fe II (UV 60)	$a^4D_{5/2} - z^6F_{3/2}$	2940.37	
2943.52	71	Mn II (UV 82)	$b^3D_2 - y^3F_3$	2944.00	
2944.88	207	Fe II (UV 78)	$a^4P_{3/2} - z^4P_{1/2}$	2945.26	
2945.73	45	Fe II (UV 60)	$a^4D_{5/2} - z^6F_{5/2}$	2946.13	
2947.17	57	Cr II (UV 192)	$a^2H_{11/2} - z^2H_{11/2}$	2947.69	
2948.25	386	Fe II (UV 78)	$a^4P_{5/2} - z^4P_{3/2}$	2948.52	
2949.88	257	Mn II (UV 5)	$a^5S_2 - z^5P_3$	2950.07	
		Cr II (UV 178)	$b^4G_{11/2} - z^2I_{13/2}$	2950.31	
2951.66	100	Fe II (UV 214)	$b^2P_{3/2} - z^4S_{3/2}$	2951.95	
		Cr II	$z^4P_{3/2} - e^6D_{5/2}$	2952.01	Lyα sec.
		Mn II (82)	$b^3D_3 - y^3F_4$	2952.03	
2954.37	736	Fe II (UV 60)	$a^4D_{5/2} - z^6F_{7/2}$	2954.64	
		Cr II (UV 192)	$a^2H_{9/2} - z^2H_{9/2}$	2954.56	
2956.48?	21	Mn II (UV 50)	$b^5D_3 - z^5D_2$	2956.87	
		Mn II (UV 50)	$b^5D_2 - z^5D_2$	2957.03	
2957.87?	11	V II (UV 11)	$a^5F_2 - z^3D_1$	2958.37	
		Cr II (104)	$a^2G_{7/2} - y^2G_{7/2}$	2958.41	
2960.10	436	Fe II (UV 254)	$a^2F_{7/2} - z^2D_{5/2}$	2960.46	
		Cr II	$b^2F_{5/2} - (a^3P)4p\ ^2D_{5/2}$	2960.42	
2961.78	443	Fe II (UV 60)	$a^4D_{3/2} - z^6F_{1/2}$	2962.14	
		Cr II (UV 94)	$a^4F_{7/2} - y^4D_{7/2}$	2962.44	
		Cr II (UV 177)	$b^4G_{11/2} - y^4F_{9/2}$	2962.58	
		Cr II (UV 55)	$b^4P_{3/2} - y^4D_{3/2}$	2962.59	
2964.57	192	Fe II (UV 252)	$a^2F_{7/2} - z^4G_{5/2}$	2965.00	
2965.60	651	Fe II (UV 78)	$a^4P_{3/2} - z^4P_{3/2}$	2965.90	
2966.45	139	Cr II (UV 94)	$a^4F_{9/2} - y^4D_{7/2}$	2966.90	
		Ni II (6)	$a^4P_{3/2} - z^2F_{5/2}$	2966.92	
2970.4	182	Fe II (UV 277)	$b^2G_{7/2} - z^2F_{5/2}$	2970.80	
2971.10	638	Fe II (UV 60)	$a^4D_{3/2} - z^6F_{5/2}$	2971.38	
		Fe II (UV 276)	$b^2G_{9/2} - y^4G_{7/2}$	2971.56	
2972.45	200	Cr II (UV 80)	$a^4H_{13/2} - z^4H_{13/2}$	2972.77	
2976.37	402	Cr II (UV 321)	$z^6D_{7/2} - e^6D_{9/2}$	2976.67	Lyα sec.
		Fe II (UV 60)	$a^4D_{1/2} - z^6F_{1/2}$	2976.81	
2977.1	109	Cr II (UV 55)	$b^4P_{5/2} - y^4D_{5/2}$	2977.58	
2979.93	839	Fe II (UV 60)	$a^4D_{1/2} - z^6F_{3/2}$	2980.22	
2980.3	98	Cr II (UV 80)	$a^4H_{11/2} - z^4H_{11/2}$	2980.61	
		Cr II (UV 80)	$a^4H_{7/2} - z^4H_{9/2}$	2980.67	
2981.36	103	Fe II (UV 253)	$a^2F_{5/2} - z^4H_{7/2}$	2981.83	
2982.53	145	Fe II (UV 335)	$b^2D_{3/2} - y^2F_{5/2}$	2982.93	
2985.38	186	Fe II (UV 78)	$a^4P_{5/2} - z^4P_{5/2}$	2985.69	
		Fe II (UV 252)	$a^2F_{7/2} - z^4G_{9/2}$	2985.76	
2986.18	428	Fe II (UV 78)	$a^4P_{1/2} - z^4P_{3/2}$	2986.42	
		Fe II (UV 390)	$z^4F_{7/2} - e^6D_{7/2}$	2986.51	Lyα sec.
		Fe II (UV 398)	$z^4D_{3/2} - e^6D_{5/2}$	2986.75	Lyα sec.

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
2987.07	72	Fe II (UV 254)	$a^2F_{5/2} - z^2D_{5/2}$	2987.48	
2988.46	124	V II (27)	$a^5P_2 - z^5P_3$	2988.90	
		Cr II (UV 80)	$a^4H_{13/2} - z^4H_{11/2}$	2988.92	
		Ni II (UV 25)	$b^2D_{5/2} - z^2F_{5/2}$	2988.93	
2989.65	185	Fe II (UV 390)	$z^4F_{5/2} - e^6D_{5/2}$	2989.94	Lyα sec.
		Cr II (UV 80)	$a^4H_{7/2} - z^4H_{7/2}$	2990.06	
2992.5 ?	43	Cr II (UV 321)	$z^6D_{5/2} - e^6D_{3/2}$	2992.94	Lyα sec.
2992.9	94	Cr II (UV 80)	$a^4H_{11/2} - z^4H_{9/2}$	2993.31	
2993.33	210	Cr II (UV 321)	$z^6D_{9/2} - e^6D_{9/2}$	2993.83	Lyα sec.
2993.91	103	Fe II (UV 335)	$b^2D_{5/2} - y^2F_{5/2}$	2994.23	
		Cr II (UV 321)	$z^6D_{7/2} - e^6D_{7/2}$	2994.40	Lyα sec.
2995.14	75	Cr II (UV 80)	$a^4H_{9/2} - z^4H_{7/2}$	2995.62	
2996.40	43	V II (27)	$a^5P_1 - z^5P_2$	2996.86	
2997.72	130	Fe II (UV 335)	$b^2D_{5/2} - y^2F_{7/2}$	2998.17	
2999.34	48	Fe II (UV 252)	$a^2F_{5/2} - z^4G_{7/2}$	2999.73	
3000.47	62	Cr II (UV 137)	$a^2F_{7/2} - z^2G_{9/2}$	3000.81	
		Fe II (UV 276)	$b^2G_{7/2} - y^4G_{5/2}$	3000.94	
3001.07	31	Cr II (UV 321)	$z^6D_{3/2} - e^6D_{5/2}$	3001.51	Lyα sec.
		Ni II (5)	$a^4P_{5/2} - z^4F_{3/2}$	3001.54	
3001.60	48	V II (27)	$a^5P_3 - z^5P_3$	3002.08	
3003.24	864	Fe II (UV 78)	$a^4P_{3/2} - z^4P_{5/2}$	3003.52	
3004.4	85	Cr II (UV 94)	$a^4F_{7/2} - y^4D_{5/2}$	3004.79	
		Fe II (UV 276)	$b^2G_{7/2} - y^4G_{7/2}$	3005.13	
3008.40	85	Cr II (UV 321)	$z^6D_{7/2} - e^6D_{5/2}$	3008.84	
3009.86	28	Fe II	$d^4P_{5/2} - (b^3P)4p\ ^4S_{3/2}$	3010.34	Lyα
3011.27	118	Cr II (UV 321)	$z^6D_{9/2} - e^6D_{7/2}$	3011.78	Lyα sec.
3015.22	95	V II (27)	$a^5P_2 - z^5P_1$	3015.69	
3015.94	166	Cr II (87)	$b^2F_{7/2} - z^2F_{7/2}$	3016.37	
3017.2	126	V II (27)	$a^5P_3 - z^5P_2$	3017.65	
3017.55	133	[Fe II]	$a^4F_{3/2} - b^2D_{5/2}$	3017.91	
		Ti II (85)	$a^2H_{11/2} - z^2H_{11/2}$	3018.06	
3018.15	71	Cr II (UV 321)	$z^6D_{3/2} - e^6D_{1/2}$	3018.64	Lyα sec.
		Cr II (95)	$b^2H_{9/2} - z^2H_{11/2}$	3018.64	
3020.35	111	Mn II	$b^3G_5 - z^3F_4$	3020.81	
		Fe II (110)	$a^2I_{11/2} - x^4F_{9/2}$	3020.89	
3021.02	18	V II (28)	$a^5P_2 - y^5D_1$	3021.54	
3021.83	40	Fe II (UV 251)	$a^2F_{7/2} - y^4P_{5/2}$	3022.30	
3023.00	14	V II (28)	$a^5P_1 - y^5D_0$	3023.47	
3024.47	50	Fe II (84)	$b^4D_{3/2} - z^2F_{5/2}$	3024.71	
		Cr II	$z^4P_{5/2} - e^6D_{3/2}$	3025.04	Lyα sec.
3025.45	21	V II (85)	$b^3P_2 - z^3S_1$	3025.86	
3027.14	195	Cr II (95)	$b^2H_{11/2} - z^2H_{11/2}$	3027.52	
		Cr II (41)	$a^2F_{7/2} - z^4G_{9/2}$	3027.71	
3028.56	96	V II (85)	$b^3P_1 - z^3S_1$	3028.93	
		Cr II (87)	$b^2F_{5/2} - z^2F_{5/2}$	3029.01	
3029.45	31	Mn II (10)	$z^5P_3 - e^5S_2$	3029.93	
3030.10	21	Ti II (85)	$a^2H_{9/2} - z^2H_{9/2}$	3030.61	
3031.53	144	Mn II	$b^3G_5 - z^3H_6$	3031.93	
3033.35	68	Cr II (15)	$a^4P_{5/2} - z^4D_{7/2}$	3033.80	
3033.82	69	Fe II (181)	$z^4P_{3/2} - e^4D_{1/2}$	3034.33	Lyα sec.
		Mn II	$b^3P_1 - z^3P_0$	3034.47	
3035.11	57	Cr II (33)	$a^4F_{5/2} - y^4D_{3/2}$	3035.42	
		Fe II (84)	$b^4D_{7/2} - z^2F_{5/2}$	3035.62	
		Mn II	$b^3P_2 - z^3P_1$	3035.69	
3035.75	38	Mn II	$b^3G_4 - z^3H_5$	3036.24	
3037.38	313	Fe II (181)	$z^4P_{5/2} - e^4D_{5/2}$	3037.85	Lyα sec.
3038.6	55	Mn II	$b^3G_3 - z^3H_4$	3038.98	
3039.0	67	Mn II	$b^3G_4 - z^3F_3$	3039.39	
		Ti II (85)	$a^2H_{11/2} - z^2H_{9/2}$	3039.61	
3040.00	32	Mn II (10)	$z^5P_2 - e^5S_2$	3040.44	
3041.37	189	Fe II (123)	$c^2G_{7/2} - x^4F_{7/2}$	3041.73	
		Cr II (65)	$a^2H_{9/2} - z^2I_{11/2}$	3041.81	
3042.12	222	Cr II (95)	$b^2H_{9/2} - z^2H_{9/2}$	3042.60	
3043.19	18	Cr II (47)	$b^4F_{9/2} - z^4G_{11/2}$	3043.66	

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{\rm lab,vac}$	Comment
		[Cr II]	$a^6S_{5/2} - b^4F_{5/2}$	3043.68	
3044.15	9	V II (40)	$b^3G_4 - y^3F_4$	3044.41	
		[Cr II]	$a^6S_{5/2} - b^4F_{3/2}$	3044.62	
3045.26	46	Fe II (98)	$b^2F_{7/2} - y^2G_{9/2}$	3045.73	
3048.11	114	Cr II (15)	$a^4P_{5/2} - z^4D_{5/2}$	3048.49	
		Cr II (15)	$a^4P_{3/2} - z^4D_{5/2}$	3048.64	
3049.6	253	Fe II (181)	$z^4P_{3/2} - e^4D_{3/2}$	3049.88	Lyα sec.
		Mn II	$b^3P_0 - z^3P_1$	3049.91	
		[Mn II] (4F)	$a^7S_3 - b^5D_4$	3049.91	
		Fe II (109)	$a^2I_{11/2} - x^4G_{9/2}$	3050.07	
3050.60	253	Cr II (65)	$a^2H_{11/2} - z^2I_{13/2}$	3051.02	
3051.1	98	Mn II	$b^3P_2 - z^3P_2$	3051.54	
		Cr II (95)	$b^2H_{11/2} - z^2H_{9/2}$	3051.62	
3051.94	78	Mn II	$b^3G_3 - z^3F_2$	3052.32	
3053.8	57	V II (34)	$a^3G_4 - z^3H_5$	3054.28	
3054.30	110	V II (40)	$b^3G_5 - y^3F_4$	3054.78	
3055.81	452	Fe II (181)	$z^4P_{1/2} - e^4D_{1/2}$	3056.24	Lyα sec.
		Cr II (33)	$a^4F_{3/2} - y^4D_{1/2}$	3056.33	
3057.13	177	Ti II (47)	$a^4P_{1/2} - z^4P_{3/2}$	3057.65	
		Fe II (109)	$a^2I_{13/2} - x^4G_{11/2}$	3057.69	
3058.47	73	Ti II (47)	$a^4P_{5/2} - z^4P_{5/2}$	3058.99	
3059.93	157	Cr II (15)	$a^4P_{5/2} - z^4D_{3/2}$	3060.26	
		Cr II (15)	$a^4P_{1/2} - z^4D_{3/2}$	3060.38	
		Cr II (15)	$a^4P_{3/2} - z^4D_{3/2}$	3060.41	
3062.69	477	Fe II (108)	$a^2I_{11/2} - z^2H_{9/2}$	3063.13	
3063.3	436	[N II] (2F)	$2p^2\ {}^3P_1 - 2p^2\ {}^1S_0$	3063.72	Not in 98
3064.42	137	Ni II (3)	$b^2D_{3/2} - z^4F_{3/2}$	3064.82	
3065.73	160	Fe II (97)	$b^2F_{5/2} - z^2F_{5/2}$	3066.21	
3066.63	97	Ti II (5)	$a^4F_{5/2} - z^4D_{5/2}$	3067.12	
		[Cr II] (8F)	$a^6S_{5/2} - a^2F_{5/2}$	3067.16	
		Ti II (5)	$a^4F_{3/2} - z^4D_{3/2}$	3067.24	
3067.56	57	V II (34)	$a^3G_3 - z^3H_4$	3068.00	
		Cr II (15)	$a^4P_{1/2} - z^4D_{1/2}$	3068.03	
		Cr II (15)	$a^4P_{3/2} - z^4D_{1/2}$	3068.06	
3071.59	237	Fe II (181)	$z^4P_{1/2} - e^4D_{3/2}$	3072.02	
3075.6 ?	19	Ti II (5)	$a^4F_{5/2} - z^4D_{3/2}$	3076.12	
3076.65	973	V II (34)	$a^3G_4 - z^3H_4$	3076.90	
		[Ni II] (6F)	$a^2D_{5/2} - a^2G_{9/2}$	3076.97	
		Fe II (181)	$z^4P_{1/2} - e^4D_{5/2}$	3077.33	Lyα sec.
3077.60	360	Fe II (108)	$a^2I_{13/2} - z^2H_{11/2}$	3078.06	
3079.16	501	Fe II (181)	$z^4P_{5/2} - e^4D_{7/2}$	3079.57	Lyα sec.
		Ti II (5)	$a^4F_{7/2} - z^4D_{5/2}$	3079.55	
3080.77	34	Fe II (108)	$a^2I_{11/2} - z^2H_{11/2}$	3081.31	
3081.70	18	V II (66)	$a^3D_2 - y^3P_1$	3082.15	
3083.41	25	Fe II (97)	$b^2F_{7/2} - z^2F_{5/2}$	3083.91	
3084.95	15	Cr II (72)	$a^2P_{1/2} - y^4F_{3/2}$	3085.36	
3087.51	178	Ni II	$b^2D_{5/2} - z^2D_{5/2}$	3087.97	
3088.57	78	Ti II (5)	$a^4F_{9/2} - z^4D_{7/2}$	3088.93	
3089.83	140	Ti II (90)	$b^2G_{7/2} - x^2F_{5/2}$	3090.31	
3090.3	15	[Cr II] (8F)	$a^6S_{5/2} - a^2F_{7/2}$	3090.65	
3093.93	156	V II (39)	$b^3G_5 - y^3G_5$	3094.06	
		Cr II (125)	$b^2G_{9/2} - x^4G_{11/2}$	3094.37	
3094.60	51	Cr II (47)	$b^4F_{3/2} - z^4G_{5/2}$	3094.84	
		Ni II (5)	$a^4P_{5/2} - z^4F_{7/2}$	3095.06	
		V II (39)	$b^3G_4 - y^3G_4$	3095.09	
3096.70	166	Fe II (97)	$b^2F_{7/2} - z^2F_{7/2}$	3097.19	
3097.54	66	Ti II (67)	$b^4P_{3/2} - z^4P_{5/2}$	3098.09	
3098.66	37	Cr II (86)	$b^2F_{7/2} - x^4D_{7/2}$	3099.05	
3100.45	13	Unidentified			
3101.32	23	V II (39)	$b^3G_4 - y^3G_3$	3101.83	
3102.93	40	V II (1)	$a^5F_4 - z^5G_5$	3103.19	
3104.11	452	Cr II (71)	$a^2P_{1/2} - z^2P_{1/2}$	3104.38	
		Ti II (90)	$b^2G_{9/2} - x^2F_{7/2}$	3104.71	
3105.78	439	Ti II (67)	$b^4P_{1/2} - z^4P_{3/2}$	3106.00	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
		Fe II (82)	$b^4D_{3/2} - x^4D_{1/2}$	3106.07	
3107.09	86	Fe II (68)	$b^2G_{7/2} - x^4D_{7/2}$	3107.47	
3108.02	83	Cr II (125)	$b^2G_{7/2} - x^4G_{9/2}$	3108.47	
3109.14	10	Cr II (55)	$b^4G_{7/2} - z^2G_{9/2}$	3109.55	
		V II (39)	$b^3G_3 - y^3G_3$	3109.60	
3109.54	28	[Ar III] (2F)	$3p^4\ ^3P_1 - 3p^4\ ^1S_0$	3110.08	Not in 98
3109.76	74	Unidentified			
3110.57	18	Ti II (77)	$b^2D_{5/2} - x^2D_{5/2}$	3110.98	
		Mn II	$b^3P_2 - y^5P_2$	3111.09	?id
3111.36	35	Ti II (67)	$b^4P_{3/2} - z^4P_{3/2}$	3111.60	
		V II (1)	$a^5F_3 - z^5G_4$	3111.60	
3112.43	21	Cr II (55)	$b^4G_{5/2} - z^2G_{7/2}$	3112.85	
		Ti II (67)	$b^4P_{1/2} - z^4P_{1/2}$	3112.95	
3113.94	25	V II (174)	$a^1H_5 - y^1H_5$	3114.47	?id
3114.78	244	Fe II (82)	$b^4D_{3/2} - x^4D_{3/2}$	3115.20	
3115.1	106	Fe II (82)	$b^4D_{1/2} - x^4D_{3/2}$	3115.59	
3115.81	52	Fe II (121)	$c^2G_{9/2} - z^2H_{9/2}$	3116.25	
3117.04	228	Fe II (82)	$b^4D_{5/2} - x^4D_{3/2}$	3117.48	
3117.69	112	Cr II (46)	$b^4F_{9/2} - y^4D_{7/2}$	3118.16	
3119.35	216	Cr II (5)	$a^4D_{1/2} - z^4F_{3/2}$	3119.55	
		Fe II (121)	$c^2G_{7/2} - z^2H_{9/2}$	3119.64	
		Ti II (27)	$a^2D_{5/2} - y^4D_{7/2}$	3119.73	
3120.10?	35	Ni II	$b^2D_{5/2} - z^2F_{7/2}$	3120.69	
		Ti II (67)	$b^4P_{5/2} - z^4P_{3/2}$	3120.73	
3121.06	116	Cr II (5)	$a^4D_{3/2} - z^4F_{5/2}$	3121.26	
3121.5	46	Cr II (70)	$a^2P_{3/2} - z^2D_{5/2}$	3121.95	
		V II (1)	$a^5F_5 - z^5G_5$	3122.04	
3122.43	39	Cr II (55)	$b^4G_{7/2} - z^2G_{7/2}$	3122.87	
3123.02	140	Cr II (54)	$b^4G_{11/2} - z^4G_{11/2}$	3123.50	
3125.75	276	Cr II (5)	$a^4D_{5/2} - z^4F_{7/2}$	3125.88	
		V II (1)	$a^5F_1 - z^5G_2$	3126.18	
		Cr II (55)	$b^4G_{11/2} - z^2G_{9/2}$	3126.37	
3127.06		Unidentified			Not in 99
3129.32	158	Cr II (5)	$a^4D_{3/2} - z^4F_{3/2}$	3129.60	
3130.96	102	V II (1)	$a^5F_3 - z^5G_3$	3131.16	
		Fe II (66)	$b^2G_{9/2} - z^2G_{7/2}$	3131.47	
3132.73	254	Cr II (5)	$a^4D_{7/2} - z^4F_{9/2}$	3132.96	
3133.49	171	Fe II (82)	$b^4D_{3/2} - x^4D_{5/2}$	3133.96	
3134.79	44	Cr II (94)	$b^2H_{9/2} - z^2I_{11/2}$	3135.21	
3135.79	450	Fe II (82)	$b^4D_{5/2} - x^4D_{5/2}$	3136.27	
		Cr II (124)	$b^2G_{7/2} - y^2H_{9/2}$	3136.24	
		Cr II (94)	$b^2H_{11/2} - z^2I_{13/2}$	3136.62	
3137.35	167	Cr II (5)	$a^4D_{5/2} - z^4F_{5/2}$	3137.59	
3140.21	83	Mn II	$a^1F_3 - z^1D_2$	3140.74	?id
		Cr II (54)	$b^4G_{5/2} - z^4G_{7/2}$	3140.81	
3140.63	87	Cr II (124)	$b^2G_{9/2} - y^2H_{11/2}$	3141.11	
3142.71	84	Fe II (7)	$a^4P_{5/2} - z^4F_{3/2}$	3143.13	
3143.2	33	Cr II (82)	$b^2F_{5/2} - z^2D_{3/2}$	3143.64	
3144.14	26	Cr II (53)	$b^4G_{9/2} - z^4I_{11/2}$	3144.59	
		Ti II (4)	$a^4F_{7/2} - z^2D_{5/2}$	3144.68	
3145.21	239	Fe II (82)	$b^4D_{7/2} - x^4D_{5/2}$	3145.66	
3146.24	39	Cr II (82)	$b^2F_{7/2} - z^2D_{5/2}$	3146.67	
3147.67	219	Cr II (5)	$a^4D_{7/2} - z^4F_{7/2}$	3148.13	
		Cr II (54)	$b^4G_{9/2} - z^4G_{9/2}$	3148.12	
3150.49	119	Cr II (54)	$b^4G_{5/2} - z^4G_{5/2}$	3150.74	
		Cr II (54)	$b^4G_{7/2} - z^4G_{7/2}$	3151.02	
3152.67	135	Cr II (72)	$a^2P_{3/2} - y^4F_{3/2}$	3153.13	
		Ti II (10)	$b^4F_{5/2} - z^4D_{5/2}$	3153.17	
3154.63	454	Fe II (66)	$b^2G_{9/2} - z^2G_{9/2}$	3155.11	bl rd sh
3156.06	39	Ti II (10)	$b^4F_{7/2} - z^4D_{7/2}$	3156.59	
3156.46	39	Fe II (67)	$b^2G_{9/2} - y^4F_{7/2}$	3156.87	
3158.58	58	Cr II (72)	$a^2P_{3/2} - y^4F_{5/2}$	3158.94	
3159.46	36	Ca II (4)	$4p\ ^2P_{1/2} - 4d\ ^2D_{3/2}$	3159.78	
		Cr II (5)	$a^4D_{7/2} - z^4F_{5/2}$	3160.01	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
3161.63?		Ti II (10)	$b^4F_{3/2} - z^4D_{1/2}$	3162.14	
3162.47	736	Fe II (7)	$a^4P_{3/2} - z^4F_{3/2}$	3162.89	
3163.52	827	Fe II (7)	$a^4P_{5/2} - z^4F_{5/2}$	3164.01	
		Fe II (120)	$c^2G_{7/2} - y^2G_{7/2}$	3163.71	
3165.28	16	Ni II (5)	$a^4P_{1/2} - z^4F_{3/2}$	3165.70	
3167.16	217	Fe II (6)	$a^4P_{5/2} - z^4D_{3/2}$	3167.58	
3168.33	448	Fe II (66)	$b^2G_{7/2} - z^2G_{7/2}$	3168.77	
		Fe II	$z^4P_{5/2} - e^6D_{5/2}$	3168.77	Lyα sec.
		Fe II (82)	$b^4D_{5/2} - x^4D_{7/2}$	3168.86	
3170.82	568	Fe II (6)	$a^4P_{3/2} - z^4D_{1/2}$	3171.26	
3172.55	62	Cr II (71)	$a^2P_{3/2} - z^2P_{1/2}$	3172.99	
3175.90	271	[Fe II] (11F)	$a^6D_{9/2} - b^4D_{7/2}$	3176.30	
3178.06	403	Fe II (82)	$b^4D_{7/2} - x^4D_{7/2}$	3178.45	
		Fe II (79)	$b^4D_{1/2} - y^4D_{1/2}$	3178.58	
3180.00	158	Ca II (4)	$4p\ ^2P_{3/2} - 4d\ ^2D_{5/2}$	3180.25	
		Fe II (157)	$c^2D_{5/2} - y^2F_{5/2}$	3180.42	
3181.45	237	Cr II (9)	$a^4G_{11/2} - z^4F_{9/2}$	3181.61	
		[Fe II] (12F)	$a^6D_{7/2} - b^2F_{5/2}$	3181.97	
		Ca II (4)	$4p\ ^2P_{3/2} - 4d\ ^2D_{3/2}$	3182.19	
		Cr II (9)	$a^4G_{7/2} - z^4F_{9/2}$	3182.19	
		Cr II (9)	$a^4G_{9/2} - z^4F_{9/2}$	3182.35	
3183.59	1156	Fe II (7)	$a^4P_{3/2} - z^4F_{5/2}$	3184.03	
3185.76	680	Fe II (7)	$a^4P_{1/2} - z^4F_{3/2}$	3186.24	
3187.60	607	Fe II (6)	$a^4P_{3/2} - z^4D_{3/2}$	3187.66	
		Fe II (120)	$c^2G_{9/2} - y^2G_{9/2}$	3188.22	
3188.2	289	He I (3)	$2s\ ^3S - 4p\ ^3P$	3188.67	Not in 98
3189.35	171	[Cr II] (7F)	$a^6S_{5/2} - a^2D_{5/2}$	3189.70	Not in 99
3193.34	633	Fe II (6)	$a^4P_{5/2} - z^4D_{5/2}$	3193.83	
3194.29	675	Fe II (6)	$a^4P_{1/2} - z^4D_{1/2}$	3194.72	
3196.51	1444	Fe II (7)	$a^4P_{5/2} - z^4F_{7/2}$	3197.00	bl rd sh
3197.5	260	Cr II (9)	$a^4G_{7/2} - z^4F_{7/2}$	3197.85	
		Cr II (9)	$a^4G_{9/2} - z^4F_{7/2}$	3198.00	
3201.73	22	Cr II (114)	$c^4D_{7/2} - x^4F_{9/2}$	3202.18	
3202.98	40	Ti II (26)	$a^2D_{3/2} - y^2F_{5/2}$	3203.46	
3205.46	48	Mn II	$a^3D_3 - z^3P_2$	3205.80	
		Cr II (114)	$c^4D_{5/2} - x^4F_{7/2}$	3206.03	
3209.68	175	Cr II (9)	$a^4G_{7/2} - z^4F_{5/2}$	3210.10	
3211.03	423	Fe II (6)	$a^4P_{1/2} - z^4D_{3/2}$	3211.37	
		Fe II	$z^4P_{3/2} - e^6D_{5/2}$	3211.76	Lyα sec.
3212.21	62	Mn II	$b^3D_2 - z^3D_2$	3212.66	
3213.92	674	Fe II (6)	$a^4P_{3/2} - z^4D_{5/2}$	3214.24	bl rd sh
3217.0	74	Cr II (83)	$b^2F_{5/2} - z^2P_{3/2}$	3217.48	
3217.85	125	Ti II (2)	$a^4F_{7/2} - z^4F_{9/2}$	3217.99	
		Cr II (9)	$a^4G_{5/2} - z^4F_{3/2}$	3218.32	
3219.49	17	Cr II (140)	$c^2G_{9/2} - x^4G_{11/2}$	3220.05	
3223.60	343	[Ni II] (6F)	$a^2D_{3/2} - a^2G_{7/2}$	3224.08	
		Ti II (2)	$a^4F_{5/2} - z^4F_{7/2}$	3223.77	
3226.56	56	Unidentified			
3228.49	1003	Fe II (6)	$a^4P_{5/2} - z^4D_{7/2}$	3228.68	bl rd sh
3229.2	133	Ti II (24)	$a^2D_{3/2} - z^2P_{1/2}$	3229.53	
3230.71	34	[Fe II] (12F)	$a^6D_{3/2} - b^2F_{5/2}$	3231.10	Not in 99 ?id
3233.15	228	Fe II (119)	$c^2G_{7/2} - z^2F_{5/2}$	3233.72	
3235.42	119	Fe II (1)	$a^4D_{7/2} - z^6D_{5/2}$	3235.86	
3237.0	62	Ti II (23)	$a^2D_{3/2} - y^2D_{3/2}$	3237.05	
		Ti II (2)	$a^4F_{7/2} - z^4F_{7/2}$	3237.51	
3238.23	159	Fe II (81)	$b^4D_{1/2} - y^4F_{3/2}$	3238.75	
		Fe II (81)	$b^4D_{3/2} - y^4F_{3/2}$	3238.33	
		V II (38)	$b^3G_4 - z^3H_5$	3238.81	
3240.23	97	Ti II (23)	$a^2D_{5/2} - y^2D_{3/2}$	3240.60	
		V II (61)	$a^3D_3 - y^3F_3$	3240.76	
		Fe II (81)	$b^4D_{5/2} - y^4F_{3/2}$	3240.80	
3242.18	69	Fe II (80)	$b^4D_{7/2} - z^2G_{7/2}$	3242.62	
3244.21	148	Fe II (119)	$c^2G_{9/2} - z^2F_{7/2}$	3244.66	
3247.72	280	Fe II (81)	$b^4D_{3/2} - y^4F_{5/2}$	3248.11	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
		Fe II (119)	$c^2G_{7/2} - z^2F_{7/2}$	3248.33	
3249.22	85	Ti II (66)	$b^4P_{5/2} - y^4D_{7/2}$	3249.54	
		Ti II (9)	$b^4F_{5/2} - z^2D_{3/2}$	3249.64	
3250.16	36	V II (38)	$b^3G_5 - z^3H_5$	3250.55	
		Fe II (81)	$b^4D_{5/2} - y^4F_{5/2}$	3250.59	
3253.34	51	Ti II (2)	$a^4F_{7/2} - z^4F_{5/2}$	3253.86	
		Ti II (23)	$a^2D_{5/2} - y^2D_{5/2}$	3253.88	
3254.78	59	Ti II (2)	$a^4F_{9/2} - z^4F_{7/2}$	3255.19	
3256.33	1108	Fe II (1)	$a^4D_{7/2} - z^6D_{7/2}$	3256.83	
3259.38	565	Fe II (81)	$b^4D_{5/2} - y^4F_{7/2}$	3259.71	bl rd sh
		Fe II (81)	$b^4D_{7/2} - y^4F_{9/2}$	3259.99	
3262.08	104	Ti II (89)	$b^2G_{9/2} - z^2H_{11/2}$	3262.53	
		Ti II (66)	$b^4P_{3/2} - y^4D_{5/2}$	3262.56	
3265.18	367	Fe II (1)	$a^4D_{5/2} - z^6D_{3/2}$	3265.70	
3267.42	36	Fe II (65)	$b^2G_{9/2} - z^4H_{9/2}$	3267.88	
		Fe II (80)	$b^4D_{7/2} - z^2G_{9/2}$	3267.98	
3270.41	105	Fe II (118)	$c^2G_{9/2} - y^4G_{7/2}$	3270.71	
		Cr II (61)	$a^2H_{11/2} - z^4G_{9/2}$	3271.07	
3272.31	163	Ti II (66)	$b^4P_{5/2} - y^4D_{5/2}$	3272.60	
		Ti II (66)	$b^4P_{1/2} - y^4D_{3/2}$	3273.02	
3275.52	141	Ni II (4)	$a^4P_{5/2} - z^4D_{3/2}$	3275.86	
		Ti II (24)	$a^2D_{3/2} - z^2P_{3/2}$	3276.23	
3277.81	1557	Fe II (1)	$a^4D_{7/2} - z^6D_{9/2}$	3278.29	
		[Fe II] (11F)	$a^6D_{3/2} - b^4D_{3/2}$	3278.49	
3281.69	1642	Fe II (1)	$a^4D_{5/2} - z^6D_{5/2}$	3282.24	
3285.77	421	Fe II (1)	$a^4D_{3/2} - z^6D_{1/2}$	3286.35	
3288.94	47	Ti II (66)	$b^4P_{5/2} - y^4D_{3/2}$	3289.38	
		Ti II (66)	$b^4P_{3/2} - y^4D_{1/2}$	3289.53	
3289.92	181	Fe II (65)	$b^2G_{7/2} - z^4H_{7/2}$	3290.30	
		[Fe II] (11F)	$a^6D_{1/2} - b^4D_{1/2}$	3290.40	
3292.18	50	Cr II (68)	$a^2P_{1/2} - z^2S_{1/2}$	3292.71	
3296.21	1471	Fe II (1)	$a^4D_{3/2} - z^6D_{3/2}$	3296.77	
3298.42	48	Fe II (91)	$b^2F_{5/2} - z^2D_{3/2}$	3298.83	
		Mn II	$b^3P_1 - z^5D_2$	3299.00	
3303.68	1362	Fe II (1)	$a^4D_{5/2} - z^6D_{7/2}$	3303.81	
		Fe II (1)	$a^4D_{1/2} - z^6D_{1/2}$	3304.42	
3307.44	237	Cr II (150)	$c^2F_{7/2} - y^2G_{9/2}$	3307.91	
		Cr II (51)	$b^4G_{9/2} - z^4H_{11/2}$	3307.99	
3309.12	37	Ti II (7)	$b^4F_{7/2} - z^4F_{9/2}$	3309.76	?wl
3311.17	71	Cr II (120)	$b^2G_{9/2} - z^2F_{7/2}$	3311.60	
		Mn II	$a^5D_5 - b^3F_4$	3311.73	
3312.66	244	Cr II (51)	$b^4G_{7/2} - z^4H_{9/2}$	3312.88	
		Cr II (51)	$b^4G_{5/2} - z^4H_{7/2}$	3313.13	
3314.49	346	Fe II (1)	$a^4D_{1/2} - z^6D_{3/2}$	3314.94	
3315.7 ?	65	Ti II (65)	$b^4P_{1/2} - z^4S_{3/2}$	3316.27	?wl
3318.69?	28	Ti II (7)	$b^4F_{5/2} - z^4F_{7/2}$	3318.98	
3322.00	44	Ti II (65)	$b^4P_{3/2} - z^4S_{3/2}$	3322.65	?wl
3323.56	126	Ti II (7)	$b^4F_{9/2} - z^4F_{9/2}$	3323.90	
		Fe II (92)	$b^2F_{7/2} - z^2G_{9/2}$	3324.02	
3324.58	129	Cr II (3)	$a^4D_{3/2} - z^4P_{5/2}$	3325.00	
		Cr II (120)	$b^2G_{7/2} - z^2F_{5/2}$	3325.09	
		Cr II (80)	$b^2F_{7/2} - z^2G_{9/2}$	3325.29	
3327.25	61	Ti II (7)	$b^4F_{3/2} - z^4F_{5/2}$	3327.73	
		Ti II	$b^4P_{5/2} - y^2F_{7/2}$	3327.81	
3328.86	124	Cr II (4)	$a^4D_{1/2} - z^6D_{3/2}$	3329.30	
3329.91	68	Ti II (7)	$b^4F_{7/2} - z^4F_{7/2}$	3330.41	
		Cr II (150)	$c^2F_{7/2} - y^2G_{7/2}$	3330.49	
3332.61	59	Ti II (65)	$b^4P_{5/2} - z^4S_{3/2}$	3333.07	
3335.71	89	Ti II (7)	$b^4F_{5/2} - z^4F_{5/2}$	3336.16	
		Cr II (80)	$b^2F_{5/2} - z^2G_{7/2}$	3336.26	
3336.77	154	Cr II (14)	$a^4P_{5/2} - z^4F_{7/2}$	3337.07	
		Cr II (4)	$a^4D_{1/2} - z^6D_{1/2}$	3337.28	
3338.3 ?	93	Ti II (55)	$a^2P_{3/2} - y^2F_{5/2}$	3338.82	
3339.14	159	Fe II (76)	$b^4D_{5/2} - y^4P_{3/2}$	3339.48	

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{\rm lab,vac}$	Comment
3340.45	159	Cr II (4)	$a^4D_{3/2} - z^6D_{3/2}$	3340.75	
		Ti II (7)	$b^4F_{3/2} - z^4F_{3/2}$	3341.32	
3341.74	34	[Mn II] (3F)	$a^7S_3 - a^5P_2$	3342.31	
3343.11	186	Cr II (3)	$a^4D_{5/2} - z^4P_{5/2}$	3343.54	
3345.28	73	[Mn II] (3F)	$a^7S_3 - a^5P_3$	3345.65	
3347.30	45	Ti II (7)	$b^4F_{7/2} - z^4F_{5/2}$	3347.71	
3348.35	126	Cr II (4)	$a^4D_{3/2} - z^6D_{1/2}$	3348.78	
3350.03	70	Cr II (4)	$a^4D_{5/2} - z^6D_{7/2}$	3350.32	
		Cr II (14)	$a^4P_{3/2} - z^4F_{5/2}$	3350.60	
		Ti II (1)	$a^4F_{9/2} - z^4G_{11/2}$	3350.37	
3350.87	63	Ni II (1)	$b^2D_{3/2} - z^4D_{3/2}$	3351.38	
3353.63	209	Cr II (4)	$a^4D_{7/2} - z^6D_{9/2}$	3354.09	
		Co II (2)	$a^5P_2 - z^5D_1$	3353.77	
3357.95	31	Cr II (79)	$b^2F_{7/2} - z^4G_{9/2}$	3358.36	
3359.08	158	Cr II (4)	$a^4D_{5/2} - z^6D_{3/2}$	3359.46	
		Co II (2)	$a^5P_3 - z^5D_2$	3359.56	
3360.79	216	Cr II (21)	$b^4D_{7/2} - z^4D_{7/2}$	3361.26	
		Ti II (53)	$a^2P_{1/2} - y^2D_{3/2}$	3361.14	
		Fe II (105)	$a^2I_{11/2} - z^2I_{11/2}$	3361.08	
3362.21	202	Cr II (21)	$b^4D_{5/2} - z^4D_{7/2}$	3362.73	
3366.77	81	Ti II (54)	$a^2P_{3/2} - z^2P_{1/2}$	3367.15	
3369.17	331	Cr II (3)	$a^4D_{7/2} - z^4P_{5/2}$	3369.01	
		Cr II (91)	$b^2H_{11/2} - z^4G_{9/2}$	3369.67	
3374.49	136	Ni II (4)	$a^4P_{5/2} - z^4D_{5/2}$	3374.94	
3376.70	929	[Fe II] (26F)	$a^4F_{9/2} - b^4D_{7/2}$	3377.17	
3378.64	284	[Ni II] (5F)	$a^2D_{5/2} - a^2P_{1/2}$	3379.13	
		Cr II (21)	$b^4D_{7/2} - z^4D_{5/2}$	3379.30	
3380.26	348	Cr II (21)	$b^4D_{5/2} - z^4D_{5/2}$	3380.79	
3381.74	66	Fe II (5)	$a^4P_{3/2} - z^6P_{5/2}$	3382.33	
3383.03	163	Cr II (4)	$a^4D_{5/2} - z^6D_{5/2}$	3383.65	
3384.3 ?	47	Ti II (1)	$a^4F_{3/2} - z^4G_{5/2}$	3384.74	
3387.56	257	[Fe II] (26F)	$a^4F_{9/2} - b^4D_{5/2}$	3388.06	
3388.64	142	Ti II (1)	$a^4F_{7/2} - z^4G_{7/2}$	3388.82	
		Co II (2)	$a^5P_2 - z^5D_2$	3389.16	
3391.94	156	Cr II (3)	$a^4D_{1/2} - z^4P_{3/2}$	3392.40	
3393.47	115	Cr II (21)	$b^4D_{1/2} - z^4D_{3/2}$	3393.96	
3394.60	341	Cr II (21)	$b^4D_{5/2} - z^4D_{3/2}$	3395.27	
		Cr II (21)	$b^4D_{3/2} - z^4D_{3/2}$	3394.81	
		Ti II (1)	$a^4F_{5/2} - z^4G_{5/2}$	3395.55	
3398.67	65	Fe II (105)	$a^2I_{13/2} - z^2I_{13/2}$	3399.32	
3402.81	190	Cr II (21)	$b^4D_{1/2} - z^4D_{1/2}$	3403.37	
		Ti II (54)	$a^2P_{1/2} - z^2P_{3/2}$	3403.40	
		Ni II (4)	$a^4P_{3/2} - z^4D_{1/2}$	3402.74	
3403.82	320	Cr II (3)	$a^4D_{3/2} - z^4P_{3/2}$	3404.28	
		Cr II (21)	$b^4D_{3/2} - z^4D_{1/2}$	3404.23	
3407.73	210	Ni II (4)	$a^4P_{1/2} - z^4D_{1/2}$	3408.28	
		Ti II (1)	$a^4F_{9/2} - z^4G_{7/2}$	3408.19	
3409.39	288	Cr II (4)	$a^4D_{7/2} - z^6D_{5/2}$	3409.74	
		Cr II (8)	$a^4G_{11/2} - z^6D_{9/2}$	3409.91	
3410.96	29	Cr II	$b^2G_{9/2} - x^4D_{7/2}$	3411.52	?id
3416.48	719	Fe II (16)	$a^2P_{3/2} - z^4P_{1/2}$	3417.00	
		Fe II	$a^6S_{5/2} - z^8P_{7/2}$	3417.03	
		Co II (2)	$a^5P_3 - z^5D_3$	3416.75	
3419.96	34	Mn II	$b^3D_3 - z^3P_2$	3420.39	
3421.75	243	Cr II (3)	$a^4D_{1/2} - z^4P_{1/2}$	3422.18	
3423.29	464	Cr II (3)	$a^4D_{5/2} - z^4P_{3/2}$	3423.71	
3424.3		Co II (2)	$a^5P_1 - z^5D_2$	3424.81	
3426.01	70	Fe II (5)	$a^4P_{5/2} - z^6P_{7/2}$	3426.56	
3433.87	283	Cr II (3)	$a^4D_{3/2} - z^4P_{1/2}$	3434.28	
3436.54	118	Fe II (91)	$b^2F_{7/2} - z^2D_{5/2}$	3437.09	
3439.42	1315	[Ni II] (5F)	$a^2D_{5/2} - a^2P_{3/2}$	3439.86	
		Mn II (1)	$a^5S_2 - z^7P_3$	3439.96	
3441.35	177	[Fe II] (26F)	$a^4F_{7/2} - b^4D_{7/2}$	3441.98	
3442.75	348	Mn II (3)	$a^5D_4 - z^5P_3$	3442.97	

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{\rm lab,vac}$ (Å)	Comment
		Fe II (89)	$b^2F_{7/2} - z^4G_{5/2}$	3443.21	
3444.51	224	Fe II (16)	$a^2P_{3/2} - z^4P_{3/2}$	3444.82	
		Ti II (6)	$b^4F_{9/2} - z^4G_{11/2}$	3445.30	
3446.91	43	Co II (2)	$a^5P_2 - z^5D_3$	3447.37	
3448.01	48	He I (7)	$2s\ ^1S - 6p\ ^1P$	3448.57	Not in 98
3449.98	71	Fe II	$a^6S_{5/2} - z^8P_{5/2}$	3450.45	
3452.81	478	[Fe II] (26F)	$a^4F_{7/2} - b^4D_{5/2}$	3453.30	
3454.66	224	Ni II (1)	$b^2D_{3/2} - z^4D_{5/2}$	3455.15	
3455.55	320	[Fe II] (26F)	$a^4F_{7/2} - b^4D_{3/2}$	3456.10	
3457.42	106	Fe II (76)	$b^4D_{7/2} - y^4P_{5/2}$	3457.92	
3458.6 ?	59	Fe II (10)	$a^2G_{9/2} - z^4F_{7/2}$	3459.11	?id
3461.01	287	Mn II (3)	$a^5D_3 - z^5P_2$	3461.31	
		Mn II (1)	$a^5S_2 - z^7P_2$	3461.02	
3461.97	146	Ti II (6)	$b^4F_{7/2} - z^4G_{9/2}$	3462.49	
3463.3 ?	25	Cr II (2)	$a^4D_{1/2} - z^6P_{3/2}$	3463.72	
3464.47	135	Fe II (4)	$a^4P_{5/2}$- $z^6F_{5/2}$	3464.95	
3466.09	221	Ni II (4)	$a^4P_{3/2} - z^4D_{3/2}$	3466.63	
3466.95	306	[N I] (2F)	$^4S_{3/2} - ^2P_{3/2}$	3467.49	
		[N I] (2F)	$^4S_{3/2} - ^2P_{1/2}$	3467.54	
3469.11	119	Fe II (114)	$c^2G_{7/2} - z^2G_{7/2}$	3469.67	
3471.80	256	Ni II (4)	$a^4P_{1/2} - z^4D_{3/2}$	3472.38	
3474.79	115	Mn II (3)	$a^5D_3 - z^5P_3$	3475.03	
		Mn II (3)	$a^5D_2 - z^5P_1$	3475.12	
3476.17	488	Fe II (4)	$a^4P_{3/2} - z^6F_{1/2}$	3476.25	
		Fe II (4)	$a^4P_{5/2} - z^6F_{7/2}$	3476.73	
		Cr II (2)	$a^4D_{3/2} - z^6P_{3/2}$	3476.23	
3479.01	39	Fe II (16)	$a^2P_{1/2} - z^4P_{1/2}$	3479.56	
3480.39	174	Fe II (4)	$a^4P_{3/2} - z^6F_{3/2}$	3480.91	
3483.48	315	Mn II (3)	$a^5D_2 - z^5P_2$	3483.90	
3484.55	133	[Fe II] (27F)	$a^4F_{3/2} - b^2F_{5/2}$	3485.00	
		Cr II (2)	$a^4D_{5/2} - z^6P_{5/2}$	3485.14	
3488.41	83	Fe II (4)	$a^4P_{3/2} - z^6F_{5/2}$	3488.98	
3489.34	100	Mn II (3)	$a^5D_1 - z^5P_1$	3489.68	
3490.17	17	Ti II (6)	$b^4F_{7/2} - z^4G_{7/2}$	3490.74	
3491.40	28	Ti II (6)	$b^4F_{3/2} - z^4G_{5/2}$	3492.06	
3493.93	135	Fe II (114)	$c^2G_{9/2} - z^2G_{9/2}$	3494.47	
3495.13	570	Fe II (16)	$a^2P_{3/2} - z^4P_{5/2}$	3495.67	
		Cr II (2)	$a^4D_{7/2} - z^6P_{7/2}$	3495.51	
3496.28	93	Mn II (3)	$a^5D_0 - z^5P_1$	3496.83	
3497.30	92	Mn II (3)	$a^5D_2 - z^5P_3$	3497.81	
3498.07	117	Mn II (3)	$a^5D_1 - z^5P_2$	3498.53	
		Fe II (114)	$c^2G_{7/2} - z^2G_{9/2}$	3498.72	
3500.84	25	Ti II (6)	$b^4F_{5/2} - z^4G_{5/2}$	3501.34	
3502.12	432	[Fe II] (26F)	$a^4F_{5/2} - b^4D_{5/2}$	3502.63	
		Co II (2)	$a^5P_3 - z^5D_4$	3502.72	
3504.65	634	[Fe II] (26F)	$a^4F_{5/2} - b^4D_{1/2}$	3505.02	
		[Fe II] (26F)	$a^4F_{5/2} - b^4D_{3/2}$	3505.51	
		V II (6)	$a^3F_3 - z^5D_2$	3505.44	
		Fe II (4)	$a^4P_{1/2} - z^6F_{1/2}$	3504.47	
		Ti II (88)	$b^2G_{9/2} - y^2G_{9/2}$	3505.90	
3507.94	206	Fe II (16)	$a^2P_{1/2} - z^4P_{3/2}$	3508.40	
3508.59	200	Fe II (4)	$a^4P_{1/2} - z^6F_{3/2}$	3509.21	
3511.34	28	Ti II (88)	$b^2G_{7/2} - y^2G_{7/2}$	3511.85	
3512.31	209	Cr II (2)	$a^4D_{7/2} - z^6P_{5/2}$	3512.83	
3514.49	343	Ni II (4)	$a^4P_{5/2} - z^4D_{7/2}$	3514.99	
3516.51	10	V II (6)	$a^3F_4 - z^5D_4$	3517.01	
3517.73	49	V II (6)	$a^3F_4 - z^5D_3$	3518.31	
3519.08	18	Unidentified			
3520.73	61	Ti II (98)	$b^2P_{1/2} - z^2D_{3/2}$	3521.27	
3522.10	36	Fe II (10)	$a^2G_{9/2} - z^4F_{9/2}$	3522.63	
3524.08	14	Co II	$a^3G_4 - z^3F_3$	3524.55	
3525.15	15	V II (6)	$a^3F_3 - z^5D_3$	3525.72	
3526.84	44	Ni II	$a^2P_{3/2} - z^2D_{5/2}$	3527.43	
3529.18	6	Unidentified			Not in 99

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
3531.33	106	V II (4)	$a^3F_2 - z^5F_1$	3531.77	
		He I (36)	2p ^3P – 11d ^3D	3531.51	
3533.32	62	[Fe II]	$a^4D_{7/2} - b^2D_{5/2}$	3533.87	
3536.10	80	Ti II (98)	$b^2P_{3/2} - z^2D_{5/2}$	3536.42	
		Fe II (75)	$b^4D_{5/2} - z^4S_{3/2}$	3536.63	
3536.73	100	[Fe II] (26F)	$a^4F_{3/2} - b^4D_{5/2}$	3537.26	
3539.56	543	[Fe II] (26F)	$a^4F_{3/2} - b^4D_{1/2}$	3539.70	
		[Fe II] (26F)	$a^4F_{3/2} - b^4D_{3/2}$	3540.20	
3541.97	31	Fe II	$c^2F_{7/2} - w^2G_{7/2}$	3542.55	
3543.35	13	Unidentified			
3543.95	8	Fe II	$c^2F_{5/2} - w^2G_{7/2}$	3544.37	
3545.60	91	Co II (1)	$a^5P_3 - z^5F_3$	3546.04	
		V II (5)	$a^3F_3 - z^3D_2$	3546.21	
3546.94	9	Unidentified			
3548.42	15	Fe II	$c^2F_{7/2} - w^2G_{9/2}$	3549.05	
3554.89	56	He I (34)	2p ^3P – 10d ^3D	3555.43	Not in 98
3556.5	54	Co II (1)	$a^5P_1 - z^5F_2$	3556.94	Not in 98
3557.37	56	V II (5)	$a^3F_4 - z^3D_3$	3557.81	
3559.99	310	[Ni II] (5F)	$a^2D_{3/2} - a^2P_{1/2}$	3560.43	
3561.66	144	Co II	$a^3G_5 - z^3F_4$	3562.12	
3564.93	26	Fe II (113)	$c^2G_{9/2} - z^4I_{9/2}$	3565.55	
3566.2	18	Ti II (42)	$a^4P_{3/2} - z^2S_{1/2}$	3566.99	
		Fe II (155)	$c^2D_{3/2} - z^2S_{1/2}$	3567.08	
		Fe II (132)	$b^2D_{5/2} - z^2F_{7/2}$	3567.17	
		V II (4)	$a^3F_2 - z^5F_2$	3567.19	
3575.64	10	Co II	$b^3P_1 - z^3D_2$	3576.24	
3577.28	292	Ni II (4)	$a^4P_{3/2} - z^4D_{5/2}$	3577.79	
3578.61	61	Co II (1)	$a^5P_2 - z^5F_3$	3579.03	
3581.56	56	Unidentified			
3585.93	405	Cr II (12)	$a^4P_{5/2} - z^4P_{5/2}$	3586.31	
		Cr II (12)	$a^4P_{3/2} - z^4P_{5/2}$	3586.51	
3587.66	109	Ti II (15)	$a^2F_{7/2} - z^4D_{7/2}$	3588.16	
		He I (31)	2p ^3P – 9d ^3D	3588.29	
3588.78	4	V II (76)	$b^3P_1 - z^3P_0$	3589.16	
		[Fe II]	$a^4D_{5/2} - b^2D_{5/2}$	3589.25	
3590.29	87	V II (5)	$a^3F_2 - z^3D_1$	3590.77	
3592.52	44	V II (4)	$a^3F_3 - z^5F_2$	3593.05	
3593.81	87	V II (4)	$a^3F_4 - z^5F_3$	3594.36	
3596.51	122	Ti II (15)	$a^2F_{7/2} - z^4D_{5/2}$	3597.08	
3598.46	23	[Co II]	$a^3P_2 - c^3F_4$	3598.90	
3604.29	186	Cr II (13)	$a^4P_{5/2} - z^6D_{3/2}$	3604.63	
		Cr II (13)	$a^4P_{1/2} - z^6D_{3/2}$	3604.80	
		Cr II (13)	$a^4P_{3/2} - z^6D_{3/2}$	3604.84	
3606.53	24	Co II	$a^3G_5 - z^3G_4$	3607.01	
3607.49	14	Unidentified			
3609.30	127	Ni II (1)	$b^2D_{5/2} - z^4D_{5/2}$	3609.84	
3613.63	259	Cr II (13)	$a^4P_{1/2} - z^6D_{1/2}$	3614.16	
		Cr II (13)	$a^4P_{3/2} - z^6D_{1/2}$	3614.20	
		He I (6)	2s ^1S – 5p ^1P	3614.67	
3615.32	66	Fe II (112)	$c^2G_{7/2} - z^4H_{7/2}$	3615.91	
3616.67	26	Cr II	$c^2F_{5/2} - z^2D_{5/2}$	3617.28	
3617.72	9	Cr II	$c^2F_{5/2} - z^2D_{3/2}$	3618.29	
3619.8	47	Co II	$a^3G_3 - z^3G_3$	3620.31	
		[Co II]	$a^3P_2 - c^3F_3$	3620.74	
3621.77	152	Co II (1)	$a^5P_3 - z^5F_4$	3622.25	
		Fe II (144)	$a^2S_{1/2} - z^2P_{3/2}$	3622.30	
3625.36	43	Ti II (52)	$a^2P_{1/2} - z^2S_{1/2}$	3625.86	
		Fe II (144)	$a^2S_{1/2} - z^2P_{1/2}$	3625.93	
3627.51	7	[Ni II] (5F)	$a^2D_{3/2} - a^2P_{3/2}$	3627.92	
3632.12	352	Cr II (13)	$a^4P_{5/2} - z^6D_{5/2}$	3632.50	
		Cr II (13)	$a^4P_{3/2} - z^6D_{5/2}$	3632.71	
3634.74	121	He I (28)	2p ^3P – 8d ^3D	3635.27	Not in 98
3637.91	110	[Co II]	$a^3F_4 - a^3D_3$	3638.40	
3639.1	4	[Co II]	$a^3P_1 - c^3F_3$	3639.68	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
3641.79	11	Ti II (52)	$a^2P_{3/2} - z^2S_{1/2}$	3642.37	
3643.67	76	Cr II (1)	$a^4D_{7/2} - z^6F_{9/2}$	3644.24	
3645.25	45	Cr II (1)	$a^4D_{5/2} - z^6F_{7/2}$	3645.73	
3647.84	51	Cr II (1)	$a^4D_{3/2} - z^6F_{5/2}$	3648.41	
3650.91	59	Cr II (156)	$b^2I_{13/2} - z^2I_{13/2}$	3651.40	
3652.26	52	Cr II (1)	$a^4D_{1/2} - z^6F_{3/2}$	3652.71	
		He I (27)	$2p\ ^3P - 8s\ ^3S$	3653.04	
3653.65	32	Co II	$c^3P_1 - z^3D_1$	3654.02	?id
		[Co II]	$a^3P_1 - c^3F_2$	3654.09	
3656.95	22	H_{38}	Balmer 38	3657.15	?id
		Co II	$c^3P_2 - z^3D_2$	3657.20	?id
3658.72	19	Cr II (147)	$c^2F_{5/2} - y^4F_{3/2}$	3659.20	
		Cr II (133)	$c^2G_{7/2} - y^4F_{5/2}$	3659.20	
3660.27	106	H_{33}	Balmer 33	3660.46	
		H_{32}	Balmer 32	3661.32	
		Ti II (75)	$b^2D_{5/2} - y^2F_{7/2}$	3660.80	
		[Fe II] (10F)	$a^6D_{9/2} - a^2F_{7/2}$	3661.00	?id
3661.67	77	H_{31}	Balmer 31	3662.26	
3662.71	46	H_{30}	Balmer 30	3663.30	
		Ti II (75)	$b^2D_{3/2} - y^2F_{5/2}$	3663.28	
3663.90	21	H_{29}	Balmer 29	3664.45	Not in 98
3665.22	71	H_{28}	Balmer 28	3665.72	
		[Fe II]	$a^4D_{1/2} - b^2D_{3/2}$	3665.74	
		Cr II (156)	$b^2I_{11/2} - z^2I_{11/2}$	3665.98	
3666.55	55	H_{27}	Balmer 27	3667.14	Not in 98
3668.13	78	H_{26}	Balmer 26	3668.73	
3669.92		H_{25}	Balmer 25	3670.51	
		Cr II (1)	$a^4D_{5/2} - z^6F_{5/2}$	3670.74	
3671.97	180	H_{24}	Balmer 24	3672.52	
3674.32		H_{23}	Balmer 23	3674.80	
3675.44	54	Cr II (1)	$a^4D_{7/2} - z^6F_{7/2}$	3676.03	
3677.03	117	H_{22}	Balmer 22	3677.41	
		Cr II (1)	$a^4D_{3/2} - z^6F_{1/2}$	3677.52	
3678.29	492	Cr II (12)	$a^4P_{5/2} - z^4P_{3/2}$	3678.71	
		Cr II (12)	$a^4P_{1/2} - z^4P_{3/2}$	3678.89	
		Cr II (12)	$a^4P_{3/2} - z^4P_{3/2}$	3678.93	
3679.76	108	H_{21}	Balmer 21	3680.40	
3681.19	188	[Co II]	$a^3F_3 - a^3D_2$	3681.68	
3683.20	138	H_{20}	Balmer 20	3683.88	?wl
3685.86	463	Ti II (14)	$a^2F_{5/2} - z^2D_{3/2}$	3686.24	
		Ti II (14)	$a^2F_{7/2} - z^2D_{5/2}$	3686.25	
3687.12	348	Cr II (118)	$b^2G_{9/2} - z^2G_{9/2}$	3687.72	
		H_{19}	Balmer 19	3687.88	
3688.63	61	Cr II (1)	$a^4D_{5/2} - z^6F_{3/2}$	3689.04	
		[Co II]	$a^3F_4 - a^3H_6$	3689.23	
3691.95	498	H_{18}	Balmer 18	3692.63	
3697.61	648	H_{17}	Balmer 17	3698.23	
3704.38	849	H_{16}	Balmer 11	3704.93	
3705.44	615	He I (25)	$2p\ ^3P - 7d\ ^3D$	3706.06	Not in 98
3706.52	437	Ca II (3)	$4p\ ^2P_{1/2} - 5s\ ^2S_{1/2}$	3707.08	
3712.47	630	H_{15}	Balmer 15	3713.05	bl rd sh
3713.40	617	Cr II (12)	$a^4P_{1/2} - z^4P_{1/2}$	3713.95	
		Cr II (12)	$a^4P_{3/2} - z^4P_{1/2}$	3713.99	
		H_{15}	Balmer 15	3713.05	
3715.69	508	Cr II (20)	$b^4D_{7/2} - z^4F_{9/2}$	3716.23	
3722.23	872	[S III] (2F)	$3p^2\ ^3P_1 - 3p^2\ ^1S_0$	3722.69	
		H_{14}	Balmer 14	3723.02	
3727.74	163	[O II] (1F)	$2p^3\ ^4S_{3/2} - 2p^3\ ^2D_{3/2}$	3727.09	?wl
3730.45?	82	[O II] (1F)	$2p^3\ ^4S_{3/2} - 2p^3\ ^2D_{5/2}$	3729.88	?wl
3734.95	754	H_{13}	Balmer 13	3735.45	rd sh
3737.38	228	Ca II (3)	$4p\ ^2P_{3/2} - 5s\ ^2S_{1/2}$	3737.96	
3738.79	187	Cr II (20)	$b^4D_{5/2} - z^4F_{7/2}$	3739.42	
3742.06	262	Ti II (72)	$b^2D_{5/2} - y^2D_{5/2}$	3742.70	
		Fe II (15)	$a^2P_{3/2} - z^4F_{5/2}$	3742.62	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
3743.81	73	Cr II (6)	$a^4G_{9/2} - z^6F_{7/2}$	3744.21	
3749.13	496	Cr II (11)	$a^4P_{5/2} - z^6P_{5/2}$	3749.73	
		Fe II (154)	$c^2D_{5/2} - z^2P_{3/2}$	3749.55	rd sh
3750.74	1315	H_{12}	Balmer 12	3751.24	rd sh
3755.06	278	Cr II (20)	$b^4D_{3/2} - z^4F_{5/2}$	3755.63	
3758.21	71	Ti II (73)	$b^2D_{3/2} - z^2P_{3/2}$	3758.76	
3759.94	114	Ti II (13)	$a^2F_{7/2} - z^2F_{7/2}$	3760.36	
		Fe II (154)	$c^2D_{3/2} - z^2P_{1/2}$	3760.53	
3762.20	146	Ti II (13)	$a^2F_{5/2} - z^2F_{5/2}$	3762.39	
		Cr II (11)	$a^4P_{5/2} - z^6P_{3/2}$	3762.73	
		Cr II (11)	$a^4P_{1/2} - z^6P_{3/2}$	3762.92	
		Cr II (11)	$a^4P_{3/2} - z^6P_{3/2}$	3762.96	
3764.63	298	Fe II (29)	$b^4P_{5/2} - z^4P_{3/2}$	3765.17	
3770.19	2696	H_{11}	Balmer 11	3771.72	rd sh
		Ni II (1)	$b^2D_{5/2} - z^4D_{7/2}$	3770.53	
		[Co II]	$a^3F_3 - a^3H_5$	3770.94	
3778.84	31	V II (21)	$b^3F_3 - z^3F_2$	3779.43	
3780.09	77	Fe II (23)	$a^2D2_{5/2} - z^4P_{5/2}$	3780.65	
3783.85	284	Fe II (14)	$a^2P_{3/2} - z^4D_{5/2}$	3784.42	
3786.84	27	Fe II (15)	$a^2P_{1/2} - z^4F_{3/2}$	3787.44	
3798.6	1460	H_{10}	Balmer 10	3799.00	rd sh
		[S III] (2F)	$3p^2\ ^3P_2 - 3p^2\ ^1S_0$	3798.25	
3800.98	758	[Co II]	$a^3F_2 - a^3H_4$	3801.55	
3806.87	206	[Cu II] (2F)	$3d^{10}\ ^1S_0 - 4s\ ^1D_2$	3807.41	
3813.8	6	Ti II (12)	$a^2F_{7/2} - z^4F_{7/2}$	3814.46	
3814.73	199	Fe II (153)	$c^2D_{3/2} - z^2F_{5/2}$	3815.21	
		Ti II (12)	$a^2F_{5/2} - z^4F_{3/2}$	3815.67	
3820.11	315	He I (22)	$2p\ ^3P - 6d\ ^3D$	3820.69	Not in 98
3822.34	40	Fe II (14)	$a^2P_{1/2} - z^4D_{3/2}$	3823.01	
3825.42	355	Fe II (29)	$b^4P_{5/2} - z^4P_{5/2}$	3826.01	
3827.61	26	Fe II (153)	$c^2D_{5/2} - z^2F_{7/2}$	3828.17	
3836.1	2073	H_9	Balmer 9	3836.47	rd sh, ?wl
3839.13	1011	H_9	Balmer 9	3836.47	?wl
3844.71	30	Mn II	$b^3F_4 - z^3G_5$	3845.25	?id
3845.74	32	Fe II (127)	$b^2D_{3/2} - z^2D_{3/2}$	3846.27	
3847.50	19	[Co II]	$a^3F_2 - a^1P_1$	3847.93	?wl
3848.16		[Fe II]	$a^6D_{9/2} - a^4G_{7/2}$	3848.80	
3848.73	17	Mg II (5)	$3d\ ^2D_{5/2} - 5p\ ^2P_{3/2}$	3849.30	Not in 98
		Mg II (5)	$3d\ ^2D_{3/2} - 5p\ ^2P_{3/2}$	3849.43	
3850.08	85	Ni II (11)	$a^2G_{7/2} - z^2F_{5/2}$	3850.65	
3854.11	12	Si II (1)	$3p^2\ ^2D_{3/2} - 4p\ ^2P_{3/2}$	3854.76	
3856.56	257	Si II (1)	$3p^2\ ^2D_{5/2} - 4p\ ^2P_{3/2}$	3857.11	
3860.41	20	Unidentified			
3863.12	52	Si II (1)	$3p^2\ ^2D_{3/2} - 4p\ ^2P_{1/2}$	3863.69	
3866.19	51	Cr II (167)	$b^2D_{5/2} - z^2F_{7/2}$	3866.69	
3869.24	2316	[Ne III] (1F)	$2p^4\ ^3P_2 - 2p^4\ ^1D_2$	3869.85	Not in 98
3873.26	69	Fe II (29)	$b^4P_{3/2} - z^4P_{1/2}$	3873.86	
3874.54	31	[Fe II]	$a^6D_{9/2} - a^4G_{9/2}$	3875.17	
3879.24	38	V II (33)	$a^3G_5 - z^3F_4$	3879.82	
3888.97	5573	He I (2)	$2s\ ^3S - 3p\ ^3P$	3889.75	
		H_8	Balmer 8	3890.15	rd sh
3896.56	53	Fe II	$a^2D2_{3/2} - z^4P_{5/2}$	3897.21	
		V II (9)	$a^3P_0 - z^5F_1$	3897.26	
3899.63	17	V II (33)	$a^3G_4 - z^3F_3$	3900.24	
3901.04	207	Ti II (34)	$a^2G_{9/2} - z^2G_{9/2}$	3901.66	
		Al II (1)	$3s3p\ ^1P_1 - 3p^2\ ^1D_2$	3901.78	?id
3903.81	61	V II (11)	$a^3P_2 - z^5D_3$	3904.37	
3906.23	71	Cr II (167)	$b^2D_{3/2} - z^2F_{5/2}$	3906.75	
3914.00	110	Ti II (34)	$a^2G_{7/2} - z^2G_{7/2}$	3914.58	
3914.97	333	Fe II (3)	$a^4P_{5/2} - z^6D_{3/2}$	3915.61	
		V II (33)	$a^3G_3 - z^3F_2$	3915.43	
3916.87	34	V II (10)	$a^3P_1 - z^3D_2$	3917.52	
3919.01	15	Fe II (191)	$d^2D1_{3/2} - y^2P_{1/2}$	3919.64	?id
3919.6	15	N II (17)	$3p\ ^1P_1 - 3d\ ^1P_1$	3920.11	Not in 98

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
3930.82	213	Fe II (3)	$a^4P_{3/2} - z^6D_{1/2}$	3931.42	
3936.54	85	Fe II (173)	$c^2F_{7/2} - z^2G_{9/2}$	3937.08	
3938.81	690	Fe II (3)	$a^4P_{5/2} - z^6D_{5/2}$	3939.41	
3943.35	13	[Fe III]	$3d^6\ ^3G_4 - 3d^6\ ^3F1_3$	3944.10	Not in 98
3945.70	255	Fe II (3)	$a^4P_{3/2} - z^6D_{3/2}$	3946.33	
3952.51	63	V II (10)	$a^3P_2 - z^3D_3$	3953.08	
3965.31	186	He I (5)	$2s\ ^1S_0 - 4p\ ^1P_1$	3965.85	rd sh, Not in 98
		Fe II (29)	$b^4P_{1/2} - z^4P_{1/2}$	3965.70	
		Cr II (10)	$a^4P_{3/2} - z^6F_{5/2}$	3965.70	
3967.93	485	[Ne III] (1F)	$2p^4\ ^3P_1 - 2p^4\ ^1D_2$	3968.58	Not in 98
3970.06	3224	Hϵ		3971.19	rd sh
		Fe II (3)	$a^4P_{3/2} - z^6D_{5/2}$	3970.50	
		Fe II (3)	$a^4P_{5/2} - z^6D_{7/2}$	3970.52	
3974.61	680	Fe II (29)	$b^4P_{3/2} - z^4P_{5/2}$	3975.29	
3978.14	12	V II (10)	$a^3P_2 - z^3D_2$	3978.86	
3980.06	35	Cr II (183)	$c^2D_{5/2} - y^2F_{7/2}$	3980.63	
3982.16		Fe II (3)	$a^4P_{1/2} - z^6D_{3/2}$	3982.73	
3986.26	0.2	Cr II (10)	$a^4P_{5/2} - z^6F_{3/2}$	3986.82	
3988.15	6	Ti II (11)	$a^2F_{7/2} - z^4G_{9/2}$	3988.73	
3993.63	484	[Ni II] (3F)	$a^2D_{5/2} - b^2D_{5/2}$	3994.19	
3995.52	45	N II (12)	$3s\ ^1P_1 - 3p\ ^1D_2$	3996.13	Not in 98
3997.60	31	V II (9)	$a^3P_2 - z^5F_3$	3998.25	
4002.70	100	Fe II (29)	$b^4P_{1/2} - z^4P_{3/2}$	4003.21	
4003.7	62	V II (10)	$a^3P_1 - z^3D_1$	4004.07	
		Cr II (194)	$d^2G_{7/2} - w^2H_{9/2}$	4004.41	
4006.19	55	V II (32)	$a^3G_5 - z^3G_5$	4006.84	
4008.77	18	[Fe III] (4F)	$3d^6\ ^5D_4 - 3d^6\ ^3G_4$	4009.48	Not in 98
		V II (32)	$a^3G_3 - z^3G_4$	4009.30	
4009.76	412	He I (55)	$2p\ ^1P_1 - 7d\ ^1D_2$	4010.39	Not in 98
4011.67	10	[Fe II] (9F)	$a^6D_{3/2} - b^2P_{3/2}$	4012.04	?id; ?wl
4012.99	63	Ti II (11)	$a^2F_{5/2} - z^4G_{5/2}$	4013.52	
		Cr II (183)	$c^2D_{3/2} - y^2F_{5/2}$	4013.63	
4016.02	28	Ni II (12)	$a^2G_{7/2} - z^2D_{5/2}$	4016.61	
4017.87	17	[Fe II] (24F)	$a^4F_{7/2} - a^2F_{7/2}$	4018.51	
4026.76	537	He I (18)	$2p\ ^3P - 5d\ ^3D$	4027.33	
4028.91	53	Ti II (87)	$b^2G_{9/2} - y^2F_{7/2}$	4029.48	
4033.73	160	[Ni II] (4F)	$a^2D_{5/2} - a^4P_{3/2}$	4034.18	
		Fe II (126)	$b^2D_{5/2} - z^4G_{5/2}$	4034.08	
4036.19	21	V II (32)	$a^3G_3 - z^3G_3$	4036.77	
4037.32		V II (9)	$a^3P_2 - z^5F_2$	4037.92	
4038.60	21	Cr II (194)	$d^2G_{9/2} - w^2H_{11/2}$	4039.11	
4042.09	20	[Ti II] (11F)	$a^4F_{7/2} - c^2D_{3/2}$	4042.80	
4046.53	42	[Co II]	$a^5F_3 - a^3D_1$	4047.25	
4049.70	36	Cr II (193)	$d^2G_{7/2} - w^2F_{5/2}$	4050.24	
		[Fe II]	$a^4P_{5/2} - c^2D_{5/2}$	4050.26	
4052.61	32	Cr II (18)	$b^4D_{7/2} - z^4P_{5/2}$	4053.07	
4054.46	63	Ti II (87)	$b^2G_{7/2} - y^2F_{5/2}$	4054.98	
		Cr II (18)	$b^4D_{5/2} - z^4P_{5/2}$	4055.22	
4056.86	6	Ti II (11)	$a^2F_{7/2} - z^4G_{5/2}$	4057.33	
4057.8	6	Unidentified			
4064.44	13	Cr II (19)	$b^4D_{5/2} - z^6D_{7/2}$	4065.21	
4065.65	16	Fe II (39)	$b^4F_{3/2} - z^4P_{1/2}$	4065.90	
		V II (215)	$d^3F_4 - x^3G_5$	4066.22	?id
4067.44	164	Ni II (11)	$a^2G_{9/2} - z^2F_{7/2}$	4068.18	
4068.91	1532	[S II] (1F)	$3p^3\ ^4S_{3/2} - 3p^3\ ^2P_{3/2}$	4069.75	?wl
4076.76	282	[S II] (1F)	$3p^3\ ^4S_{3/2} - 3p^3\ ^2P_{1/2}$	4077.50	
4080.35	57	[Fe II] (24F)	$a^4F_{3/2} - a^2F_{5/2}$	4081.14	?wl
4082.54	37	[Fe II]	$a^4P_{3/2} - c^2D_{5/2}$	4083.13	
4084.4	101	[Fe II] (23F)	$a^4F_{9/2} - b^2H_{9/2}$	4084.93	
		[Fe II] (24F)	$a^4F_{5/2} - a^2F_{7/2}$	4085.47	
4089.3 ?	23	Fe II (39)	$b^4F_{5/2} - z^4P_{3/2}$	4089.91	
		Cr II (19)	$b^4D_{3/2} - z^6D_{1/2}$	4089.99	
4100–10		Hδ		4102.89	rd sh
4111.38	47	Cr II (26)	$b^4P_{3/2} - z^4D_{5/2}$	4112.15	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
		Cr II (19)	$b^4D_{7/2} - z^6D_{5/2}$	4112.16	
4115.01	495	[Fe II] (23F)	$a^4F_{9/2} - b^2H_{11/2}$	4115.63	
4120.5		[Co II]	$a^3F_2 - c^3P_0$	4121.28	?id
4121.3		He I (16)	$2p\ ^3P - 5s\ ^3S$	4121.98	Not in 98
4123.17	305	Fe II (28)	$b^4P_{5/2} - z^4F_{5/2}$	4123.83	
4125.31	77	Fe II (22)	$a^2D2_{5/2} - z^4F_{5/2}$	4125.95	
		[Co II]	$a^5P_3 - a^5D_1$	4125.89	
4128.74	397	Mn II (2)	$a^5D_4 - z^7P_3$	4129.29	
4129.3		Fe II (27)	$b^4P_{5/2} - z^4D_{3/2}$	4129.91	
4138.90	28	Fe II (39)	$b^4F_{7/2} - z^4P_{5/2}$	4139.57	
4144.61	284	He I (53)	$2p\ ^1P_1 - 6d\ ^1D_2$	4144.93	
4146.33	16	Cr II (162)	$b^2D_{5/2} - z^2D_{5/2}$	4146.95	
4147.6	64	[Fe II] (21F)	$a^4F_{9/2} - a^4G_{7/2}$	4147.82	
		[Ni II] (10F)	$a^4F_{9/2} - a^2G_{9/2}$	4148.41	
4153.21	290	[Co II]	$a^3F_4 - b^3P_2$	4153.76	
4158.5	21	[Fe II] (37F)	$a^4D_{7/2} - b^2F_{7/2}$	4159.08	
4161.21	21	Fe II (39)	$b^4F_{5/2} - z^4P_{5/2}$	4161.80	
4162.00?	8	Ti II (21)	$a^2D_{5/2} - z^4D_{7/2}$	4162.71	
4164.20	108	Ti II (105)	$b^2F_{7/2} - x^2D_{5/2}$	4164.82	
4172.48	57	Ti II (105)	$b^2F_{5/2} - x^2D_{3/2}$	4173.09	
		Cr II (18)	$b^4D_{3/2} - z^4P_{3/2}$	4173.08	
4174.02	964	Fe II (27)	$b^4P_{5/2} - z^4D_{5/2}$	4174.64	
4177.92	1043	[Fe II] (21F)	$a^4F_{9/2} - a^4G_{9/2}$	4178.37	
		Fe II (21)	$a^2D_{5/2} - z^4D_{7/2}$	4178.87	
4179.41	2127	Fe II (28)	$b^4P_{5/2} - z^4F_{7/2}$	4180.03	
4188.39	36	Ni II (10)	$a^2G_{9/2} - z^2G_{7/2}$	4189.03	
4190.11	20	Unidentified			Not in 98
4190.90	24	Ti II (21)	$a^2D_{5/2} - z^4D_{3/2}$	4191.41	
		V II (25)	$a^5P_1 - z^5D_2$	4191.59	
4192.66	36	Ni II (10)	$a^2G_{7/2} - z^2G_{7/2}$	4193.25	
4198.31	22	[Fe II] (22F)	$a^4F_{3/2} - b^2P_{1/2}$	4198.98	
4198.8		[Fe IV]	$3d^5\ ^4G_{11/2} - 3d^5\ ^2H_{9/2}$	4199.4	Not in 98
4201.83	497	[Ni II] (3F)	$a^2D_{5/2} - b^2D_{3/2}$	4202.35	
4204.9	8	V II (25)	$a^5P_3 - z^5D_3$	4205.40	
4205.91	56	Mn II (2)	$a^5D_3 - z^7P_2$	4206.57	
		V II (37)	$b^3G_4 - z^3F_3$	4206.27	
4207.15	48	[Fe IV]	$3d^5\ ^4G_{9/2} - 3d^5\ ^2H_{9/2}$	4207.8	Not in 98
4207.86	13	Mn II (2)	$a^5D_2 - z^7P_3$	4208.42	
4209.35	23	[Fe IV]	$3d^5\ ^4G_{7/2} - 3d^5\ ^2H_{9/2}$	4210.1	Not in 98
4211.7	181	[Fe II] (23F)	$a^4F_{7/2} - b^2H_{11/2}$	4212.29	
4214.00	15	Unidentified			Not in 99
4215.25	19	N I (5)	$3s\ ^4P_{3/2} - 4p\ ^4P_{5/2}$	4215.99	
		[Co II]	$a^3F_2 - c^3P_1$	4215.79	?id
4216.61	12	N I (5)	$3s\ ^4P_{1/2} - 4p\ ^4P_{3/2}$	4217.28	
		Cr II (18)	$b^4D_{1/2} - z^4P_{1/2}$	4216.92	
4217.68	7	Cr II (18)	$b^4D_{3/2} - z^4P_{1/2}$	4218.24	
		[Co II]	$a^5P_2 - a^5D_2$	4218.23	
4218.79	5	Unidentified			Not in 98
4223.08	7	Unidentified			Not in 98
4223.99	8	[Co II]	$a^5P_1 - a^5D_1$	4224.74	Not in 98
4225.61	61	N I (5)	$3s\ ^4P_{3/2} - 4p\ ^4P_{1/2}$	4226.07	
		V II (37)	$b^3G_3 - z^3F_2$	4226.41	
4226.88	24	Unidentified			Not in 98
4227.69	21	Fe II (45)	$a^6S_{5/2} - z^4P_{5/2}$	4228.36	Not in 98
4233.72	3625	Fe II (27)	$b^4P_{5/2} - z^4D_{7/2}$	4234.36	rd sh
4237.4 ?		V II (18)	$b^3F_4 - z^3D_3$	4238.00	Not in 98 id?
4238.3 ?		Mn II (6)	$a^5F_1 - z^5F_2$	4239.06	Not in 98 id?
4239.3 ?		Cr II (17)	$b^4D_{5/2} - z^6P_{7/2}$	4239.92	
		Mn II (2)	$a^5D_2 - z^7P_2$	4239.98	
4243.02	68	Cr II (31)	$a^4F_{9/2} - z^4D_{7/2}$	4243.56	
4244.60	4378	[Fe II] (21F)	$a^4F_{9/2} - a^4G_{11/2}$	4245.16	rd sh
4245.4	1223	[Fe II] (21F)	$a^4F_{7/2} - a^4G_{7/2}$	4246.01	
4249.49	267	[Ni II] (3F)	$a^2D_{3/2} - b^2D_{5/2}$	4250.00	
		[Fe II] (36F)	$a^4D_{7/2} - b^4D_{7/2}$	4250.28	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
4252.02	28	[Fe II] (23F)	$a^4F_{5/2} - b^2H_{9/2}$	4252.64	
4253.21	17	Cr II (31)	$a^4F_{5/2} - z^4D_{5/2}$	4253.83	
4255.22	11	N I (6)	$3s\ ^4P_{3/2} - 4p\ ^4D_{5/2}$	4255.93	
4256.60	11	Cr II (192)	$d^2G_{9/2} - w^2G_{9/2}$	4257.31	
4258.74	264	Fe II (28)	$b^4P_{3/2} - z^4F_{3/2}$	4259.35	
4262.63	190	Cr II (31)	$a^4F_{7/2} - z^4D_{5/2}$	4263.11	
4267.00	79	[Fe II] (36F)	$a^4D_{7/2} - b^4D_{5/2}$	4267.55	
4269.8	15	Cr II (31)	$a^4F_{3/2} - z^4D_{3/2}$	4270.48	
4273.86	214	Fe II (27)	$b^4P_{3/2} - z^4D_{1/2}$	4274.53	
4276.2	126	Cr II (31)	$a^4F_{5/2} - z^4D_{3/2}$	4276.77	
4277.43	2707	[Fe II] (21F)	$a^4F_{7/2} - a^4G_{9/2}$	4278.03	rd sh
4282.99	52	[Mn II] (6F)	$a^5S_2 - b^5D_0$	4283.51	
4284.74	42	Cr II (31)	$a^4F_{3/2} - z^4D_{1/2}$	4285.39	
4287.95	6470	[Fe II] (7F)	$a^6D_{9/2} - a^6S_{5/2}$	4288.60	rd sh
4290.75	150	Ti II (41)	$a^4P_{3/2} - z^4D_{5/2}$	4291.43	
		Ti II	$b^2P_{3/2} - y^2F_{5/2}$	4291.56	
4294.66	201	[Ni II] (4F)	$a^2D_{3/2} - a^4P_{3/2}$	4295.30	
		Ti II (20)	$a^2D_{5/2} - z^2D_{5/2}$	4295.31	
4297.11	657	Fe II (28)	$b^4P_{3/2} - z^4F_{5/2}$	4297.78	
4300.58	204	Ti II (41)	$a^4P_{5/2} - z^4D_{7/2}$	4301.26	
4302.45	113	Ti II (41)	$a^4P_{1/2} - z^4D_{3/2}$	4303.12	
4303.73	882	Fe II (27)	$b^4P_{3/2} - z^4D_{3/2}$	4304.38	
4306.50	856	[Fe II] (21F)	$a^4F_{5/2} - a^4G_{5/2}$	4307.10	
4308.42	142	Ti II (41)	$a^4P_{3/2} - z^4D_{3/2}$	4309.08	
4310.85?	15	[Ni II] (10F)	$a^4F_{7/2} - z^2G_{7/2}$	4311.55	
4313.39	120	Ti II (41)	$a^4P_{5/2} - z^4D_{5/2}$	4314.08	
4314.90	310	Fe II (32)	$a^4H_{9/2} - z^4F_{7/2}$	4315.52	
4315.4	46	[Ni II] (10F)	$a^4F_{7/2} - z^2G_{9/2}$	4316.02	
		Ti II (41)	$a^4P_{1/2} - z^4D_{1/2}$	4316.19	
4320.13	1852	[Fe II] (21F)	$a^4F_{5/2} - a^4G_{7/2}$	4320.84	
4323.74	36	[Co II]	$a^3F_3 - b^3P_2$	4324.49	
4326.82	494	[Ni II] (4F)	$a^2D_{5/2} - a^4P_{5/2}$	4327.45	
4337–46		Hγ		4341.68	rd sh
4347.39	1179	[Fe II] (21F)	$a^4F_{7/2} - a^4G_{11/2}$	4348.07	
4352.34	2349	Fe II (27)	$b^4P_{3/2} - z^4D_{5/2}$	4352.99	
4353.35	1452	[Fe II] (21F)	$a^4F_{5/2} - a^4G_{9/2}$	4354.00	
4358.9	1848	[Fe II] (21F)	$a^4F_{3/2} - a^4G_{5/2}$	4359.58	
4359.90	5126	[Fe II] (7F)	$a^6D_{7/2} - a^6S_{5/2}$	4360.56	rd sh
4365.41	94	Unidentified			
4368.17	27	Ti II (104)	$b^2F_{7/2} - y^2G_{9/2}$	4368.89	
4369.98	157	Fe II (28)	$b^4P_{1/2} - z^4F_{3/2}$	4370.64	
4373.02	981	[Fe II] (21F)	$a^4F_{3/2} - a^4G_{7/2}$	4373.66	
4375.39	6	Ti II (93)	$b^2P_{3/2} - y^2D_{5/2}$	4376.04	
4376.26	4	[Cu II] (1F)	$3d^{10}\ ^1S_0 - 4s\ ^3D_2$	4376.92	
4383.33	467	[Fe II] (6F)	$a^6D_{9/2} - b^4F_{7/2}$	4383.97	
4384.96	460	[Fe II] (36F)	$a^4D_{3/2} - b^4D_{7/2}$	4385.44	
		Fe II (32)	$a^4H_{11/2} - z^4F_{9/2}$	4385.55	
4385.99	1130	Fe II (27)	$b^4P_{1/2} - z^4D_{1/2}$	4386.61	rd sh
4388.48	117	He I (51)	$2p\ ^1P_1 - 5d\ ^1D_2$	4389.16	Not in 98
4394.66	54	Ti II (51)	$a^2P_{1/2} - z^4D_{3/2}$	4395.29	
4395.61	156	Ti II (19)	$a^2D_{5/2} - z^2F_{7/2}$	4396.27	
4396.4	35	Ti II (61)	$b^4P_{5/2} - z^4D_{7/2}$	4397.08	
4400.38	148	Ti II (51)	$a^2P_{3/2} - z^4D_{5/2}$	4401.01	
4403.34	44	[Fe II] (36F)	$a^4D_{3/2} - b^4D_{5/2}$	4403.83	?wl
4405.34	30	V II (30)	$a^3G_5 - z^5F_5$	4405.90	
4410.50	5	[Fe II] (22F)	$a^4F_{3/2} - b^2P_{3/2}$	4411.09	
		[Co II]	$a^3F_2 - b^3P_1$	4411.07	
4411.69?		[Co II]	$a^5P_2 - a^5D_4$	4412.29	?id
4414.37	3562	[Fe II] (7F)	$a^6D_{5/2} - a^6S_{5/2}$	4415.02	
		Fe II (32)	$a^4H_{9/2} - z^4F_{9/2}$	4414.84	
4416.89	4328	[Fe II] (6F)	$a^6D_{9/2} - b^4F_{9/2}$	4417.51	rd sh
		Fe II (27)	$b^4P_{1/2} - z^4D_{3/2}$	4418.07	
4422.5	105	Ti II (94)	$b^2P_{3/2} - z^2P_{3/2}$	4423.18	
4428.1	16	[Fe II]	$a^4P_{3/2} - b^2D_{5/2}$	4428.75	Not in 98

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
4433.03	289	[Fe II] (6F)	$a^6D_{7/2} - b^4F_{5/2}$	4433.69	
4435.80	2	[Fe II] (36F)	$a^4D_{1/2} - b^4D_{5/2}$	4436.33	Not in 99
4438.14	24	He I (50)	$2p\ ^1P_1 - 5s\ ^1S_0$	4438.80	Not in 98
4439.48	4	[Fe II] (36F)	$a^4D_{1/2} - b^4D_{1/2}$	4440.17	
4440.36	5	[Fe II] (36F)	$a^4D_{1/2} - b^4D_{3/2}$	4440.96	Not in 99
4444.39	105	Ti II (19)	$a^2D_{3/2} - z^2F_{5/2}$	4445.04	
4447.52	25	N II (15)	$3p\ ^1P_1 - 3d\ ^1D_2$	4448.28	Not in 98
4451.07	24	Ti II (19)	$a^2D_{5/2} - z^2F_{5/2}$	4451.73	
4452.69	2334	[Fe II] (7F)	$a^6D_{3/2} - a^6S_{5/2}$	4453.35	
4455.85	41	Fe II	$c^4P_{5/2} - w^4D_{7/2}$	4456.52	?id
4458.54	1899	[Fe II] (6F)	$a^6D_{7/2} - b^4F_{7/2}$	4459.20	
4462.07	75	[Ni II] (10F)	$a^4F_{5/2} - z^2G_{7/2}$	4462.72	
4469.17	134	Ti II (31)	$a^2G_{9/2} - z^2F_{7/2}$	4469.70	
4471.04	1373	[Fe II] (6F)	$a^6D_{5/2} - b^4F_{3/2}$	4471.55	?wl
4472.04	1231	He I (14)	$2p\ ^3P - 4d\ ^3D$	4472.73	Not in 98
4473.54	118	Fe II (37)	$b^4F_{5/2} - z^4F_{3/2}$	4474.18	
4475.50	1110	[Fe II] (7F)	$a^6D_{1/2} - a^6S_{5/2}$	4476.16	
4479.80	73	[Fe II]	$a^2G_{9/2} - c^2D_{5/2}$	4480.38	
4481.45	16	Fe II	$c^4P_{5/2} - w^4D_{3/2}$	4481.94	?id
		Mg II (4)	$3d\ ^2D_{5/2} - 4f\ ^2F_{7/2}$	4482.38	
		Mg II (4)	$3d\ ^2D_{5/2} - 4f\ ^2F_{5/2}$	4482.41	
		Mg II (4)	$3d\ ^2D_{3/2} - 4f\ ^2F_{5/2}$	4482.58	
4485.88	186	[Ni II] (3F)	$a^2D_{3/2} - b^2D_{3/2}$	4486.47	
4489.53	1536	[Fe II] (6F)	$a^6D_{5/2} - b^4F_{5/2}$	4490.01	
		Fe II (37)	$b^4F_{7/2} - z^4F_{5/2}$	4490.44	
4492.00	1115	Fe II (37)	$b^4F_{3/2} - z^4F_{3/2}$	4492.67	
4493.23	595	[Fe II] (6F)	$a^6D_{7/2} - b^4F_{9/2}$	4493.89	
4501.82	98	Ti II (31)	$a^2G_{7/2} - z^2F_{5/2}$	4502.54	
4508.86	1431	Fe II (38)	$b^4F_{3/2} - z^4D_{1/2}$	4509.55	
4510.15	336	[Fe II] (6F)	$a^6D_{3/2} - b^4F_{3/2}$	4510.87	
4513.14	59	Unidentified			
4515.5		[Fe II] (6F)	$a^6D_{5/2} - b^4F_{7/2}$	4516.17	
4515.9	2046	Fe II (37)	$b^4F_{5/2} - z^4F_{5/2}$	4516.60	
4520.78	1828	Fe II (37)	$b^4F_{9/2} - z^4F_{7/2}$	4521.49	
4523.2	1580	Fe II (38)	$b^4F_{5/2} - z^4D_{3/2}$	4523.90	
4528.95	187	[Fe II] (6F)	$a^6D_{3/2} - b^4F_{5/2}$	4529.65	
4533.65	68	[Fe II] (6F)	$a^6D_{1/2} - b^4F_{3/2}$	4534.27	
4534.69	448	Ti II (50)	$a^2P_{3/2} - z^2D_{5/2}$	4535.24	
		Fe II (37)	$b^4F_{3/2} - z^4F_{5/2}$	4535.44	
4540.17?	19	Cr II (39)	$a^2F_{5/2} - z^4D_{5/2}$	4540.87	
4542.11	355	Fe II (38)	$b^4F_{3/2} - z^4D_{3/2}$	4542.79	
4550.06	2825	Fe II (38)	$b^4F_{7/2} - z^4D_{5/2}$	4550.75	
4556.47	2605	Fe II (37)	$b^4F_{7/2} - z^4F_{7/2}$	4557.17	
4559.26	405	Cr II (44)	$b^4F_{9/2} - z^4D_{7/2}$	4559.93	
		Cr II (44)	$b^4F_{5/2} - z^4D_{7/2}$	4560.06	
4564.33	111	Ti II (50)	$a^2P_{1/2} - z^2D_{3/2}$	4565.04	
4566.26	24	Cr II (39)	$a^2F_{5/2} - z^4D_{3/2}$	4567.02	
4571.72	191	Mg I (1)	$3s^2\ ^1S_0 - 3p\ ^3P_1$	4572.38	
4572.55	130	Ti II (82)	$a^2H_{9/2} - z^2G_{7/2}$	4573.25	
4577.01	721	Fe II (38)	$b^4F_{5/2} - z^4D_{5/2}$	4577.62	
		[Fe II]	$a^2G_{7/2} - c^2D_{3/2}$	4577.68	
4580.7	101	Fe II (26)	$b^4P_{5/2} - z^6P_{7/2}$	4581.35	
4581.74	410	[Cr II] (3F)	$a^6S_{5/2} - a^4P_{5/2}$	4582.42	
4583.3	460	Fe II (37)	$b^4F_{5/2} - z^4F_{7/2}$	4584.12	
4584.42	4398	Fe II (38)	$b^4F_{9/2} - z^4D_{7/2}$	4585.12	rd sh
4588.77	237	Cr II (44)	$b^4F_{7/2} - z^4D_{5/2}$	4589.48	
4590.4	39	Cr II (44)	$b^4F_{3/2} - z^4D_{5/2}$	4591.19	
		Ti II (50)	$a^2P_{3/2} - z^2D_{3/2}$	4591.24	
4592.65	99	Cr II (44)	$b^4F_{5/2} - z^4D_{5/2}$	4593.34	
4594.24	13	Fe II (44)	$a^6S_{5/2} - z^4F_{5/2}$	4595.11	
		Ni II	$a^2G_{9/2} - z^4G_{7/2}$	4594.93	
4596.54	39	Fe II (28)	$b^4F_{3/2} - z^4D_{5/2}$	4596.97	
		Fe II	$c^4P_{5/2} - w^4P_{5/2}$	4597.30	?id
4597.6	47	[Ni III]	$3d^8\ ^3F_3 - 3d^8\ ^1G_4$	4598.1	Not in 98, ?wl. ?id

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
4601.58	14	Unidentified			Not in 99
4602.08	27	N II (5)	3s $^3P_1$ – 3p $^3P_2$	4602.77	Not in 98
		Fe II (43)	$a^6S_{5/2}$ – $z^4D_{3/2}$	4602.67	
4607.71	134	[Fe III] (3F)	$3d^6$ $^5D_4$ – $3d^6$ $^3F2_3$	4608.32	Not in 98
4614.62	24	N II (5)	3s $^3P_1$ – 3p $^3P_1$	4615.16	Not in 98
4617.27	103	Cr II (44)	$b^4F_{3/2}$ – $z^4D_{3/2}$	4617.92	
4619.49	184	Cr II (44)	$b^4F_{5/2}$ – $z^4D_{3/2}$	4620.10	
4621.14	267	Fe II (38)	$b^4F_{7/2}$ – $z^4D_{7/2}$	4621.81	
4623.76	225	[Co II]	a^3F_4 – a^3G_5	4624.35	
4628.8	297	[Ni II] (4F)	$a^2D_{3/2}$ – $a^4P_{5/2}$	4629.34	
4629.98	2884	Fe II (37)	$b^4F_{9/2}$ – $z^4F_{9/2}$	4630.64	rd sh
4634.76	98	Cr II (44)	$b^4F_{3/2}$ – $z^4D_{1/2}$	4635.37	
4635.91	46	Fe II	$d^2D2_{5/2}$ – $y^2F_{7/2}$	4636.61	
4640.33	950	[Fe II] (4F)	$a^6D_{3/2}$ – $b^4P_{1/2}$	4640.97	
4643.54	17	N II (5)	3s $^3P_2$ – 3p $^3P_1$	4644.39	Not in 98
4649.59	51	Fe II (25)	$b^4P_{5/2}$ – $z^6F_{5/2}$	4650.25	
4652.37	12	N I	3s $^2P_{1/2}$ – 4p $^2P_{3/2}$	4653.12	Not in 99
4657.69	268	Fe II (43)	$a^6S_{5/2}$ – $z^4D_{5/2}$	4658.29	
4658.3		[Co II]	a^3F_3 – a^3G_3	4658.94	
4658.72	1732	[Fe III] (3F)	$3d^6$ $^5D_4$ – $3d^6$ $^3F2_4$	4659.35	Not in 98
4661.13	259	N I	3s $^2P_{1/2}$ – 4p $^2P_{1/2}$	4661.76	
4664.4	74	Fe II (44)	$a^6S_{5/2}$ – $z^4F_{7/2}$	4665.01	
4665.08	288	[Fe II] (4F)	$a^6D_{1/2}$ – $b^4P_{1/2}$	4665.75	
4667.38	527	Fe II (37)	$b^4F_{7/2}$ – $z^4F_{9/2}$	4668.06	
		[Fe III] (3F)	$3d^6$ $^5D_3$ – $3d^6$ $^3F2_2$	4668.32	
4670.71	253	N I	3s $^2P_{3/2}$ – 4p $^2P_{3/2}$	4671.20	
		Fe II (25)	$b^4P_{5/2}$ – $z^6F_{7/2}$	4671.49	
4679.17	27	N I	3s $^2P_{3/2}$ – 4p $^2P_{1/2}$	4679.90	
4680.70?	12	Cr II (25)	$b^4P_{3/2}$ – $z^4F_{5/2}$	4681.20	?wl
4688.18	15	[Fe II] (5F)	$a^6D_{7/2}$ – $a^4H_{7/2}$	4688.86	Not in 98
4698.17	36	Cr II	$c^2D_{5/2}$ – $y^4F_{5/2}$	4698.91	Not in 98, ?id
4702.20	751	[Fe III] (3F)	$3d^6$ $^5D_3$ – $3d^6$ $^3F2_3$	4702.85	Not in 98
4713.75	399	He I (12)	2p ^3P – 4s ^3S	4714.47	
4716.9 ?	8	[Fe II] (5F)	$a^6D_{7/2}$ – $a^4H_{9/2}$	4717.68	
		[Cr II]	$a^6D_{9/2}$ – $b^4G_{11/2}$	4717.49	?id
4719.15	9	Unidentified			
4720.73	14	Fe II (54)	$b^2P_{3/2}$ – $z^4P_{5/2}$	4721.47	
4728.71	2271	[Fe II] (4F)	$a^6D_{5/2}$ – $b^4P_{3/2}$	4729.39	
4732.07	357	Fe II (43)	$a^6S_{5/2}$ – $z^4D_{7/2}$	4732.78	
4734.48	229	[Fe III] (3F)	$3d^6$ $^5D_2$ – $3d^6$ $^3F2_2$	4735.23	Not in 98
4737.91	27	Unidentified			Not in 98
4746.11	66	[Fe II] (20F)	$a^4F_{9/2}$ – $b^4F_{5/2}$	4746.81	
4747.86	180	[Co II]	a^3F_3 – a^3G_4	4748.57	
4755.32	401	[Fe III] (3F)	$3d^6$ $^5D_3$ – $3d^6$ $^3F2_4$	4756.02	rd sh, Not in 98
4770.04	248	[Fe III] (3F)	$3d^6$ $^5D_2$ – $3d^6$ $^3F2_3$	4770.76	rd sh, Not in 98
4772.65	114	[Fe II] (4F)	$a^6D_{3/2}$ – $b^4P_{3/2}$	4773.40	
4775.33	907	[Fe II] (20F)	$a^4F_{9/2}$ – $b^4F_{7/2}$	4776.05	
4778.26	84	[Fe III] (3F)	$3d^6$ $^5D_1$ – $3d^6$ $^3F2_2$	4779.02	Not in 98
4780.55	18	Ti II (92)	$b^2P_{1/2}$ – $z^2S_{1/2}$	4781.32	
		[Fe II] (5F)	$a^6D_{5/2}$ – $a^4H_{9/2}$	4781.50	
4798.89	348	[Fe II] (4F)	$a^6D_{1/2}$ – $b^4P_{3/2}$	4799.62	
4802.97	192	[Co II]	a^3F_2 – a^3G_3	4803.70	
4805.67	45	Ti II (92)	$b^2P_{3/2}$ – $z^2S_{1/2}$	4806.43	
4813.04	29	Cr II (30)	$a^4F_{7/2}$ – $z^4F_{9/2}$	4813.68	
4815.17	3407	[Fe II] (20F)	$a^4F_{9/2}$ – $b^4F_{9/2}$	4815.88	rd sh
4824.80	344	Cr II (30)	$a^4F_{9/2}$ – $z^4F_{9/2}$	4825.47	
4826.41	81	Fe II (30)	$a^4H_{13/2}$ – $z^6F_{11/2}$	4827.08	
4833.80	93	Fe II (30)	$a^4H_{11/2}$ – $z^6F_{9/2}$	4834.55	
4836.73	52	Cr II (30)	$a^4F_{5/2}$ – $z^4F_{7/2}$	4837.58	
4840.60	19	Fe II (30)	$a^4H_{9/2}$ – $z^6F_{7/2}$	4841.35	
4848.87	229	Cr II (30)	$a^4F_{7/2}$ – $z^4F_{7/2}$	4849.59	
4853.24	161	[Fe II] (20F)	$a^4F_{7/2}$ – $b^4F_{3/2}$	4854.08	
4855–70		Hβ		4862.68	rd sh
4871.74	71	Fe II (25)	$b^4P_{3/2}$ – $z^6F_{5/2}$	4872.64	

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{\rm lab,vac}$ (Å)	Comment
		[V II] (8F)	$a^5D_0 - b^3D_1$	4872.79	
4875.12	1029	[Fe II] (20F)	$a^4F_{7/2} - b^4F_{5/2}$	4875.85	
4877.07	96	Cr II (30)	$a^4F_{3/2} - z^4F_{3/2}$	4877.76	
		Cr II (30)	$a^4F_{7/2} - z^4F_{5/2}$	4877.83	
4879.37	33	Unidentified			
4882.3	47	[Fe III] (2F)	$3d^6\ ^5D_4 - 3d^6\ ^3H_4$	4882.36	Not in 98
4885.13	17	Cr II (30)	$a^4F_{5/2} - z^4F_{3/2}$	4885.97	
4890.27	3202	[Fe II] (4F)	$a^6D_{7/2} - b^4P_{5/2}$	4890.98	
		[Fe II] (3F)	$a^6D_{3/2} - a^2D2_{3/2}$	4891.07	
4894.45?	41	Fe II (35)	$b^4F_{7/2} - z^6P_{5/2}$	4895.19	Not in 98
4896.8 ?	16	Cr II (190)	$d^2G_{7/2} - x^2G_{9/2}$	4897.42	
4899.25	561	[Fe II]	$a^2G_{9/2} - b^2D_{5/2}$	4899.97	
		[V II] (8F)	$a^5D_3 - b^3D_2$	4900.01	
4900.6 ?	29	[Fe IV]	$3d^5\ ^4G_{9/2} - 3d^5\ ^4F_{7/2}$	4901.3	Not in 98
4902.11	39	[Mn II]	$a^5S_2 - a^3P_2$	4902.80	?id
		Cr II (190)	$d^2G_{9/2} - x^2G_{9/2}$	4902.99	
4903.79	29	[Fe IV]	$3d^5\ ^4G_{7/2} - 3d^5\ ^4F_{7/2}$	4904.4	Not in 98
4905.99	1608	[Fe II] (20F)	$a^4F_{7/2} - b^4F_{7/2}$	4906.71	
4907.2	75	[Fe IV]	$3d^5\ ^4G_{11/2} - 3d^5\ ^4F_{9/2}$	4907.9	Not in 98
4911.88	32	Ti II (114)	$c^2D_{5/2} - y^2P_{3/2}$	4912.56	
4912.95?	11	Cr II (190)	$d^2G_{7/2} - x^2G_{7/2}$	4913.83	
4915.53	12	N I (9)	$3s\ ^2P_{1/2} - 4p\ ^2S_{1/2}$	4916.31	
4917.47	50	[Ti II] (23F)	$a^2F_{5/2} - c^2D_{3/2}$	4918.25	
4922.52	333	He I (48)	$2p\ ^1P_1 - 4d\ ^1D_2$	4923.30	Not in 98
4924.55	4490	Fe II (42)	$a^6S_{5/2} - z^6P_{3/2}$	4925.30	bl rd sh
4931.12	275	[Fe III] (1F)	$3d^6\ ^5D_1 - 3d^6\ ^3P2_0$	4931.91	rd sh, Not in 98
4935.63	63	N I (9)	$3s\ ^2P_{3/2} - 4p\ ^2S_{1/2}$	4936.49	
4941.9	23	Cr II (36)	$a^2D_{5/2} - z^4F_{3/2}$	4942.36	Not in 98 id?
4945.68	7	Fe II	$(^5D)4d\ e^6F_{3/2} - (^5D_2)4f\ ^2[1]_{1/2}$	4946.44	?E_u
4948.04	495	[Fe II] (20F)	$a^4F_{7/2} - b^4F_{9/2}$	4948.75	
4951.40	702	[Fe II] (20F)	$a^4F_{5/2} - b^4F_{3/2}$	4952.12	
4954.00	14	Unidentified			
4956.82	19	Unidentified			Not in 98
4958.97	42	[Fe II] (4F)	$a^6D_{5/2} - b^4P_{5/2}$	4959.60	
4966.44	69	[Fe II] (3F)	$a^6D_{7/2} - a^2D2_{5/2}$	4967.17	
4967.1	24	[Mn II]	$a^5D_2 - b^3G_4$	4967.82	?id
4970.0?	10	Fe II	$(^5D)4d\ e^6F_{1/2} - (^5D_2)4f\ ^2[1]_{1/2}$	4970.75	?E_u
4974.05	838	[Fe II] (20F)	$a^4F_{5/2} - b^4F_{5/2}$	4974.78	
4977.59	31	Fe II	$(^5D)4d\ e^6F_{1/2} - (^5D_2)4f\ ^2[2]_{3/2}$	4978.42	?E_u
4980.6	14	Unidentified			
4983.7	19	Unidentified			
4985.19	46	Fe II	$(^5D)4d\ ^6D_{3/2} - (^5D_0)4f\ ^2[3]_{5/2}$	4985.97	?E_u
4988.07	18	[Fe III]	$3d^6\ ^5D_3 - 3d^6\ ^3H_4$	4988.60	Not in 98 id?
		N II (24)	$3p\ ^3S_1 - 3d\ ^3P_0$	4988.77	
4991.2	28	Fe II	$(^5D)4d\ e^6F_{5/2} - (^5D_3)4f\ ^2[4]_{7/2}$	4991.90	?E_u
4991.75	41	Fe II (25)	$b^4P_{1/2} - z^6F_{1/2}$	4992.52	
4994.05	86	Fe II (36)	$b^4F_{9/2} - z^6P_{7/2}$	4994.75	
4995.0	16	N II (24)	$3p\ ^3S_1 - 3d\ ^3P_1$	4995.76	
4997.14?	2	Ti II (71)	$b^2D_{5/2} - z^4D_{7/2}$	4997.76	Not in 99 id?
5001.73	172	Fe II (25)	$b^4P_{1/2} - z^6F_{3/2}$	5002.14	
		N II (19)	$3p\ ^3D_1 - 3d\ ^3F_2$	5002.53	
		N II (19)	$3p\ ^3D_2 - 3d\ ^3F_3$	5002.87	
5006.17	630	[Fe II] (20F)	$a^4F_{5/2} - b^4F_{7/2}$	5006.91	
5007.26	466	[Fe II] (4F)	$a^6D_{3/2} - b^4P_{5/2}$	5008.02	
5009.64	126	Fe II	$(^5D)4d\ e^6F_{3/2} - (^5D_3)4f\ ^2[0]_{1/2}$	5010.42	Not in 99 E_u?
5011.89	583	[Fe III] (1F)	$3d^6\ ^5D_2 - 3d^6\ ^3P2_1$	5012.66	Not in 98
5016.23	1196	He I (4)	$2s\ ^1S_0 - 3p\ ^1P_1$	5017.08	Not in 98
5019.05	6600	Fe II (42)	$a^6S_{5/2} - z^6P_{5/2}$	5019.84	bl rd sh
5020.92	796	[Fe II] (20F)	$a^4F_{3/2} - b^4F_{3/2}$	5021.63	
5023.10	19	Fe II	$(^5D)4d\ e^6F_{3/2} - (^5D_3)4f\ ^2[3]_{5/2}$	5023.82	?E_u
5027.40	14	Fe II	$(^5D)4d\ e^6F_{7/2} - (^5D_4)4f\ ^2[2]_{5/2}$	5028.21	?E_u
5028.33	15	[Fe II]	$a^2G_{7/2} - b^2D_{5/2}$	5029.28	
5031.32	62	Fe II	$(^5D)4d\ e^6F_{9/2} - (^5D_4)4f\ ^2[5]_{9/2}$	5032.03	?E_u
5033.11	32	[Fe IV]	$3d^5\ ^4G_{5/2} - 3d^5\ ^2F2_{5/2}$	5033.8	Not in 98

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
		[Fe III]	$3d^6\ ^5D_3 - 3d^6\ ^3H_5$	5034.08	?id
		Fe II	$(^5D)4d\ ^6D_{5/2} - (^5D_2)4f\ ^2[3]_{7/2}$	5034.11	?E_u
5034.10	64	[Fe IV]	$3d^5\ ^4G_{7/2} - 3d^5\ ^2F2_{5/2}$	5035.0	Not in 98
5036.12	43	[Fe II] (4F)	$a^6D_{1/2} - b^4P_{5/2}$	5036.89	
		Fe II	$(^5D)4d\ e^6F_{9/2} - (^5D_4)4f\ ^2[5]_{11/2}$	5037.11	?E_u
5037.50	20	Fe II (36)	$b^4F_{7/2} - z^6P_{7/2}$	5038.32	
		[Fe II] (3F)	$a^6D_{5/2} - a^2D2_{5/2}$	5037.97	
		Fe II	$(^5D)4d\ ^6D_{5/2} - (^5D_2)4f\ ^2[2]_{5/2}$	5038.12	?E_u
5041.67	156	Si II (5)	$4p\ ^2P_{1/2} - 4d\ ^2D_{3/2}$	5042.43	
5044.19	418	[Fe II] (20F)	$a^4F_{3/2} - b^4F_{5/2}$	5044.93	
5045.59	57	N II (4)	$3s\ ^3P_2 - 3p\ ^3S_1$	5046.51	
		Fe II	$(^5D)4d\ e^6F_{7/2} - (^5D_4)4f\ ^2[3]_{5/2}$	5046.52	?E_u
5048.73	326	He I (47)	$2p\ ^1P_1 - 4s\ ^1S_0$	5049.15	
		[Ti II] (19F)	$b^4F_{7/2} - b^2F_{7/2}$	5049.40	
		[Fe II]	$a^2P_{3/2} - c^2D_{5/2}$	5049.60	
5056.64	214	Si II (5)	$4p\ ^2P_{3/2} - 4d\ ^2D_{5/2}$	5057.39	
		Si II (5)	$4p\ ^2P_{3/2} - 4d\ ^2D_{3/2}$	5057.73	
5060.78	339	[Fe II]	$a^2G_{7/2} - b^2D_{3/2}$	5061.49	
5062.28	41	Fe II	$(^5D)4d\ e^6F_{7/2} - (^5D_4)4f\ ^2[4]_{7/2}$	5063.13	?E_u
5065.90	18	Fe II	$(^5D)4d\ ^6D_{1/2} - (^5D_1)4f\ ^2[2]_{3/2}$	5066.51	?E_u
5066.92	5	Unidentified			
5068.57	41	Fe II	$(^5D)4d\ e^6F_{5/2} - (^5D_4)4f\ ^2[2]_{3/2}$	5069.31	?E_u
5071.49	53	Fe II	$(^5D)4d\ e^6F_{7/2} - (^5D_4)4f\ ^2[5]_{9/2}$	5072.31	?E_u
5073.10	270	[Fe II] (19F)	$a^4F_{9/2} - a^4H_{9/2}$	5073.81	
5074.81	7	Fe II (205)	$d^2F_{7/2} - x^2D_{5/2}$	5075.47	
5075.81	10	Unidentified			
5076.48	14	Fe II	$(^5D)4d\ ^6P_{5/2} - (^5D_0)4f\ ^2[3]_{7/2}$	5077.18	?E_u
5077.63	8	Unidentified			
5079.09	8	Fe II	$(^5D)4d\ ^6D_{3/2} - (^5D_2)4f\ ^2[1]_{1/2}$	5079.71	?E_u
5080.30	10	Unidentified			
5081.54	5	[Ti II] (19F)	$b^4F_{9/2} - b^2F_{7/2}$	5082.38	Not in 99
5082.89	19	Fe II	$(^5D)4d\ ^6D_{7/2} - (^5D_3)4f\ ^2[3]_{7/2}$	5083.32	?E_u
		Fe II	$(^5D)4d\ ^6D_{3/2} - (^5D_2)4f\ ^2[2]_{5/2}$	5083.65	?E_u
5084.51	59	[Fe II] (35F)	$a^4D_{7/2} - a^2F_{5/2}$	5085.15	
5085.44	130	[Fe III] (1F)	$3d^6\ ^5D_0 - 3d^6\ ^3P2_1$	5086.19	Not in 98
5087.7	12	Fe II	$(^5D)4d\ ^6D_{3/2} - (^5D_2)4f\ ^2[2]_{3/2}$	5087.72	?E_u
		[Fe II] (3F)	$a^6D_{3/2} - a^2D2_{5/2}$	5087.93	
		Fe II	$a^2F_{7/2} - z^4P_{5/2}$	5088.41	?id
5089.93	60	Fe II	$(^5D)4d\ e^6F_{5/2} - (^5D_4)4f\ ^2[3]_{5/2}$	5090.63	?E_u
5094.10	37	Fe II (205)	$d^2F_{5/2} - x^2D_{3/2}$	5094.88	
		Fe II	$(^5D)4d\ ^6D_{7/2} - (^5D_3)4f\ ^2[4]_{7/2}$	5095.00	?E_u
		Fe II	$(^5D)4d\ ^6D_{9/2} - (^5D_3)4f\ ^2[5]_{9/2}$	5095.00	?E_u
5098.03	34	Fe II	$(^5D)4d\ ^6D_{7/2} - (^5D_3)4f\ ^2[4]_{9/2}$	5098.69	?E_u
		Cr II (24)	$b^4P_{1/2} - z^6D_{3/2}$	5098.73	
5101.30	181	Fe II (35)	$b^4F_{9/2} - z^6F_{7/2}$	5102.09	
5102.86	11	Unidentified			
5104.22	9	Unidentified			Not in 98
5104.99	9	N II (34)	$3p\ ^1S_0 - 4s\ ^1P_1$	5105.87	Not in 98
		Cr II (38)	$a^2F_{7/2} - z^4F_{9/2}$	5105.42	
5106.8	31	Fe II	$(^5D)4d\ ^6D_{5/2} - (^5D_3)4f\ ^2[2]_{3/2}$	5107.52	?E_u
		Fe II	$(^5D)4d\ e^6F_{5/2} - (^5D_4)4f\ ^2[4]_{7/2}$	5107.53	?E_u
5108.55	538	[Fe II] (18F)	$a^4F_{5/2} - b^4P_{1/2}$	5109.37	
5112.24	1250	[Fe II] (19F)	$a^4F_{9/2} - a^4H_{11/2}$	5113.05	rd sh
5114.83	28	[Co II]	$a^1D_2 - b^1D_2$	5115.60	
5117.7	25	[Fe III]	$3d^6\ ^3F2_4 - 3d^54s\ ^5S_2$	5118.32	Not in 98 id?
		Fe II	$(^5D)4d\ ^6D_{1/2} - (^5D_2)4f\ ^2[1]_{3/2}$	5118.46	?E_u
5120.96	42	Fe II (35)	$b^4F_{7/2} - z^6F_{5/2}$	5121.78	
5128.42	5	Fe II (167)	$c^2F_{5/2} - z^2F_{5/2}$	5129.29	Not in 99
5129.74	39	Ti II (86)	$b^2G_{9/2} - z^2G_{9/2}$	5130.58	
5133.34	250	Fe II (35)	$b^4F_{9/2} - z^6F_{9/2}$	5134.10	
5137.48	72	Fe II (35)	$b^4F_{5/2} - z^6F_{3/2}$	5138.23	
5141.06	15	Fe II	$(^5D)4d\ ^6D_{3/2} - (^5D_3)4f\ ^2[1]_{1/2}$	5142.12	?E_u; ?wl
5141.86	13	Fe II	$(^5D)4d\ ^6P_{3/2} - (^5D_1)4f\ ^2[2]_{3/2}$	5142.80	?E_u; ?wl
5144.91	36	Fe II	$(^5D)4d\ ^6P_{7/2} - (^5D_2)4f\ ^2[5]_{9/2}$	5145.31	?E_u

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
		Fe II	$(^5D)4d\ ^6P_{3/2} - (^5D_1)4f\ ^2[2]_{5/2}$	5145.79	?E_u
		Cr II (38)	$a^2F_{7/2} - z^4F_{7/2}$	5145.83	
5146.74	192	Fe II (35)	$b^4F_{7/2} - z^6F_{7/2}$	5147.56	
5149.58	22	Fe II	$(^5D)4d\ ^6D_{3/2} - (^5D_3)4f\ ^2[2]_{5/2}$	5150.34	?E_u
		Fe II	$(^5D)4d\ ^6P_{7/2} - (^5D_2)4f\ ^2[4]_{9/2}$	5150.90	?E_u
5151.56	29	Fe II (35)	$b^4F_{3/2} - z^6F_{1/2}$	5152.38	
5154.1	15	Cr II (23)	$b^4P_{3/2} - z^4P_{5/2}$	5154.93	
5154.97	43	Fe II (35)	$b^4F_{5/2} - z^6F_{5/2}$	5155.84	
5158.7	1385	[Fe II] (18F)	$a^4F_{7/2} - b^4P_{3/2}$	5159.44	
5159.44	6749	[Fe II] (19F)	$a^4F_{9/2} - a^4H_{13/2}$	5160.21	
5161.8	19	Fe II (35)	$b^4F_{3/2} - z^6F_{3/2}$	5162.62	
5164.60	995	[Fe II] (35F)	$a^4D_{7/2} - a^2F_{7/2}$	5165.39	
5169.65	4575	Fe II (42)	$a^6S_{5/2} - z^6P_{7/2}$	5170.47	bl rd sh
5172.38	58	Fe II (35)	$b^4F_{9/2} - z^6F_{11/2}$	5173.08	
5173.17	45	[Fe II]	$a^2P_{1/2} - c^2D_{3/2}$	5173.91	
		Mg I (2)	$3p\ ^3P_1 - 4s\ ^3S_1$	5174.12	?id
5181.02	44	Fe II	$(^5D)4d\ ^6D_{5/2} - (^5D_4)4f\ ^2[1]_{3/2}$	5181.76	?E_u
		Fe II (35)	$b^4F_{5/2} - z^6F_{7/2}$	5181.97	
5182.61	781	[Fe II] (18F)	$a^4F_{3/2} - b^4P_{1/2}$	5183.39	
5185.45	136	[Fe II] (19F)	$a^4F_{7/2} - a^4H_{7/2}$	5186.23	
5186.56	88	Ti II (86)	$b^2G_{7/2} - z^2G_{7/2}$	5187.36	
		[Fe II]	$a^2P_{1/2} - c^2D_{5/2}$	5187.42	
5189.31	79	Ti II (70)	$b^2D_{5/2} - z^2D_{5/2}$	5190.12	
5192.23	57	[Ar III] (3F)	$3p^4\ ^1D_2 - 3p^4\ ^1S_0$	5193.26	Not in 98
5195.77	62	Fe II	$(^5D)4d\ ^6P_{3/2} - (^5D_2)4f\ ^2[1]_{3/2}$	5196.34	?wl; ?E_u
5198.23	2742	Fe II (49)	$a^4G_{5/2} - z^4F_{3/2}$	5199.02	
5199.82	327	[Fe II] (35F)	$a^4D_{5/2} - a^2F_{5/2}$	5200.62	
5204.45	51	Fe II	$(^5D)4d\ ^6D_{5/2} - (^5D_4)4f\ ^2[2]_{5/2}$	5205.09	?E_u
5211.51	20	Cr II (38)	$a^2F_{5/2} - z^4F_{7/2}$	5212.28	
		Cr II (24)	$b^4P_{3/2} - z^6D_{1/2}$	5212.32	
5212.22	16	Ti II (103)	$b^2F_{7/2} - y^2F_{7/2}$	5212.99	
5213.7	10	Cr II (38)	$b^2F_{7/2} - z^4D_{7/2}$	5214.59	
5216.55	26	Fe II	$(^5D)4d\ ^6D_{9/2} - (^5D_4)4f\ ^2[6]_{11/2}$	5217.30	?E_u
		V II (55)	$a^3D_3 - z^5D_3$	5217.38	
		[V II] (6F)	$a^5D_0 - b^3P_1$	5217.50	
5217.48	22	Fe II	$(^5D)4d\ e^6G_{7/2} - (^5D_1)4f\ ^2[4]_{9/2}$	5218.31	?E_u
		Fe II	$(^5D)4d\ e^6G_{9/2} - (^5D_2)4f\ ^2[5]_{11/2}$	5218.32	?E_u
5219.5	32	Fe II	$(^5D)4d\ ^6D_{9/2} - (^5D_4)4f\ ^2[4]_{9/2}$	5220.29	?E_u
5220.74	1166	[Fe II] (19F)	$a^4F_{7/2} - a^4H_{9/2}$	5221.51	
5223.87	13	Fe II	$(^5D)4d\ ^6D_{5/2} - (^5D_4)4f\ ^2[3]_{5/2}$	5224.71	?E_u
5227.2	90	Ti II (70)	$b^2D_{3/2} - z^2D_{3/2}$	5228.00	
5227.93	74	Fe II	$(^5D)4d\ e^6G_{5/2} - (^5D_1)4f\ ^2[3]_{7/2}$	5228.78	?E_u
5235.28	3034	Fe II (49)	$a^4G_{7/2} - z^4F_{5/2}$	5236.08	bl rd sh
5238.03	170	Cr II (43)	$b^4F_{9/2} - z^4F_{9/2}$	5238.79	
5244.16	11	Cr II (38)	$a^2F_{5/2} - z^4F_{5/2}$	5244.92	
5245.90?	7	[V II] (6F)	$a^5D_2 - b^3P_1$	5246.69	Not in 98
5247.50	13	Cr II (23)	$b^4P_{1/2} - z^4P_{3/2}$	5248.23	
5248.58	4	[Cr II] (13F)	$a^6D_{3/2} - a^4F_{3/2}$	5249.24	
		Fe II	$(^5D)4d\ e^6G_{3/2} - (^5D_1)4f\ ^2[3]_{5/2}$	5249.41	?E_u
5250.05	25	Cr II (24)	$b^4P_{3/2} - z^6D_{5/2}$	5250.90	
		Fe II	$(^5D)4d\ ^6D_{3/2} - (^5D_4)4f\ ^2[2]_{3/2}$	5250.80	?E_u
5251.9	42	Fe II	$(^5D)4d\ e^6G_{5/2} - (^5D_1)4f\ ^2[4]_{7/2}$	5252.69	?E_u
5255.57	366	Fe II (49)	$a^4G_{5/2} - z^4F_{5/2}$	5256.39	
5257.57	104	Fe II (41)	$a^6S_{5/2} - z^6F_{5/2}$	5258.40	
		Fe II	$(^5D)4d\ f^4D_{7/2} - (^5D_2)4f\ ^2[5]_{9/2}$	5258.58	?E_u
5262.26	4234	[Fe II] (19F)	$a^4F_{7/2} - a^4H_{11/2}$	5263.08	
5265.46	214	Fe II (48)	$a^4G_{5/2} - z^4D_{3/2}$	5266.28	
5269.52	1361	[Fe II] (18F)	$a^4F_{5/2} - b^4P_{3/2}$	5270.34	
5271.10	1237	[Fe III] (1F)	$3d^6\ ^5D_3 - 3d^6\ ^3P2_2$	5271.87	Not in 98
5273.99	4042	[Fe II] (18F)	$a^4F_{9/2} - b^4P_{5/2}$	5274.81	
5276.60	4409	Fe II (49)	$a^4G_{9/2} - z^4F_{7/2}$	5277.47	
5278.98	176	[Fe II] (35F)	$a^4D_{3/2} - a^2F_{5/2}$	5279.84	
5280.69	78	Cr II (43)	$b^4F_{9/2} - z^4F_{7/2}$	5281.35	
		Cr II (43)	$b^4F_{5/2} - z^4F_{7/2}$	5281.52	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{lab,vac}$ (Å)	Comment
5283.77	285	[Fe II] (35F)	$a^4D_{5/2} - a^2F_{7/2}$	5284.58	
5284.74	1307	Fe II (41)	$a^6S_{5/2} - z^6F_{7/2}$	5285.58	
5289.09	38	Unidentified			Not in 98
5297.46	959	[Fe II] (19F)	$a^4F_{5/2} - a^4H_{7/2}$	5298.30	
5299.77	53	[Fe II]	$a^2P_{3/2} - a^2S_{1/2}$	5300.35	
		[Cr II]	$a^6D_{7/2} - a^4F_{7/2}$	5300.90	
5306.59	74	Cr II (23)	$b^4P_{5/2} - z^4P_{5/2}$	5307.33	
		Fe II	$(^5D)4d\ f^4D_{5/2} - (^5D_2)4f\ ^2[4]_{7/2}$	5307.66	?E_u
5309.00	46	Cr II (43)	$b^4F_{7/2} - z^4F_{5/2}$	5309.88	
5311.2	11	Fe II	$(^5D)4d\ e^6G_{9/2} - (^5D_3)4f\ ^2[5]_{9/2}$	5312.11	?E_u
		Cr II (43)	$b^4F_{3/2} - z^4F_{5/2}$	5312.16	
5314.28	188	Cr II (43)	$b^4F_{5/2} - z^4F_{5/2}$	5315.04	
5317.23	8598	Fe II (49)	$a^4G_{11/2} - z^4F_{9/2}$	5318.09	rd sh
		Fe II (48)	$a^4G_{7/2} - z^4D_{5/2}$	5318.26	
5326.18	420	Fe II (49)	$a^4G_{7/2} - z^4F_{7/2}$	5327.03	
5334.32	3175	[Fe II] (19F)	$a^4F_{5/2} - a^4H_{9/2}$	5335.13	rd sh
5337.37	42	Ti II (69)	$b^2D_{5/2} - z^2F_{7/2}$	5338.26	
5338.36	124	Fe II (48)	$a^4G_{5/2} - z^4D_{5/2}$	5339.22	
		Cr II (43)	$b^4F_{5/2} - z^4F_{3/2}$	5339.26	
5340.19	110	[Cr II]	$a^6D_{9/2} - a^4F_{9/2}$	5341.05	
5348.36	406	[Fe II] (18F)	$a^4F_{3/2} - b^4P_{3/2}$	5349.14	rd sh
5359.81	32	Fe II	$(^5D)4d\ f^4D_{7/2} - (^5D_3)4f\ ^2[4]_{7/2}$	5360.37	?E_u
		Fe II	$(^5D)4d\ e^6G_{7/2} - (^5D_3)4f\ ^2[3]_{5/2}$	5360.74	?E_u
5363.54	1296	Fe II (48)	$a^4G_{9/2} - z^4D_{7/2}$	5364.36	
5367.34	20	Unidentified			
5377.17	2559	[Fe II] (19F)	$a^4F_{3/2} - a^4H_{7/2}$	5377.95	rd sh
5384.1	30	Unidentified			
5386.91	33	[Cr II]	$a^6D_{7/2} - b^4P_{5/2}$	5387.76	
5392.10	28	Unidentified			
5395.34	86	[Mn II] (9F)	$a^5D_4 - b^5D_3$	5396.27	
5398.65	24	Fe II	$(^5D)4d\ f^4D_{5/2} - (^5D_3)4f\ ^2[2]_{3/2}$	5399.44	?E_u
5400.30	48	Fe II	$(^5D)4d\ f^4D_{5/2} - (^5D_3)4f\ ^2[3]_{7/2}$	5401.06	?E_u
5405.70	14	Unidentified			
5408.44	27	Cr II (24)	$b^4P_{5/2} - z^6D_{5/2}$	5409.11	
5409.8	20	Fe II (184)	$d^2D1_{5/2} - x^4F_{5/2}$	5410.31	
		Cr II (29)	$a^4F_{3/2} - z^6D_{3/2}$	5410.77	
5413.40	1394	[Fe II] (17F)	$a^4F_{5/2} - a^2D2_{3/2}$	5414.16	rd sh
5414.80	203	Fe II (48)	$a^4G_{7/2} - z^4D_{7/2}$	5415.58	
5415.66	107	[Mn II] (9F)	$a^5D_4 - b^5D_4$	5416.53	
5419.33	18	Ti II (69)	$b^2D_{5/2} - z^2F_{5/2}$	5420.26	
5421.65	37	Cr II (23)	$b^4P_{3/2} - z^4P_{1/2}$	5422.43	
5425.94	547	Fe II (49)	$a^4G_{9/2} - z^4F_{9/2}$	5426.76	
5428.5	61	Fe II	$b^4G_{11/2} - w^4F_{9/2}$	5429.33	
5430.56	13	Fe II	$(^5D)4d\ e^4G_{7/2} - (^5D_1)4f\ ^2[4]_{9/2}$	5431.50	Not in 99 E_u?
5433.80	1466	[Fe II] (18F)	$a^4F_{7/2} - b^4P_{5/2}$	5434.64	rd sh
5443.3	11	Fe II	$(^5D)4d\ f^4D_{3/2} - (^5D_3)4f\ ^2[1]_{3/2}$	5443.86	?E_u
		[Cr II] (12F)	$a^6D_{9/2} - b^4P_{5/2}$	5444.25	
		Fe II	$b^4G_{7/2} - w^4F_{9/2}$	5444.42	
5446.47	25	Fe II	$(^5D)4d\ f^4D_{3/2} - (^5D_3)4f\ ^2[2]_{5/2}$	5447.32	?E_u
		Fe II (52)	$b^2P_{1/2} - z^4F_{3/2}$	5447.50	
5452.5	21	N II (29)	$3p\ ^3P_0 - 3d\ ^3P_1$	5453.58	
		[Fe II]	$a^4P_{5/2} - b^2F_{5/2}$	5453.33	
		[Fe II]	$a^2P_{1/2} - a^2S_{1/2}$	5452.40	
		[Fe III]	$3d^6\ ^3G_5 - 3d^6\ ^1F_3$	5453.13	?id
5454.85	11	N II (29)	$3p\ ^3P_1 - 3d\ ^3P_0$	5455.73	Not in 98
5458.38	53	[V II] (5F)	$a^5D_1 - a^3D_3$	5459.16	
		Fe II	$(^5D)4d\ ^4S_{3/2} - (^5D_0)4f\ ^2[3]_{5/2}$	5459.25	?E_u
5466.63	36	Fe II	$(^5D)4d\ e^4G_{5/2} - (^5D_1)4f\ ^2[3]_{7/2}$	5467.45	?E_u
5471.44	180	[Co II]	$a^5F_5 - a^3G_5$	5472.24	
5474.02	101	[Mn II] (9F)	$a^5D_3 - b^5D_2$	5474.87	
		[Mn II] (9F)	$a^5D_3 - b^5D_3$	5475.44	
5477.98	533	[Fe II] (34F)	$a^4D_{3/2} - b^2P_{1/2}$	5478.76	
		Cr II (50)	$b^4G_{5/2} - z^4F_{5/2}$	5479.00	
		Fe II (49)	$a^4G_{7/2} - z^4F_{9/2}$	5479.19	

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{\rm lab,vac}$	Comment
5478.8	37	Cr II (50)	$b^4G_{11/2} - z^4F_{9/2}$	5479.89	
5480.84	3	N II (29)	$3p\ ^3P_2 - 3d\ ^3P_1$	5481.57	
		[Mn II] (9F)	$a^5D_3 - b^5D_1$	5481.60	
5482.93	26	Fe II	$(^5D)4d\ e^4G_{9/2} - (^5D_3)4f\ ^2[6]_{11/2}$	5483.83	?E_u
5484.72	24	Unidentified			
5485.43	24	Unidentified			
5488.23	20	Fe II	$(^5D)4d\ e^4G_{7/2} - (^5D_2)4f\ ^2[4]_{9/2}$	5489.14	?E_u
5493.07	49	Fe II	$(^5D)4d\ e^4G_{5/2} - (^5D_1)4f\ ^2[4]_{7/2}$	5489.14	?E_u
		Fe II	$(^5D)4d\ f^4D_{7/2} - (^5D_4)4f\ ^2[4]_{7/2}$	5493.92	?E_u
5494.64	22	Fe II	$(^5D)4d\ f^4D_{7/2} - (^5D_4)4f\ ^2[4]_{9/2}$	5495.36	?E_u
5495.52	59	[Mn II] (9F)	$a^5D_3 - b^5D_4$	5496.30	
5496.56	676	[Fe II] (17F)	$a^4F_{3/2} - a^2D2_{3/2}$	5497.35	
5499.3	22	Fe II	$(^5D)4d\ ^6S_{5/2} - (^5D_2)4f\ ^2[3]_{7/2}$	5500.10	?E_u
5502.67	26	Cr II (50)	$b^4G_{9/2} - z^4F_{7/2}$	5503.60	
5504.0	32	Cr II (50)	$b^4G_{5/2} - z^4F_{3/2}$	5504.74	
		Fe II	$(^5D)4d\ f^4D_{7/2} - (^5D_4)4f\ ^2[5]_{9/2}$	5504.74	?E_u
		Fe II	$(^5D)4d\ ^6S_{5/2} - (^5D_2)4f\ ^2[2]_{5/2}$	5504.89	?E_u
5505.95	42	Fe II	$y^4D_{7/2} - e^4D_{5/2}$	5506.78	Lyα sec.
		[Cr II] (12F)	$a^6D_{5/2} - b^4P_{3/2}$	5506.72	
5507.78	20	Fe II	$(^5D)4d\ f^4D_{5/2} - (^5D_4)4f\ ^2[2]_{5/2}$	5508.60	?E_u
5509.09	16	Cr II (50)	$b^4G_{7/2} - z^4F_{5/2}$	5510.14	?wl
5511.5	19	Cr II (23)	$b^4P_{5/2} - z^4P_{3/2}$	5512.23	
		Fe II	$(^5D)4d\ e^4G_{9/2} - (^5D_4)4f\ ^2[5]_{11/2}$	5512.31	?E_u
5516.78	33	[Cr II]	$a^6D_{3/2} - a^4H_{7/2}$	5517.48	
5519.04?	25	[Mn II]	$a^5S_2 - a^5G_2$	5519.89	Not in 98 id?
		[Mn II]	$a^5S_2 - a^5G_3$	5520.12	?id
5520.71?	20	Fe II (52)	$b^2P_{1/2} - z^4D_{3/2}$	5521.38	?id
		[Mn II]	$a^5S_2 - a^5G_4$	5521.63	?id
		Fe II	$z^6F_{5/2} - c^4D_{5/2}$	5521.67	4p-4s
5522.10?	14	Fe II	$z^6F_{5/2} - c^4D_{3/2}$	5522.97	4p-4s
5524.02?	9	[Fe II] (33F)	$a^4D_{7/2} - a^4G_{5/2}$	5524.82	
5524.89?	13	Fe II	$(^5D)4d\ e^6G_{5/2} - (^5D_4)4f\ ^2[3]_{7/2}$	5525.67	?E_u
5525.72	47	Fe II (56)	$b^2H_{9/2} - z^4D_{7/2}$	5526.66	
5528.07	2717	[Fe II] (17F)	$a^4F_{7/2} - a^2D2_{5/2}$	5528.87	rd sh
		[Fe II] (34F)	$a^4D_{1/2} - b^2P_{1/2}$	5529.14	
5531.26	47	[Mn II] (9F)	$a^5D_2 - b^5D_3$	5532.20	
5535.52	1405	Fe II (55)	$b^2H_{11/2} - z^4F_{9/2}$	5536.38	
5537.63	7	[Mn II] (9F)	$a^5D_2 - b^5D_1$	5538.49	Not in 99
5539.56	36	Unidentified			
5541.09	16	Fe II	$z^6F_{3/2} - c^4D_{5/2}$	5542.02	4p-4s
5543.1 ?	20	[Mn II] (9F)	$a^5D_2 - b^5D_0$	5544.12	
5552.06	349	[Fe II] (39F)	$a^4P_{5/2} - b^4D_{7/2}$	5552.85	
5557.03	245	[Fe II] (18F)	$a^4F_{5/2} - b^4P_{5/2}$	5557.83	
5560.82	7	[Co II]	$a^5F_4 - a^3G_4$	5561.59	
		N I (25)	$3p\ ^4D_{7/2} - 5d\ ^4F_{9/2}$	5561.88	
5565.04	40	N I (25)	$3p\ ^4D_{5/2} - 5d\ ^4F_{7/2}$	5565.81	
		N I (25)	$3p\ ^4D_{3/2} - 5d\ ^4F_{5/2}$	5565.81	
5568.48	47	[Mn II] (9F)	$a^5D_1 - b^5D_3$	5569.17	
		Fe II	$b^4G_{7/2} - w^4F_{5/2}$	5569.39	
5574.44	39	[V II] (14F)	$a^5F_2 - b^3D_3$	5575.40	?id
		Fe II	$z^6F_{5/2} - c^4D_{7/2}$	5575.53	4p-4s
		[Mn II] (9F)	$a^5D_1 - b^5D_1$	5575.54	
5578.75	29	Fe II	$(^5D)4d\ e^4G_{7/2} - (^5D_3)4f\ ^2[3]_{7/2}$	5579.46	Not in 98 E_u?
5581.65	241	[Fe II] (39F)	$a^4P_{5/2} - b^4D_{5/2}$	5582.37	
5583.45	15	[Fe II]	$a^4P_{1/2} - b^2F_{5/2}$	5584.41	
5585.9	12	[Mn II] (9F)	$a^5D_0 - b^5D_2$	5586.83	
5588.0	54	[Fe II] (39F)	$a^4P_{5/2} - b^4D_{1/2}$	5588.45	
		[Fe II]	$a^2P_{3/2} - b^2D_{5/2}$	5589.06	
5588.97	155	[Fe II] (39F)	$a^4P_{5/2} - b^4D_{3/2}$	5589.71	
5590.87	13	[Cr II]	$a^4G_{5/2} - c^4D_{1/2}$	5691.54	
5592.20	27	Fe II (55)	$b^2H_{9/2} - z^4F_{9/2}$	5592.92	
5600.12	47	[Co II]	$a^5F_3 - a^3G_3$	5601.05	
5613.96	182	[Fe II] (39F)	$a^4P_{3/2} - b^4D_{7/2}$	5614.83	
5618.24?	13	[Cr II]	$a^4G_{7/2} - c^4D_{5/2}$	5618.92	Not in 99

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
		[Cr II]	$a^4G_{9/2} - c^4D_{5/2}$	5619.31	
5621.4 ?		Cr II (189)	$d^2G_{9/2} - y^2G_{9/2}$	5622.19	
		Fe II	$z^6P_{7/2} - c^4D_{5/2}$	5622.06	?id; 4p-4s
5628.11	162	[Fe II]	$a^2P_{3/2} - b^2D_{3/2}$	5628.81	
5630.71	57	[Cr II]	$a^4G_{5/2} - c^4D_{7/2}$	5631.41	
		[Cr II]	$a^4G_{11/2} - c^4D_{5/2}$	5631.43	
5644.62	77	[Fe II] (18F)	$a^4F_{3/2} - b^4P_{5/2}$	5645.53	
		Fe II	$y^4D_{7/2} - e^4D_{7/2}$	5645.44	Lyα sec.
5650.5	147	[Fe II] (39F)	$a^4P_{3/2} - b^4D_{1/2}$	5651.23	
5651.6	104	[Fe II] (39F)	$a^4P_{3/2} - b^4D_{3/2}$	5652.51	
5655.58	345	[Fe II] (17F)	$a^4F_{5/2} - a^2D2_{5/2}$	5656.42	
5658.54	72	Fe II (57)	$a^2F_{5/2} - z^4F_{3/2}$	5659.51	
5660.58	9	[Fe II] (33F)	$a^4D_{5/2} - a^4G_{5/2}$	5661.40	Not in 98
5564.64	16	Unidentified			Not in 98
5667.13	64	N II (3)	$3s\ ^3P_1 - 3p\ ^3D_2$	5668.20	Not in 98
5673.92	532	[Fe II]	$a^2G_{9/2} - c^2G_{9/2}$	5674.78	
5676.52	27	N II (3)	$3s\ ^3P_0 - 3p\ ^3D_1$	5677.59	Not in 98
5680.15	91	N II (3)	$3s\ ^3P_2 - 3p\ ^3D_3$	5681.13	Not in 98
5682.22	34	[Co II]	$a^5F_4 - a^3G_5$	5683.23	
5686.65	30	N II (3)	$3s\ ^3P_1 - 3p\ ^3D_1$	5687.79	?wl
5696.93	24	Fe II (18)	$a^2D2_{3/2} - z^6D_{5/2}$	5697.71	
5704.23	15	[Ni II] (14F)	$a^2F_{5/2} - z^2G_{7/2}$	5705.17	
5711.55	70	N II (3)	$3s\ ^3P_2 - 3p\ ^3D_2$	5712.35	Not in 98
5718.86	145	[Fe II] (39F)	$a^4P_{1/2} - b^4D_{5/2}$	5719.80	
5722.33?	11	[Fe II] (33F)	$a^4D_{7/2} - a^4G_{9/2}$	5722.96	Not in 98
5726.30	85	[Fe II] (39F)	$a^4P_{1/2} - b^4D_{3/2}$	5727.50	?wl
		Fe II (57)	$a^2F_{5/2} - z^4F_{5/2}$	5727.55	?wl
5730.31	80	[Co II]	$a^5F_3 - a^3G_4$	5731.10	
5733.40	26	Fe II (57)	$a^2F_{7/2} - z^4F_{7/2}$	5734.31	
5747.60	1138	[Fe II] (34F)	$a^4D_{5/2} - b^2P_{3/2}$	5748.56	
5755.10	11290	[N II] (3F)	$2p^2\ ^1D_2 - 2p^2\ ^1S_0$	5756.19	
5759.77	601	[N II] (3F)	$2p^2\ ^1D_2 - 2p^2\ ^1S_0$	5756.19	rd sh, Not in 98
5768.22	28	[Fe II]	$b^4P_{5/2} - c^2D_{5/2}$	5769.14	
5792.42	33	Cr II	$z^4P_{1/2} - d^4P_{3/2}$	5793.40	4p-4s
5795.77	49	Cr II	$z^4P_{3/2} - d^4P_{5/2}$	5796.83	4p-4s
5799.82	112	[Fe II]	$a^2P_{1/2} - b^2D_{3/2}$	5800.60	
		[Co II]	$b^3P_2 - a^5D_3$	5800.60	
5814.06	50	Fe II	$c^4F_{3/2} - y^2D_{3/2}$	5814.66	
		Fe II (163)	$c^2F_{5/2} - z^2D_{3/2}$	5815.29	
		Fe II	$y^4D_{5/2} - e^4D_{5/2}$	5815.42	Lyα sec.
5816.72	91	[Mn II]	$a^5D_4 - a^3F_4$	5817.74	
5827.9 ?	28	Cr II (198)	$c^4F_{5/2} - x^4G_{7/2}$	5828.88	
5836.10	557	[Fe II]	$a^2G_{7/2} - c^2G_{7/2}$	5837.07	
5842.60	38	Cr II (198)	$c^4F_{7/2} - x^4G_{9/2}$	5843.56	
5844.38	47	[Fe II] (34F)	$a^4D_{3/2} - b^2P_{3/2}$	5845.51	
5847.85	69	[Fe II]	$a^2G_{7/2} - c^2G_{9/2}$	5848.94	?wl
5855.09	31	Fe II	$(^5D)4d\ e^4F_{5/2} - (^5D_2)4f\ ^2[3]_{7/2}$	5855.81	?E_u
5857.84	32	[Mn II]	$a^5D_3 - a^3F_3$	5858.87	
5865.98	107	Unidentified			Not in 98
5870.73	642	[Fe II]	$a^2G_{9/2} - a^2I_{13/2}$	5871.65	
5876.12	8107	He I (11)	$2p\ ^3P_0 - 3d\ ^3D_1$	5877.25	
5914.27	135	[Fe II]	$a^2D2_{3/2} - c^2D_{3/2}$	5914.90	
		Fe II (217)	$x^4D_{5/2} - e^4D_{3/2}$	5915.40	Lyα sec.
		Cr II	$z^6D_{5/2} - d^4P_{5/2}$	5915.43	4p-4s
5923.2 ?	58	Fe II (217)	$x^4D_{3/2} - e^4D_{1/2}$	5923.85	Lyα sec.
		[Mn II]	$a^5D_2 - a^3F_3$	5923.90	
5938.18?	42	Unidentified			
5942.00?	33	Fe II (58)	$a^2F_{5/2} - z^4D_{7/2}$	5943.02	?id
		N II(28)	$3p\ ^3P_2 - 3d\ ^3D_3$	5943.30	
5953.53	24	Fe II (182)	$d^2D1_{5/2} - z^2P_{3/2}$	5954.16	?wl
5956.46	93	Fe II (217)	$x^4D_{1/2} - e^4D_{1/2}$	5957.15	Lyα sec.
		Fe II	$(^5D)4d\ e^4F_{5/2} - (^5D_3)4f\ ^2[3]_{7/2}$	5957.35	?E_u
5958.60	76	Si II (4)	$4p\ ^2P_{1/2} - 5s\ ^2S_{1/2}$	5959.21	?wl
5979.61	101	Si II (4)	$4p\ ^2P_{3/2} - 5s\ ^2S_{1/2}$	5980.59	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
5983.52	84	[Fe II]	$a^2D2_{5/2} - a^2S_{1/2}$	5984.31	
5988.32	2	Unidentified			Not in 99
5992.06	774	Fe II (46)	$a^4G_{11/2} - z^6F_{9/2}$	5993.04	
5995.57?	0.8	Fe II (47)	$a^4G_{7/2} - z^6P_{7/2}$	5996.43	Not in 98
6000.30	72	N I (16)	$3p\ ^2S_{1/2} - 4d\ ^2P_{1/2}$	6001.13	
6002.16?	22	Cr II	$z^6D_{5/2} - d^4P_{3/2}$	6002.91	4p-4s
6009.22	125	N I (16)	$3p\ ^2S_{1/2} - 4d\ ^2P_{3/2}$	6010.14	
6018.41?	29	Fe II (217)	$x^4D_{5/2} - e^4D_{5/2}$	6019.56	Lyα sec. wl?
6041.24	57	Cr II	$z^4P_{5/2} - d^4P_{5/2}$	6042.14	4p-4s
6044.90	212	[Fe II]	$a^2G_{7/2} - a^2I_{11/2}$	6045.75	
6053.79?	20	Cr II (105)	$c^4D_{7/2} - z^4D_{7/2}$	6055.14	?wl
6062.0	14	Fe II (217)	$x^4D_{7/2} - e^4D_{7/2}$	6062.65	Lyα sec.
		[Cr II]	$a^4P_{5/2} - c^4D_{5/2}$	6063.42	?id
6079.19	74	[Cr II]	$a^4P_{5/2} - c^4D_{7/2}$	6080.11	?id
		[Cr II]	$a^4P_{3/2} - c^4D_{7/2}$	6080.70	?id
		Fe II (200)	$c^4F_{3/2} - x^4F_{5/2}$	6080.36	
		[V II]	$a^5F_2 - b^3P_2$	6080.60	?id
6084.91	277	Fe II (46)	$a^4G_{9/2} - z^6F_{7/2}$	6085.80	
6096.0 ?	30	[Fe II]	$b^4P_{3/2} - c^2D_{3/2}$	6096.65	
6097.09	67	[Fe III] (10F)	$3d^6\ ^3P2_2 - 3d^6\ ^1D2_2$	6097.97	Not in 98
6103.9	71	Fe II (200)	$c^4F_{5/2} - x^4F_{5/2}$	6105.19	?wl
6114.28	10	Fe II (46)	$a^4G_{7/2} - z^6F_{5/2}$	6115.02	
6116.87	34	Fe II (46)	$a^4G_{5/2} - z^6F_{3/2}$	6117.75	
6123.42	107	Mn II (13)	$e^5D_4 - (^6S)4f\ ^5F_5$	6124.14	
		Mn II (13)	$e^5D_4 - (^6S)4f\ ^5F_4$	6124.52	
6126.67	106	Mn II (13)	$e^5D_3 - (^6S)4f\ ^5F_4$	6127.56	
		Mn II (13)	$e^5D_3 - (^6S)4f\ ^5F_3$	6127.92	
6130.23	167	Mn II (13)	$e^5D_2 - (^6S)4f\ ^5F_3$	6130.43	
		Mn II (13)	$e^5D_2 - (^6S)4f\ ^5F_2$	6130.74	
		Mn II (13)	$e^5D_2 - (^6S)4f\ ^5F_1$	6130.98	
6131.97	97	Mn II (13)	$e^5D_1 - (^6S)4f\ ^5F_2$	6132.50	
		Mn II (13)	$e^5D_1 - (^6S)4f\ ^5F_1$	6132.74	
6148.62	523	Fe II (74)	$b^4D_{3/2} - z^4P_{1/2}$	6149.44	
6150.02	615	Fe II (74)	$b^4D_{1/2} - z^4P_{1/2}$	6150.96	
6154.9 ?	20	Cr II	$a^4F_{9/2} - z^6F_{9/2}$	6155.66	?id
6159.06	84	Fe II (200)	$c^4F_{5/2} - x^4F_{7/2}$	6159.72	
		[V II]	$a^5D_2 - b^3G_3$	6159.78	
6161.62	49	Fe II (161)	$c^2F_{5/2} - z^4H_{7/2}$	6162.46	
6173.58	84	Fe II	$(^5D)5s\ e^6D_{9/2} - (^4D)sp\ ^6D_{9/2}$	6174.31	?E_u
6176.17	32	Fe II (200)	$c^4F_{7/2} - x^4F_{7/2}$	6176.85	?wl
6189.40	265	[Fe II] (44F)	$a^2G_{9/2} - b^2F_{7/2}$	6190.26	
6202.48	8	[Mn II]	$a^5D_1 - a^3P_0$	6203.14	Not in 99 wl?
6216.80	35	[V II]	$a^5D_4 - b^3G_4$	6218.02	?id
6220.02	23	[Ti II] (28F)	$a^2G_{9/2} - c^2D_{5/2}$	6221.02	Not in 99, ?id
6230.14	79	[Fe II] (15F)	$a^4F_{5/2} - a^2P_{1/2}$	6230.98	
		Fe II (34)	$b^4F_{7/2} - z^6D_{5/2}$	6231.07	
6234.21	57	Fe II	$z^4F_{9/2} - c^4D_{7/2}$	6235.26	4p-4s
6239.22	620	Fe II (74)	$b^4D_{3/2} - z^4P_{3/2}$	6240.11	
6248.41	1145	Fe II (74)	$b^4D_{5/2} - z^4P_{3/2}$	6249.28	
6256.56	19	Fe II (34)	$b^4F_{3/2} - z^6D_{3/2}$	6257.08	?wl
6261.88	37	[Fe II] (44F)	$a^2G_{9/2} - b^2F_{5/2}$	6262.85	
6265.17	5	[V II]	$a^3D_1 - b^1F_3$	6265.93	Not in 99 id?
		[V II]	$b^3G_3 - d^3P_1$	6266.33	?id
		[V II]	$a^3G_5 - d^3F_4$	6266.34	?id
6270.62	83	Fe II	$b^2H_{11/2} - z^6F_{9/2}$	6271.70	
6276.44	54	[Fe II] (15F)	$a^4F_{7/2} - a^2P_{3/2}$	6277.25	
6280.81	106	[Fe II]	$a^2D2_{3/2} - a^2S_{1/2}$	6281.69	
		Fe II (34)	$b^4F_{5/2} - z^6D_{5/2}$	6281.56	
6287.00	16	[Mn II]	$a^5D_2 - a^3P_1$	6287.77	
6292.65	149	Fe II	$(^5D)4d\ ^4P_{3/2} - (^5D_0)4f\ ^2[3]_{5/2}$	6293.57	?E_u
6297.32	8	Unidentified			
6301.14	221	[O I] (1F)	$2p^4\ ^3P_2 - 2p^4\ ^1D_2$	6302.05	
6306.3	25	Fe II (200)	$c^4F_{9/2} - x^4F_{9/2}$	6307.04	
		Cr II	$b^2P_{3/2} - y^2P_{3/2}$	6307.39	

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
6308.51	19	Fe II (34)	$b^4F_{7/2} - z^6D_{7/2}$	6309.27	
6312.82	1443	[S III] (3F)	$3p^2\ ^1D_2 - 3p^2\ ^1S_0$	6313.81	Not in 98
6318.77	490	Fe II	$z^4D_{7/2} - c^4D_{7/2}$	6319.73	rd sh, 4p-4s
6347.95	332	Si II (2)	$4s\ ^2S_{1/2} - 4p\ ^2P_{3/2}$	6348.84	
6353.93	118	[Fe II]	$a^2D2_{5/2} - b^2D_{5/2}$	6354.87	
6357.83	28	Fe II	$(^5D)4d\ ^4P_{5/2} - (^5D_2)4f\ ^2[4]_{7/2}$	6358.92	?E_u
		[Mn II]	$a^5D_0 - a^3P_1$	6359.21	
6364.5	8	[O I] (1F)	$2p^4\ ^3P_1 - 2p^4\ ^1D_2$	6365.53	
6365.96	377	[Ni II] (7F)	$a^4F_{7/2} - b^2D_{5/2}$	6366.86	
6370.38	284	Fe II (49)	$a^6S_{5/2} - z^6D_{3/2}$	6371.21	
6372.08	310	Si II (2)	$4s\ ^2S_{1/2} - 4p\ ^2P_{1/2}$	6373.13	
		Fe II	$z^4F_{7/2} - c^4D_{5/2}$	6372.89	4p-4s
6376.68	34	Fe II	$(^5D)4d\ ^4P_{1/2} - (^5D_1)4f\ ^2[2]_{3/2}$	6377.56	?E_u
6384.48	447	Fe II	$z^4D_{5/2} - c^4D_{5/2}$	6385.49	4p-4s
6386.26	194	Fe II	$z^4D_{5/2} - c^4D_{3/2}$	6387.22	4p-4s
6392.71?	17	Unidentified			
6397.11	89	[Fe II] (44F)	$a^2G_{7/2} - b^2F_{7/2}$	6398.08	
6405.48	37	[Fe II]	$a^2D2_{5/2} - b^2D_{1/2}$	6406.39	
6407.80	81	Fe II (74)	$b^4D_{3/2} - z^4P_{5/2}$	6409.02	?wl
6412.00	61	[Mn II] (8F)	$a^5D_4 - a^5P_2$	6412.90	
6417.73	749	Fe II (74)	$b^4D_{5/2} - z^4P_{5/2}$	6418.67	
6424.31	101	[Mn II] (8F)	$a^5D_4 - a^5P_3$	6425.22	
6429.86	27	Unidentified			
6433.51	1070	Fe II (40)	$a^6S_{5/2} - z^6D_{5/2}$	6434.43	
6438.03	42	Unidentified			
6441.27	421	[Fe II] (15F)	$a^4F_{5/2} - a^2P_{3/2}$	6442.18	
6443.81	85	Fe II	$z^4F_{7/2} - c^4D_{7/2}$	6444.74	4p-4s
6446.9	7	Fe II (199)	$c^4F_{7/2} - x^4G_{9/2}$	6448.19	?wl
6457.20	3116	Fe II (74)	$b^4D_{7/2} - z^4P_{5/2}$	6458.15	
6474.76	172	[Fe II] (44F)	$a^2G_{7/2} - b^2F_{5/2}$	6475.65	
6482.99	136	Fe II (199)	$c^4F_{9/2} - x^4G_{11/2}$	6483.99	
		N II (8)	$3s\ ^1P_1 - 3p\ ^1P_1$	6483.84	
6486.19	211	[Fe II]	$b^4P_{3/2} - a^2S_{1/2}$	6487.07	
6492.30	189	Fe II	$z^4D_{3/2} - c^4D_{5/2}$	6493.05	4p-4s
6493.81	211	Fe II	$z^4D_{3/2} - c^4D_{3/2}$	6494.84	4p-4s
6507.29	86	Fe II	$z^4F_{5/2} - c^4D_{5/2}$	6508.14	4p-4s
6512.12	89	[Fe II]	$b^4F_{7/2} - c^2D_{5/2}$	6513.03	
6516.97	1345	Fe II (40)	$a^6S_{5/2} - z^6D_{7/2}$	6517.88	
6520.26	45	[Co II]	$b^3F_4 - b^1G_4$	6521.28	
6549.09	1678	[N II] (1F)	$2p^2\ ^3P_1 - 2p^2\ ^1D_2$	6549.86	
6550–75	814	Hα		6564.61	bl rd sh
6584.33	3721	[N II] (1F)	$2p^2\ ^3P_2 - 2p^2\ ^1D_2$	6585.27	bl rd sh
6667.73	1010	[Ni II] (2F)	$a^2D_{5/2} - a^2F_{5/2}$	6668.64	
6678.93	2162	He I (46)	$2p\ ^1P_1 - 3d\ ^1D_2$	6680.00	bl rd sh
6690.31	53	[Fe II]	$a^2D2_{3/2} - b^2D_{5/2}$	6691.25	
6701.0 ?	58	[Ni II] (7F)	$a^4F_{5/2} - b^2D_{5/2}$	6702.09	
6710.16?	4	[Mn II] (2F)	$a^7S_3 - a^5D_1$	6710.88	
6717.36	97	[S II] (2F)	$3p^3\ ^4S_{3/2} - 3p^3\ ^2D_{5/2}$	6718.29	
6731.53	349	[S II] (2F)	$3p^3\ ^4S_{3/2} - 3p^3\ ^2D_{3/2}$	6732.67	
6747.65	92	[Fe II]	$b^4P_{1/2} - a^2S_{1/2}$	6748.79	
6792.99	69	[Fe IV]	$3d^5\ ^4P_{3/2} - 3d^5\ ^2D3_{3/2}$	6794.4	Not in 98 wl?
6795.16	46	[Ni II] (8F)	$a^4F_{9/2} - a^4P_{5/2}$	6796.07	
6810.07	284	[Fe II] (31F)	$a^4D_{7/2} - b^4F_{9/2}$	6811.10	
6814.63	250	[Ni II] (8F)	$a^4F_{5/2} - a^4P_{3/2}$	6815.45	
6823.65	18	Unidentified			
6830.10	22	[Fe II] (31F)	$a^4D_{5/2} - b^4F_{3/2}$	6830.90	
6862.69	21	Unidentified			Not in 98
6873.09	190	[Fe II] (31F)	$a^4D_{5/2} - b^4F_{5/2}$	6874.07	
6874.66	300	[Fe II] (43F)	$a^2G_{9/2} - b^2G_{9/2}$	6875.74	
6896.94	237	[Fe II] (14F)	$a^4F_{9/2} - a^2G_{7/2}$	6898.08	
6924.56	28	[Co II]	$b^3F_3 - b^1G_4$	6925.74	
6927.28	36	Fe II	$z^4F_{9/2} - d^2G_{7/2}$	6928.24	4p-4s
6933.39	12	[Co II] (3F)	$a^5F_5 - a^5P_3$	6934.27	
6943.85	486	Fe II	$z^4F_{9/2} - d^2G_{9/2}$	6944.93	4p-4s

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{\rm lab,vac}$	Comment
6945.76	235	[Fe II] (43F)	$a^2G_{7/2} - b^2G_{7/2}$	6946.80	
6962.6	14	Unidentified			
6967.30	147	[Fe II] (31F)	$a^4D_{3/2} - b^4F_{3/2}$	6968.23	
6983.1	24	Unidentified			
6998.08	4	[Fe IV]	$3d^5\ ^4P_{5/2} - 3d^5\ ^2D3_{5/2}$	6999.0	Not in 98
7031.73	53	Fe II	$z^4D_{7/2} - d^2G_{7/2}$	7032.69	4p-4s
7048.91	101	[Fe II] (31F)	$a^4D_{1/2} - b^4F_{3/2}$	7049.93	
		Fe II	$z^4D_{7/2} - d^2G_{9/2}$	7049.89	4p-4s
7066.10	8428	He I (10)	$2p\ ^3P - 3s\ ^3S$	7067.20	
7079.19	152	[Ni II] (8F)	$a^4F_{3/2} - a^4P_{3/2}$	7079.99	?wl
7089.56	89	[Fe III]	$3d^6\ ^3F2_3 - 3d^6\ ^1D2_2$	7090.29	Not in 98 wl?
7100.92	150	[Co II]	$a^3P_1 - a^3D_3$	7102.21	?id
7110.29	8	Unidentified			Not in 99
7132.59	86	[Fe II] (30F)	$a^4D_{5/2} - b^4P_{1/2}$	7133.73	
		[Fe II] (43F)	$a^2G_{7/2} - b^2G_{9/2}$	7133.08	?wl
7136.78	1220	[Ar III] (1F)	$3p^4\ ^3P_2 - 3p^4\ ^1D_2$	7137.76	rd sh, Not in 98
7156.26	9013	[Fe II] (14F)	$a^4F_{9/2} - a^2G_{9/2}$	7157.13	rd sh
7165.17	96	Fe II	$x^4G_{7/2} - e^4D_{5/2}$	7166.32	Lyα sec. id?
7169.32	18	[Fe III]	$3d^6\ ^3F2_2 - 3d^6\ ^1D2_2$	7170.26	Not in 98
7173.08	2041	[Fe II] (14F)	$a^4F_{7/2} - a^2G_{7/2}$	7173.98	
7184.91	57	[Fe IV]	$3d^5\ ^4D_{7/2} - 3d^5\ ^4F_{7/2}$	7186.0	Not in 98
7186.89?	43	Fe II	$z^4F_{7/2} - d^2G_{7/2}$	7187.83	4p-4s
7191.50	74	[Fe IV]	$3d^5\ ^4D_{5/2} - 3d^5\ ^4F_{5/2}$	7192.7	Not in 98
7194.10	49	[Fe IV]	$3d^5\ ^4D_{3/2} - 3d^5\ ^4F_{3/2}$	7194.8	Not in 98 wl?
7203.00	63	Fe II	$z^4D_{5/2} - d^2G_{7/2}$	7203.87	4p-4s
7204.82	136	Fe II	$z^4F_{7/2} - d^2G_{9/2}$	7205.80	4p-4s
7223.48	210	Fe II (73)	$b^4D_{3/2} - z^4D_{1/2}$	7224.38	
		[Fe IV]	$3d^5\ ^4D_{9/2} - 3d^5\ ^4F_{7/2}$	7224.8	
7225.37	115	Fe II (73)	$b^4D_{1/2} - z^4D_{1/2}$	7226.46	
7255.30	114	O I (20)	$3p\ ^3P_1 - 5s\ ^3S_1$	7256.15	Not in 98
		O I (20)	$3p\ ^3P_2 - 5s\ ^3S_1$	7256.48	
		O I (20)	$3p\ ^3P_0 - 5s\ ^3S_1$	7256.53	
7256.95	494	[Ni II] (8F)	$a^4F_{7/2} - a^4P_{5/2}$	7257.82	
7282.28	844	He I (45)	$2p\ ^1P_1 - 3s\ ^1S_0$	7283.36	bl rd sh
7290.12	51	Fe II (72)	$b^4D_{3/2} - z^4F_{5/2}$	7291.05	
		[Fe II]	$a^4P_{1/2} - a^2F_{5/2}$	7290.97	
7292.47	279	[Ca II] (1F)	$4s\ ^2S_{1/2} - 3d\ ^2D_{5/2}$	7293.48	
7298.88	35	He I	$3s\ ^3S_1 - 9p\ ^3P_1$	7300.05	Not in 98
7302.56	55	Fe II (72)	$b^4D_{5/2} - z^4F_{5/2}$	7303.57	
7308.89	713	[Ni II] (7F)	$a^4F_{5/2} - b^2D_{3/2}$	7309.66	
		Fe II (73)	$b^4D_{3/2} - z^4D_{3/2}$	7310.09	
7311.29	30	Fe II (73)	$b^4D_{1/2} - z^4D_{3/2}$	7312.23	
7314.56	26	[Cr II]	$a^4D_{7/2} - b^4G_{11/2}$	7315.21	?wl
7320.0	47	N I	$3p\ ^2D_{3/2} - 4d\ ^2D_{3/2}$	7320.99	
		[O II] (2F)	$2p^3\ ^2D_{5/2} - 2p^3\ ^2P_{1/2}$	7320.94	
7321.58	141	Fe II (73)	$b^4D_{5/2} - z^4D_{3/2}$	7322.67	
		[O II] (2F)	$2p^3\ ^2D_{5/2} - 2p^3\ ^2P_{3/2}$	7322.00	
7324.88	239	[Ca II] (1F)	$4s\ ^2S_{1/2} - 3d\ ^2D_{3/2}$	7325.91	
7331.68	101	[O II] (2F)	$2p^3\ ^2D_{3/2} - 2p^3\ ^2P_{1/2}$	7331.68	Not in 98
		[O II] (2F)	$2p^3\ ^2D_{3/2} - 2p^3\ ^2P_{3/2}$	7332.75	
		Mn II (4)	$a^5P_2 - z^5P_1$	7332.61	
7336.20	24	Fe II	$(^5D)5s\ e^6D_{5/2} - (^4D)sp\ ^6F_{7/2}$	7337.43	?E_u
7348.57	91	N I	$3p\ ^2D_{5/2} - 4d\ ^2D_{5/2}$	7349.59	
		Mn II (4)	$a^5P_1 - z^5P_1$	7349.85	
7354.62	13	[V II] (4F)	$a^5D_0 - a^5P_2$	7355.79	
		[Cr II]	$a^4D_{7/2} - b^4G_{9/2}$	7355.68	
		Mn II (4)	$a^5P_3 - z^5P_2$	7355.58	
7359.38	72	Fe II	$z^4F_{5/2} - d^2G_{7/2}$	7360.35	4p-4s
7360.98	8	N I	$3p\ ^2D_{5/2} - 4d\ ^2D_{3/2}$	7362.15	Not in 99
7370.5 ?	8	Mn II (4)	$a^5P_2 - z^5P_2$	7371.80	
7371.70	29	[Fe II] (30F)	$a^4D_{1/2} - b^4P_{1/2}$	7372.95	
7378.90	4299	[Ni II] (2F)	$a^2D_{5/2} - a^2F_{7/2}$	7379.86	
7389.13	2024	[Fe II] (14F)	$a^4F_{5/2} - a^2G_{7/2}$	7390.21	
7406.96	25	N I	$3p\ ^2D_{3/2} - 4d\ ^2F_{5/2}$	7408.16	

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{\rm lab,vac}$ (Å)	Comment
		N I	3p $^2D_{5/2}$ – 4d $^2F_{7/2}$	7408.28	
7412.65	1863	[Ni II] (2F)	$a^2D_{3/2}$ – $a^2F_{5/2}$	7413.65	
7416.77	61	Mn II (4)	a^5P_3 – z^5P_3	7417.85	
7420.65?	27	Cr II	$c^4D_{5/2}$ – $z^4F_{7/2}$	7421.69	
7422.51	27	[Co II] (3F)	a^5F_3 – a^5P_2	7423.44	
7424.67	41	N I (3)	3s $^4P_{1/2}$ – 3p $^4S_{3/2}$	7425.69	
7429.62	6	N I	3p $^2D_{3/2}$ – 4d $^2P_{1/2}$	7430.80	Not in 99
7433.29	40	[Fe II] (47F)	$a^2P_{3/2}$ – $b^2F_{5/2}$	7434.29	
		Mn II (4)	a^5P_2 – z^5P_3	7434.35	
7443.26	139	N I (3)	3s $^4P_{3/2}$ – 3p $^4S_{3/2}$	7444.35	
7450.33	125	Fe II (73)	$b^4D_{3/2}$ – $z^4D_{5/2}$	7451.39	
7453.52	2943	[Fe II] (14F)	$a^4F_{7/2}$ – $a^2G_{9/2}$	7454.59	
7458.52?	9	[V II] (4F)	a^5D_2 – a^5P_1	7459.84	Not in 98
7460.34	21	[V II] (4F)	a^5D_4 – a^5P_3	7461.35	Not in 98
7463.37	476	Fe II (73)	$b^4D_{5/2}$ – $z^4D_{5/2}$	7464.46	
7469.13	216	N I (3)	3s $^4P_{5/2}$ – 3p $^4S_{3/2}$	7470.35	
7480.85	136	Fe II (72)	$b^4D_{5/2}$ – $z^4F_{7/2}$	7481.76	
7486.15	31	N I	3p $^2D_{5/2}$ – 4d $^2P_{3/2}$	7487.24	
7496.63	139	Fe II	$e^6D_{7/2}$ – $w^6P_{5/2}$	7497.68	?E_u
7501.17	134	Unidentified			
7507.54	74	Fe II	$e^6D_{5/2}$ – (^{5}D)5p $^6P_{3/2}$	7508.60	?E_u
7511.43	49	Unidentified			Not in 98
7514.22	293	Fe II	$e^6D_{9/2}$ – $w^6P_{7/2}$	7515.23	?E_u
7516.34	278	Fe II	$z^4P_{5/2}$ – $c^4D_{7/2}$	7517.17	4p-4s
		Fe II (73)	$b^4D_{7/2}$ – $z^4D_{5/2}$	7517.90	
7521.59	29	Fe II	$e^6D_{3/2}$ – (^{4}D)sp $^6F_{5/2}$	7522.79	?E_u
7534.38	190	Fe II (72)	$b^4D_{7/2}$ – $z^4F_{7/2}$	7535.44	
7539.88	24	[Co II]	a^3F_4 – a^3P_2	7541.04	
7542.80	23	[V II]	a^5D_4 – a^5P_2	7544.03	
7547.8	38	N I	3p $^2D_{3/2}$ – 5s $^2P_{1/2}$	7548.29	
		[Mn II] (7F)	a^5D_4 – a^5G_5	7549.80	
7551.96	21	N I	3p $^2D_{5/2}$ – 5s $^2P_{3/2}$	7552.99	
7553.86	2	[Fe II] (1F)	$a^6D_{5/2}$ – $a^4P_{1/2}$	7554.50	?wl
7561.97	160	[Fe II]	$b^4F_{3/2}$ – $b^2D_{5/2}$	7563.37	
		[Mn II] (7F)	a^5D_4 – a^5G_6	7563.50	
7567.16	19	[Cr II]	$a^4D_{3/2}$ – $b^4F_{3/2}$	7567.96	
7571.0	13	[Cr II]	$a^4D_{3/2}$ – $b^4F_{7/2}$	7572.60	?wl
7573.21	44	[Co II]	a^3D_2 – a^5D_3	7574.53	
7580.37	74	Fe II	$e^6D_{3/2}$ – (^{3}D)sp $^6F_{3/2}$	7581.41	?E_u
		[Fe II]	$a^4D_{5/2}$ – $a^4H_{9/2}$	7581.67	
7584.88	38	[Cr II]	$a^4G_{11/2}$ – $b^4G_{11/2}$	7586.07	
7613.78	392	[Ni II] (7F)	$a^4F_{3/2}$ – $b^2D_{3/2}$	7614.82	
		[Fe II] (30F)	$a^4D_{3/2}$ – $b^4P_{3/2}$	7615.22	
7617.16	54	[Fe II]	$a^2H_{11/2}$ – $c^2G_{9/2}$	7618.56	
7622.08	126	Fe II	$e^6D_{3/2}$ – (^{5}D)5p $^6P_{3/2}$	7623.30	?E_u
7632.39	25	[Cr II]	$a^4G_{7/2}$ – $b^4G_{9/2}$	7632.94	
		[Cr II]	$a^4G_{9/2}$ – $b^4G_{9/2}$	7633.81	
7638.39	551	[Fe II] (1F)	$a^6D_{7/2}$ – $a^4P_{5/2}$	7639.64	
7656.27	102	Fe II (73)	$b^4D_{5/2}$ – $z^4D_{7/2}$	7657.59	
7658.36	113	Fe II	$z^4P_{3/2}$ – $c^4D_{5/2}$	7659.62	4p-4s
7661.69	153	Fe II	$e^6D_{5/2}$ – $w^6P_{5/2}$	7662.99	?E_u
7665.8	131	[Fe II] (1F)	$a^6D_{3/2}$ – $a^4P_{1/2}$	7667.41	?wl
7687.65	267	[Fe II] (1F)	$a^6D_{5/2}$ – $a^4P_{3/2}$	7689.05	
7691.39	68	Fe II	$e^6D_{1/2}$ – (^{5}D)5p $^6P_{3/2}$	7692.62	?E_u
7695.39	37	[Ni II] (8F)	$a^4F_{5/2}$ – $a^4P_{5/2}$	7696.68	
7697.10	23	[Mn II] (7F)	a^5D_3 – a^5G_4	7698.38	Not in 98
7704.23	62	[Mn II] (7F)	a^5D_3 – a^5G_5	7705.69	Not in 98
7712.41	1570	Fe II (73)	$b^4D_{7/2}$ – $z^4D_{7/2}$	7713.83	rd sh
		Fe II	$z^4D_{7/2}$ – $d^4P_{5/2}$	7713.56	4p-4s
7720.94	53	Unidentified			
7732.60	38	Fe II	$e^6D_{7/2}$ – $w^6P_{7/2}$	7733.80	?E_u
7733.9	63	[Fe II] (1F)	$a^6D_{1/2}$ – $a^4P_{1/2}$	7735.28	
7741.59	16	Unidentified			Not in 99
7751.89	337	[Ar III] (1F)	3p^4 $^3P_1$ – 3p^4 $^1D_2$	7753.24	Not in 98

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
7756.60	109	Unidentified			
7765.49	323	[Fe II] (30F)	$a^4D_{7/2} - b^4P_{5/2}$	7766.82	
7781.35	58	Fe II	$e^6D_{3/2} - w^6P_{5/2}$	7782.50	?E_u
7787.71	33	Mg II	5s $^2S_{1/2}$ – 6p $^2P_{3/2}$	7788.64	Not in 98 id?
7790.19	23	Fe II	$e^4D_{7/2}$ – 4p $^4P_{5/2}$	7791.41	?E_u
7792.46	70	[Cr II]	$a^4D_{7/2} - b^4F_{5/2}$	7793.66	
		[Cr II]	$a^4D_{7/2} - b^4F_{9/2}$	7794.05	
7802.09	55	Fe II	$z^4P_{1/2} - c^4D_{3/2}$	7803.40	4p-4s
7807.26	58	[Fe II] (1F)	$a^6D_{5/2} - a^4P_{5/2}$	7808.40	
7809.55	19	[Mn II] (7F)	$a^5D_2 - a^5G_4$	7811.05	?wl
7817.02	29	He I (69)	3s $^3S_1$ – 7p ^{3}P1	7818.30	Not in 98
7836.65	64	Fe II	$z^4P_{1/2} - c^4D_{1/2}$	7838.06	4p-4s
7842.18	29	Fe II (72)	$b^4D_{7/2} - z^4F_{9/2}$	7843.54	
7850.52	13	Si II	4d $^2D_{5/2}$ – 5f $^2F_{5/2}$	7851.78	Not in 99 id?
		Si II	4d $^2D_{5/2}$ – 5f $^2F_{7/2}$	7851.88	id? E_u?
7863.16	6	Unidentified			Not in 99
7867.51	770	Fe II	$z^4D_{5/2} - d^4P_{3/2}$	7868.72	4p-4s
7876.90	111	[P II] (3F)	$3p^2\ ^1D_2 - 3p^2\ ^1S_0$	7878.16	?id
7880.30	46	[Mn II] (7F)	$a^5D_1 - a^5G_2$	7881.40	
		[Mn II] (7F)	$a^5D_1 - a^5G_3$	7881.89	
7887.15	48	N I	3p $^2P_{1/2}$ – 4d $^2D_{3/2}$	7888.39	Not in 99
7891.06	242	[Ni III]	$3d^8\ ^3F_3 - 3d^8\ ^1D_2$	7892.10	Not in 98
7895.30	193	Fe II	$e^6D_{7/2}$ – 5p $^4P_{5/2}$	7896.75	Lyα
		N I	3p $^2P_{3/2}$ – 4d $^2D_{5/2}$	7896.15	
7897.34	75	Mg II (8)	4p $^2P_{3/2}$ – 4d $^2D_{5/2}$	7898.54	Not in 98
7909.7	53	Fe II	$e^6D_{5/2} - w^6P_{7/2}$	7909.81	
		N I	3p $^2P_{3/2}$ – 4d $^2D_{3/2}$	7910.65	
7918.71	273	Fe II	$z^4D_{5/2} - d^4P_{5/2}$	7919.98	4p-4s
7954.25?	18	[Fe II]	$a^2H_{11/2} - a^2I_{11/2}$	7955.70	Not in 99
7970.0	91	Fe II	$e^6D_{5/2}$ – 5p $^4F_{5/2}$	7971.21	Lyα
7971.51	344	Fe II	$e^6D_{7/2}$ – 5p $^4F_{7/2}$	7972.63	Lyα
7976.72	445	Fe II	$z^4D_{3/2} - d^4P_{1/2}$	7978.10	4p-4s
7983.01	227	Fe II	$e^6D_{9/2}$ – 5p $^4F_{9/2}$	7984.09	Lyα
8001.35	1428	[Cr II] (1F)	$a^6S_{5/2} - a^6D_{9/2}$	8002.28	
8009.94	140	Fe II	$e^6D_{3/2}$ – 5p $^4F_{3/2}$	8010.83	?wl; Lyα
		[Fe II]	$a^2P_{1/2} - b^4D_{1/2}$	8011.75	?wl
8032.31	62	Fe II	$b^2F_{7/2} - z^4D_{7/2}$	8033.53	
8034.87	11	[Ni II] (8F)	$a^4F_{3/2} - a^4P_{5/2}$	8035.75	wl?
8038.82	93	Fe II	$e^6D_{9/2}$ – 5p $^6F_{7/2}$	8039.23	Lyα
		[Fe II] (30F)	$a^4D_{5/2} - b^4P_{5/2}$	8039.46	?wl
8084.85	122	Fe II	$z^4D_{3/2} - d^4P_{5/2}$	8086.10	4p-4s
8092.41	107	Fe II	$e^6D_{1/2}$ – 5p $^4D_{1/2}$	8093.39	Lyα
8100.96	193	[Cr II]	$a^4G_{5/2} - b^4F_{5/2}$	8101.83	
		[Cr II]	$a^4G_{5/2} - b^4F_{9/2}$	8102.25	
		[Cr II]	$a^4G_{11/2} - b^4F_{9/2}$	8102.28	
8107.87	91	[Cr II]	$a^4G_{5/2} - b^4F_{3/2}$	8108.52	
		[Cr II]	$a^4D_{7/2} - a^2F_{7/2}$	8109.20	
		Fe II	$z^4F_{5/2} - d^4P_{5/2}$	8109.52	4p-4s
		[Fe II]	$a^4P_{5/2} - a^4G_{9/2}$	8109.70	
8111.35	904	Mn II	$z^5P_3 - c^5D_4$	8112.62	4p-4s
8116.4	146	[Cr II]	$a^4G_{7/2} - b^4F_{7/2}$	8117.64	
8122.03	103	[Co II]	$a^3F_3 - a^3P_2$	8123.31	
8126.33	916	[Cr II] (1F)	$a^6S_{5/2} - a^6D_{7/2}$	8127.53	
8130.26	31	N I	3p $^2P_{3/2}$ – 5s $^2P_{5/2}$	8131.41	
8133.75	17	Unidentified			
8137.56	133	Fe II	$z^4D_{1/2} - d^4P_{3/2}$	8138.78	4p-4s
8141.56	88	Unidentified			
8158.53	509	Fe II	$e^6D_{5/2}$ – 5p $^4F_{7/2}$	8159.78	Lyα
8162.04	17	Fe II	$e^6D_{7/2}$ – 5p $^6F_{5/2}$	8163.18	Lyα
8169.0	20	Fe II	$b^4G2_{7/2} - x^4F_{5/2}$	8170.55	?id
8174.3	9	Fe II	$b^4G2_{11/2} - y^4H_{11/2}$	8175.72	Not in 99 id?
8185.87	139	N I (2)	3s $^4P_{3/2}$ – 3p $^4P_{5/2}$	8187.11	
8189.03	142	N I (2)	3s $^4P_{1/2}$ – 3p $^4P_{3/2}$	8190.26	
8191.57	150	Fe II	$e^6D_{9/2}$ – 5p $^6F_{9/2}$	8192.88	Lyα

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{\rm lab,vac}$	Comment
8199.63	15	[Fe II]	$a^2D2_{3/2} - c^2G_{7/2}$	8201.28	?wl
8201.4	40	N I (2)	$3s\ ^4P_{1/2} - 3p\ ^4P_{1/2}$	8202.61	
8208.13	99	Fe II	$e^6D_{9/2} - 4p\ ^4G_{9/2}$	8209.41	Lyα
8211.8	156	N I (2)	$3s\ ^4P_{3/2} - 3p\ ^4P_{3/2}$	8212.98	
		Fe II	$e^6D_{3/2} - 5p\ ^4P_{5/2}$	8213.33	Lyα
8217.31	365	N I (2)	$3s\ ^4P_{5/2} - 3p\ ^4P_{5/2}$	8218.60	
8222.4	195	Fe II	$e^6D_{7/2} - 5p\ ^4D_{7/2}$	8223.56	Lyα
8224.06	224	N I (2)	$3s\ ^4P_{3/2} - 3p\ ^4P_{1/2}$	8225.39	
		Fe II	$z^6F_{9/2} - b^4G_{9/2}$	8224.48	4p-4s
8230.38	1893	Fe II	$e^6D_{7/2} - 5p\ ^4F_{9/2}$	8231.23	Lyα
		[Cr II] (1F)	$a^6S_{5/2} - a^6D_{5/2}$	8232.23	
8235.49?	50	Mg II (7)	$4p\ ^2P_{3/2} - 5s\ ^2S_{1/2}$	8236.90	
		H I	Paschen 49	8236.70	
8237.99	45	H I	Paschen 47	8239.40	Not in 98
		Fe II	$e^4D_{3/2} - 5p\ ^4P_{1/2}$	8239.41	?E_u
8243.36	266	N I (2)	$3s\ ^4P_{5/2} - 3p\ ^4P_{3/2}$	8244.65	
8251.29	154	Fe II	$z^6F_{9/2} - b^4G_{11/2}$	8252.62	4p-4s
8260.43	136	[Fe II]	$a^2H_{9/2} - a^2I_{11/2}$	8261.64	
		Fe II	$b^4G_{9/2} - x^4F_{7/2}$	8261.97	
8265.35	99	H I	Paschen 35	8266.56	Not in 98
8269.00	47	H I	Paschen 34	8270.22	Not in 98
8272.91	82	H I	Paschen 33	8274.21	
		[Cr II] (25F)	$a^4G_{7/2} - a^2F_{5/2}$	8274.33	
8277.47	63	H I	Paschen 32	8278.59	Not in 98
8282.28	116	H I	Paschen 31	8283.40	Not in 98
8285.16	24	Fe II	$e^6D_{5/2} - 5p\ ^6F_{3/2}$	8286.31	Lyα
8288.62	2586	Fe II	$e^6D_{7/2} - 5p\ ^6F_{7/2}$	8289.85	Lyα
		Fe II	$e^6D_{9/2} - 5p\ ^6F_{11/2}$	8290.12	?E_u
8293.38	123	H I	Paschen 29	8294.59	
8299.76	115	H I	Paschen 28	8301.12	
8302.23	210	[Ni II] (2F)	$a^2D_{3/2} - a^2F_{7/2}$	8303.27	
8307.01	356	Fe II	$z^6F_{7/2} - b^4G_{9/2}$	8307.99	4p-4s
		[Fe II]	$a^4H_{11/2} - c^2G_{9/2}$	8308.33	
		H I	Paschen 27	8308.39	
8309.59	394	[Cr II] (1F)	$a^6S_{5/2} - a^6D_{3/2}$	8310.77	
8315.20	171	H I	Paschen 26	8316.55	Not in 98
8324.21	165	H I	Paschen 25	8325.72	
8331.40	180	Mn II	$z^5P_3 - c^5D_3$	8332.52	4p-4s
8334.70	226	H I	Paschen 24	8336.07	
		[Co II]	$a^3F_2 - a^3P_0$	8336.11	
		[Ti II]	$a^2F_{5/2} - b^2P_{3/2}$	8335.74	
8343.61	27	[Fe II] (30F)	$a^4D_{1/2} - b^4P_{5/2}$	8344.59	
8346.53	238	H I	Paschen 23	8347.85	
8358.36	1517	Fe II	$e^6D_{5/2} - 5p\ ^6F_{5/2}$	8359.53	Lyα
8360.0	382	H I	Paschen 22	8361.30	
8362.66	188	He I (68)	$3s\ ^3S - 6p\ ^3P$	8363.99	Not in 98
8368.10	35	Fe II	$z^6F_{5/2} - b^4G_{7/2}$	8369.32	4p-4s
8375.42	263	H I	Paschen 21	8376.78	
8379.79	25	Unidentified			
8388.30	203	[Fe II]	$a^4H_{9/2} - c^2G_{7/2}$	8389.53	
8393.37	376	H I	Paschen 20	8394.71	
8401.76?	45	[Cr II]	$a^4D_{3/2} - a^2D_{3/2}$	8403.31	Not in 98
8411.32	308	Mn II	$z^5P_2 - c^5D_3$	8412.52	4p-4s
8414.28	338	H I	Paschen 19	8415.63	
8421.50	328	Fe II	$e^6D_{5/2} - 5p\ ^4D_{7/2}$	8422.86	Lyα
8424.92	339	Fe II	$e^6D_{3/2} - 5p\ ^6F_{3/2}$	8426.22	Lyα
8438.92	474	H I	Paschen 18	8440.28	
8447.38	901	O I (4)	$3s\ ^3S_1 - 3p\ ^3P_0$	8448.57	Lyβ
		O I (4)	$3s\ ^3S_1 - 3p\ ^3P_2$	8448.68	Lyβ
		O I (4)	$3s\ ^3S_1 - 3p\ ^3P_1$	8449.08	Lyβ
8451.91	2096	Fe II	$e^6D_{7/2} - 5p\ ^6F_{9/2}$	8453.33	Lyα
8468.4	471	H I	Paschen 17	8469.59	
8469.49	1478	Fe II	$e^6D_{7/2} - 4p\ ^4G_{9/2}$	8470.92	Lyα
8480.95	154	[Fe II]	$a^4H_{7/2} - c^2G_{7/2}$	8482.24	

Table C.1. continued.

$\lambda_{\rm obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition	$\lambda_{\rm lab,vac}$ (Å)	Comment
8491.03	6392	Fe II	$e^6D_{5/2} - 5p\ ^6F_{7/2}$	8492.44	Lyα
8500.58	1502	Fe II	$e^6D_{3/2} - 5p\ ^6F_{5/2}$	8501.94	Lyα
8503.36	460	H I	Paschen 16	8504.82	
8509.60	215	Fe II	$e^6D_{1/2} - 5p\ ^6F_{3/2}$	8511.00	Lyα
8524.69	168	Fe II	$z^6D_{9/2} - c^4F_{7/2}$	8526.00	4p-4s
8543.15	175	Ca II (2)	$3d\ ^2D_{5/2} - 4p\ ^2P_{3/2}$	8544.44	
8546.49	1030	H I	Paschen 15	8547.73	
		Fe II	$z^6D_{9/2} - c^4F_{9/2}$	8548.12	4s-4p
8568.73	156	N I (8)	$3s\ ^2P_{1/2} - 3p\ ^2P_{3/2}$	8570.09	
8572.20	8	[Co II]	$a^3F_2 - a^3P_2$	8573.79	
8576.07	66	Fe II	$c^4D_{1/2} - w^4P_{3/2}$	8577.32	
8579.77	131	[Cl II] (1F)	$3p^4\ ^3P_2 - 3p^4\ ^1D_2$	8581.05	?id
		[V II] (11F)	$a^5F_3 - a^3G_3$	8581.46	?wl
8583.2	25	Fe II	$b^4G_{7/2} - x^4G_{7/2}$	8585.08	Not in 98
8595.45	558	N I (8)	$3s\ ^2P_{1/2} - 3p\ ^2P_{1/2}$	8596.36	
		Mn II	$z^5P_2 - c^5D_2$	8597.22	4p-4s
8599.37	843	H I	Paschen 14	8600.76	
8601.47	215	[Fe II]	$a^4H_{13/2} - a^2I_{13/2}$	8602.86	
8617.99	3025	[Fe II] (13F)	$a^4F_{9/2} - a^4P_{5/2}$	8619.33	
8630.24	993	N I (8)	$3s\ ^2P_{3/2} - 3p\ ^2P_{3/2}$	8631.61	
8649.84	118	Mn II	$z^5P_1 - c^5D_2$	8651.14	4p-4s
		[Ti II] (16F)	$b^4F_{9/2} - a^2H_{11/2}$	8651.38	
8654.45	59	Fe II	$z^6D_{7/2} - c^4P_{5/2}$	8655.93	4p-4s
8656.87	168	N I (8)	$3s\ ^2P_{3/2} - 3p\ ^2P_{1/2}$	8658.26	
8663.34	203	Ca II (2)	$3d\ ^2D_{3/2} - 4p\ ^2P_{1/2}$	8664.52	
8666.05	847	H I	Paschen 13	8667.40	
8673.25	696	Fe II	$z^6D_{7/2} - c^4F_{7/2}$	8674.71	4p-4s
8681.40	284	N I (1)	$3s\ ^4P_{5/2} - 3p\ ^4D_{7/2}$	8682.67	
8684.47	384	N I (1)	$3s\ ^4P_{3/2} - 3p\ ^4D_{5/2}$	8685.79	
8687.29	325	N I (1)	$3s\ ^4P_{1/2} - 3p\ ^4D_{3/2}$	8688.54	
8696.19	75	Fe II	$z^6D_{7/2} - c^4F_{9/2}$	8697.60	4p-4s
		Mn II	$e^7S_3 - x^7P_4$	8697.60	
8704.53	300	N I (1)	$3s\ ^4P_{1/2} - 3p\ ^4D_{1/2}$	8705.64	
		[Cr II] (18F)	$a^4D_{3/2} - a^4F_{5/2}$	8706.08	
8707.73	264	Fe II	$z^6D_{7/2} - c^4F_{5/2}$	8708.71	4p-4s
		Cr II	$e^6D_{5/2} - 5p\ ^6P_{7/2}$	8709.02	Lyα
		[Fe II] (52F)	$a^2D2_{5/2} - b^2F_{7/2}$	8709.22	
8710.00	14	[Fe II]	$a^4H_{11/2} - a^2I_{11/2}$	8711.15	
8712.81	233	N I (1)	$3s\ ^4P_{3/2} - 3p\ ^4D_{3/2}$	8714.09	
8716.91	218	[Fe II] (42F)	$a^2G_{9/2} - a^2F_{7/2}$	8718.19	
8719.92	84	N I (1)	$3s\ ^4P_{5/2} - 3p\ ^4D_{5/2}$	8721.23	
8723.46	476	Fe II	$e^4D_{7/2} - 5p\ ^4P_{5/2}$	8724.82	Lyα
8729.84	155	N I (1)	$3s\ ^4P_{3/2} - 3p\ ^4D_{1/2}$	8731.30	
		Mn II	$z^5P_2 - c^5D_1$	8730.92	4p-4s
8735.88	86	[Fe II]	$a^4H_{11/2} - a^2I_{13/2}$	8737.22	
8740.15	21	[Fe II]	$b^2P_{3/2} - a^2S_{1/2}$	8741.47	
8751.50	1208	H I	Paschen 12	8752.87	
8758.3 ?	40	Cr II	$e^6D_{9/2} - x^6D_{9/2}$	8759.76	Lyα
8761.8 ?	31	Cr II	$e^6D_{7/2} - x^6D_{7/2}$	8783.62	Lyα; ?wl
8770.21	69	Mn II	$e^7S_3 - x^7P_3$	8771.58	
8777.85	8	He I	$3p\ ^3P_2 - 9d\ ^3D_3$	8779.18	Not in 98
8782.04	69	Cr II	$e^6D_{5/2} - x^6D_{5/2}$	8783.62	Lyα
8785.33	436	Cr II	$e^6D_{3/2} - 5p\ ^6P_{5/2}$	8786.82	Lyα
		Mn II	$z^5P_1 - c^5D_1$	8786.53	4p-4s
8793.58	21	[Cr II] (18F)	$a^4D_{5/2} - a^4F_{7/2}$	8794.53	?wl
8802.91	19	Unidentified			
8806.26	416	Fe II	$z^6D_{5/2} - c^4P_{5/2}$	8807.58	4p-4s
8807.5	149	Mg I (7)	$3p\ ^1P_1 - 3d\ ^1D_2$	8809.17	?id
8810.61	29	Fe II	$b^4G_{11/2} - x^4G_{11/2}$	8812.25	
8815.63	30	Fe II	$e^4D_{7/2} - 5p\ ^4F_{7/2}$	8817.44	Lyα; ?wl
8821.09	157	Mn II	$e^7S_3 - x^7P_2$	8822.01	
		Cr II	$e^6D_{3/2} - x^6D_{3/2}$	8822.71	Lyα
8825.72	178	Fe II	$z^6D_{5/2} - c^4F_{7/2}$	8827.02	4p-4s
8830.78	790	Cr II	$e^6D_{7/2} - 5p\ ^6P_{7/2}$	8832.26	Lyα

Table C.1. continued.

$\lambda_{\mathrm{obs,vac}}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{\mathrm{lab,vac}}$	Comment
8834.94	28	Fe II	$(^3H)5s\ e^4H_{9/2} - (^3H)5p\ ^4I_{11/2}$	8836.39	?E_u
8839.93	576	Cr II	$e^6D_{1/2} - 5p\ ^6P_{3/2}$	8841.35	Lyα
8863.85	1676	H I	Paschen 11	8865.22	
8866.45	29	Cr II	$e^6D_{1/2} - x^6D_{1/2}$	8867.54	Lyα
8876.92	396	Cr II	$e^6D_{5/2} - 5p\ ^6P_{5/2}$	8878.43	Lyα
8886.88	156	[Fe II] (42F)	$a^2G_{7/2} - a^2F_{5/2}$	8888.06	
8893.05	1209	[Fe II] (13F)	$a^4F_{7/2} - a^4P_{3/2}$	8894.32	
8896.29	248	Cr II	$e^6D_{3/2} - 5p\ ^6P_{3/2}$	8897.74	Lyα
8907.59	991	Cr II	$e^6D_{7/2} - 5p\ ^6P_{5/2}$	8909.00	Lyα
8913.60	637	Fe II	$z^6D_{5/2} - c^4F_{3/2}$	8915.08	4p-4s
		Cr II	$e^6D_{5/2} - x^6D_{3/2}$	8915.07	Lyα
8917.42	1344	Cr II	$e^6D_{9/2} - x^6D_{7/2}$	8918.89	Lyα
8923.19	145	Cr II	$e^6D_{3/2} - x^6D_{1/2}$	8924.63	Lyα
8927.66	4564	Fe II	$e^4D_{7/2} - 5p\ ^4D_{5/2}$	8929.10	Lyα
8939.09	108	Fe II	$e^4D_{5/2} - 5p\ ^4F_{5/2}$	8940.50	Lyα
8948.10	12	Unidentified			Not in 98
8957.06	131	Fe II	$e^4D_{5/2} - 5p\ ^4D_{3/2}$	8958.36	Lyα
8988.96	69	Cr II	$e^6D_{9/2} - 5p\ ^6P_{7/2}$	8990.30	Lyα
9016.05	2150	H I	Paschen 10	9017.39	
9029.94	134	N I (15)	$3p\ ^2S_{1/2} - 3d\ ^2P_{1/2}$	9031.40	
9034.65	262	[Fe II] (13F)	$a^4F_{5/2} - a^4P_{1/2}$	9035.98	
9046.75	68	N I	$3s'\ ^2D_{5/2} - 3p'\ ^2F_{7/2}$	9048.36	?id
9053.22	692	[Fe II] (13F)	$a^4F_{7/2} - a^4P_{5/2}$	9054.43	
9061.73	246	N I (15)	$3p\ ^2S_{1/2} - 3d\ ^2P_{3/2}$	9062.96	
9069.9	756	[S III] (1F)	$3p^2\ ^3P_1 - 3p^2\ ^1D_2$	9071.11	Not in 98
9071.66	744	Fe II	$e^4D_{3/2} - 5p\ ^4D_{1/2}$	9072.95	Lyα
		[Cr II]	$a^4P_{5/2} - b^4F_{3/2}$	9072.56	
9076.82	2248	Fe II	$e^4D_{5/2} - 5p\ ^4P_{5/2}$	9078.01	Lyα
9078.62	486	Fe II	$e^4D_{5/2} - 4p\ ^4P_{3/2}$	9079.86	Lyα
9084.28	42	[Fe II] (49F)	$a^2H_{9/2} - b^2F_{5/2}$	9085.91	
		[Co II]	$a^3P_1 - b^3P_0$	9085.23	
		[Co II]	$a^3P_2 - b^3P_1$	9085.29	
9096.04	184	Fe II	$e^6D_{9/2} - (^5D)5p\ ^6D_{7/2}$	9097.60	?E_u
9107.74?	19	[V II] (25F)	$a^3P_0 - a^1P_1$	9109.10	Not in 98 id?
9112.99?	29	Unidentified			
9117.57	35	Fe II	$z^6D_{1/2} - c^4F_{3/2}$	9118.60	4p-4s
		[Fe II] (51F)	$a^2D2_{5/2} - b^4D_{7/2}$	9118.92	
		Fe II	$c^4F_{3/2} - z^4G_{5/2}$	9119.23	
9123.86	1380	Fe II	$e^4D_{7/2} - 5p\ ^4D_{7/2}$	9125.41	Lyα
9133.41	1300	Fe II	$e^4D_{7/2} - 5p\ ^4F_{9/2}$	9134.89	Lyα
9138.48	3	Unidentified			Not in 99
9141.83	20	[V II] (9F)	$a^5F_1 - b^3F_3$	9142.56	?id
		Cr II	$e^6D_{9/2} - (^5D)5p\ ^6D_{9/2}$	9143.46	?E_u
9151.87	15	Cr II	$e^6D_{7/2} - (^5D)5p\ ^6D_{7/2}$	9153.26	?E_u
9157.00	132	Fe II	$x^4P_{1/2} - e^4D_{1/2}$	9158.31	Lyα sec.
		Fe II	$e^6D_{5/2} - (^4P)sp\ ^6P_{5/2}$	9158.34	?E_u
9176.96	2592	Fe II	$e^4D_{5/2} - 5p\ ^4F_{7/2}$	9178.40	Lyα
9179.05	2419	Fe II	$e^4D_{3/2} - 5p\ ^4F_{5/2}$	9180.55	Lyα
9188.27	243	Fe II	$e^6D_{7/2} - (^5D)5p\ ^6D_{5/2}$	9189.67	?E_u
9198.01	1482	Fe II	$e^4D_{3/2} - 5p\ ^4D_{3/2}$	9199.40	Lyα
9204.37	3681	Fe II	$e^4D_{1/2} - 5p\ ^4F_{3/2}$	9205.65	Lyα
9205.5	2957	Fe II	$e^4D_{7/2} - 5p\ ^6F_{7/2}$	9206.60	Lyα
		Fe II	$e^6D_{9/2} - (^5D)5p\ ^6D_{9/2}$	9206.58	?E_u
9212.00	567	Fe II	$e^4D_{1/2} - 5p\ ^4D_{1/2}$	9213.41	Lyα
9219.25	67	Mg II (1)	$4s\ ^2S_{1/2} - 4p\ ^2P_{3/2}$	9220.78	
9227.89	207	[Fe II] (13F)	$a^4F_{5/2} - a^4P_{3/2}$	9229.15	
9230.15	2394	H I	Paschen 9	9231.55	
9232.74	82	[Fe II]	$b^4F_{9/2} - c^2G_{9/2}$	9234.24	
9245.37	94	Mg II (1)	$4s\ ^2S_{1/2} - 4p\ ^2P_{1/2}$	9246.80	
9252.75	114	Fe II	$e^6D_{5/2} - (^5D)5p\ ^6D_{3/2}$	9254.30	?E_u
9268.71	428	[Fe II] (13F)	$a^4F_{3/2} - a^4P_{1/2}$	9270.11	
9273.44	45	Fe II	$e^6D_{1/2} - (^4P)sp\ ^6P_{3/2}$	9274.76	?E_u
9298.08	1459	Fe II	$e^4D_{5/2} - 5p\ ^4D_{5/2}$	9299.44	Lyα
9304.84	191	Fe II	$e^6D_{3/2} - (^5D)5p\ ^6D_{1/2}$	9306.16	?E_u

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
9308.68	3	Unidentified			Not in 99
9324.31	114	Fe II	$e^4D_{3/2} - 5p\ ^4P_{5/2}$	9325.62	Lyα
9328.21	74	Fe II	$e^6D_{3/2} - (^4P)sp\ ^6P_{5/2}$	9329.52	?E_u
9337.12	76	Fe II	$e^4D_{5/2} - 5p\ ^6F_{3/2}$	9338.81	Lyα
		[Co II]	$a^3F_4 - b^3F_3$	9338.40	
9343.69	165	Fe II	$e^4D_{1/2} - 5p\ ^4D_{3/2}$	9343.83	Lyα
		[Cr II] (23F)	$a^4G_{7/2} - a^4F_{9/2}$	9344.47	
		[Cr II] (23F)	$a^4G_{9/2} - a^4F_{9/2}$	9345.78	
9350.09?	26	Cr II	$e^6D_{5/2} - (^5D)5p\ ^6D_{3/2}$	9351.68	Not in 99 E_u?
9352.29	147	[Fe II]	$b^4F_{7/2} - c^2G_{7/2}$	9353.75	
9378.22	73	Fe II	$e^4D_{3/2} - 4p\ ^4P_{1/2}$	9379.53	Lyα
9383.13	60	[Fe II]	$b^4F_{7/2} - c^2G_{9/2}$	9384.29	
9387.97	439	N I (7)	$3s\ ^2P_{1/2} - 3p\ ^2D_{3/2}$	9389.38	
		[Cr II] (23F)	$a^4G_{7/2} - a^4F_{7/2}$	9389.01	
		[Cr II] (23F)	$a^4G_{9/2} - a^4F_{7/2}$	9390.33	
9389.99	601	Fe II	$z^6D_{5/2} - c^4P_{3/2}$	9391.48	4p-4s
9393.93	946	N I (7)	$3s\ ^2P_{3/2} - 3p\ ^2D_{5/2}$	9395.37	
9400.23	95	[Fe II] (13F)	$a^4F_{5/2} - a^4P_{5/2}$	9401.62	
9407.88	864	Fe II	$e^4D_{7/2} - 5p\ ^6F_{9/2}$	9409.21	Lyα
		Fe II	$e^4D_{1/2} - (^5D)5p\ ^6D_{1/2}$	9409.66	?E_u
9415.5	16	Fe II	$c^4F_{7/2} - z^4G_{9/2}$	9416.71	
9418.65	34	Fe II	$e^6D_{7/2} - (^5D)5p\ ^6D_{7/2}$	9419.88	?E_u
9422.26	9	Unidentified			Not in 99
9424.13	2	Cr II	$c^4D_{1/2} - z^4P_{3/2}$	9425.34	Not in 99 id?
9424.97	11	Unidentified			Not in 98
9429.66	642	Fe II	$e^4D_{7/2} - 4p\ ^4G_{9/2}$	9431.02	Lyα
		Fe II	$e^4D_{5/2} - 5p\ ^6F_{5/2}$	9431.90	Lyα
9438.10	36	Fe II	$e^6D_{5/2} - (^5D)5p\ ^6D_{5/2}$	9439.26	Not in 98 E_u?
9445.28	196	[Fe III]	$3d^6\ ^3H_5 - 3d^6\ ^1G_4$	9446.80	Not in 98
9448.08	17	Mn II	$b^5D_4 - z^5P_3$	6449.44	
9453.23	44	[Cr II]	$b^4D_{7/2} - b^2H_{9/2}$	9454.79	?id
9461.78	186	N I (7)	$3s\ ^2P_{3/2} - 3p\ ^2D_{3/2}$	9463.27	
9464.70	357	He I (67)	$3s\ ^3S - 5p\ ^3P$	9466.19	Not in 98
9466.3	205	Fe II	$c^4P_{1/2} - z^4S_{3/2}$	9467.47	
		[Fe II]	$b^4F_{5/2} - c^2G_{7/2}$	9468.00	
9470.5	31	[Fe II]	$b^4P_{5/2} - b^4D_{5/2}$	9472.06	
9472.02	155	[Fe II] (13F)	$a^4F_{3/2} - a^4P_{3/2}$	9473.53	
9476.70	7	Unidentified			Not in 99
9483.22	25	[Fe II]	$a^2F_{5/2} - c^2D_{5/2}$	9484.26	?wl
9491.66	28	[Fe II]	$b^4P_{5/2} - b^4D_{3/2}$	9493.20	
		[Cr II]	$b^4D_{1/2} - b^2F_{5/2}$	9493.25	?id
9498.91	284	Fe II	$z^4P_{5/2} - d^4P_{3/2}$	9500.42	4p-4s
9501.27	87	Unidentified			
9511.31	48	Fe II	$e^4D_{5/2} - 5p\ ^4D_{7/2}$	9512.60	Lyα
9515.44	31	[Fe II]	$a^2G_{9/2} - b^2H_{9/2}$	9516.45	Not in 99 wl?
9517.89	45	He I (76)	$3p\ ^3P - 7d\ ^3D$	9519.24	Not in 98
9528.07	161	Fe II	$z^6D_{3/2} - c^4P_{3/2}$	9529.52	4p-4s
9532.16	2014	[S III] (1F)	$3p^2\ ^3P_2 - 3p^2\ ^1D_2$	9533.23	Not in 98
9547.14	3990	H I	Paschen 8	9548.59	
9555.54		[Cr II]	$b^4P_{1/2} - a^2S_{1/2}$	9557.30	
9557.97		Fe II	$e^4D_{3/2} - 5p\ ^4D_{5/2}$	9559.46	Lyα
9561.15	159	Fe II	$z^4D_{7/2} - d^2F_{7/2}$	9562.66	4p-4s
9573.78	699	Fe II	$z^4P_{5/2} - d^4P_{5/2}$	9575.23	4p-4s
9581.65	55	Mn II	$z^5P_3 - e^3F_4$	9582.87	4p-3d
9591.96?	21	Fe II	$z^4D_{7/2} - d^2F_{5/2}$	9593.57	4p-4s
		[Cr II] (16F)	$a^4D_{1/2} - b^4P_{1/2}$	9593.59	
9599.82	497	Fe II	$e^4D_{5/2} - 5p\ ^6F_{7/2}$	9601.41	Lyα
		Fe II	$e^4D_{3/2} - 5p\ ^6F_{3/2}$	9601.05	Lyα
9604.26	16	Mn II	$z^5P_3 - e^3F_3$	9605.04	4p-3d
		He I (71)	$3s\ ^1S_0 - 6p\ ^1P_1$	9606.05	
9609.62	63	[Fe III]	$3d^6\ ^3H_4 - 3d^6\ ^1G_4$	9611.23	Not in 98
9616.06	998	Fe II	$z^6D_{1/2} - c^4P_{3/2}$	9617.60	4p-4s
9619.60	45	Fe II	$e^6D_{3/2} - (^5D)5p\ ^6D_{5/2}$	9621.24	?E_u
9625.00	13	Unidentified			Not in 99

Table C.1. continued.

$\lambda_{obs,vac}$ (Å)	Intensity (rel units)	Spectrum	Transition (Å)	$\lambda_{lab,vac}$	Comment
9662.39	112	Fe II	$e^4D_{9/2} - (^4P)sp\ ^6D_{7/2}$	9663.87	?E_u
9671.01?	20	[Fe II]	$b^2P_{3/2} - b^2D_{3/2}$	9672.31	Not in 99
9683.26	63	[Fe II]	$a^2G_{9/2} - b^2H_{11/2}$	9684.73	
9698.12	109	Fe II	$e^4D_{3/2} - 5p\ ^6F_{5/2}$	9699.48	Lyα
9702.92	128	[Fe III]	$3d^6\ ^3H_6 - 3d^6\ ^1I_6$	9703.93	Not in 98
		He I (75)	$3p\ ^3P - 7s\ ^3S$	9705.3	
9709.99	42	Mn II	$z^5P_2 - e^3F_3$	9711.50	4p-3d
9712.63	16	[Fe II]	$b^2P_{1/2} - a^2S_{1/2}$	9713.85	Not in 99
9781.29	23	Unidentified			Not in 99
9813.25	234	Fe II	$z^4P_{3/2} - d^4P_{1/2}$	9814.81	4p-4s
9850.44	136	Fe II	$z^4F_{7/2} - d^2F_{7/2}$	9851.80	4p-4s
9880.43	112	Fe II	$z^4D_{5/2} - d^2F_{7/2}$	9881.95	4p-4s
9882.1	54	Fe II	$z^4D_{5/2} - c^2P_{3/2}$	9883.84	4p-4s
9887.28?	37	Mn II	$z^5P_2 - c^3P_2$	9888.76	4p-3d
9896.17	201	Fe II	$z^4P_{3/2} - d^4P_{3/2}$	9897.54	4p-4s
9911.48	953	Fe II	$z^6D_{3/2} - c^4P_{1/2}$	9913.03	4p-4s
9944.1	154	[Fe III]	$3d^6\ ^3H_5 - 3d^6\ ^1I_6$	9944.90	Not in 98
		[Co II]	$a^3F_2 - a^1D_2$	9946.13	
9950.36	70	[Fe II]	$a^2H_{11/2} - b^2G_{9/2}$	9951.99	
9953.6	33	Cr II	$e^4D_{3/2} - (^5D)5p\ ^4F_{5/2}$	9955.22	Lyα
9957.52	403	Fe II	$z^4F_{9/2} - b^4G_{9/2}$	9959.05	4p-4s
		Mn II	$z^5P_1 - c^3P_2$	9960.17	4p-3d
9971.4	93	Unidentified			
9975.83	242	Cr II	$e^4D_{7/2} - (^5D)5p\ ^4F_{9/2}$	9977.56	Lyα
9998.79	2221	Fe II	$z^4F_{9/2} - b^4G_{11/2}$	10000.34	4p-4s
10006.71	252	Fe II	$z^6D_{1/2} - c^4P_{1/2}$	10008.38	4p-4s
10050.58	4556	H I	Paschen 7	10052.13	
10069.30	171	Cr II	$e^4D_{7/2} - x^6D_{9/2}$	10070.97	Lyα
10107.21	34	N I (18)	$3p\ ^4D_{1/2} - 3d\ ^4F_{3/2}$	10107.90	
10110.77	97	N I (18)	$3p\ ^4D_{3/2} - 3d\ ^4F_{5/2}$	10111.66	
		Cr II	$e^4D_{1/2} - x^6D_{3/2}$	10113.01	Lyα
10114.48	85	N I (18)	$3p\ ^4D_{5/2} - 3d\ ^4F_{7/2}$	10115.25	
10116.38	35	N I (18)	$3p\ ^4D_{7/2} - 3d\ ^4F_{9/2}$	10117.41	
10133.61	93	Fe II	$z^4P_{1/2} - d^4P_{3/2}$	10134.56	4p-4s
10165.9	21	Fe II	$z^4D_{7/2} - b^4G_{7/2}$	10166.39	4p-4s
		N I (18)	$3p\ ^4D_{7/2} - 3d\ ^4F_{7/2}$	10167.63	
10171.0		Unidentified			
10175.57	521	Fe II	$z^4D_{7/2} - b^4G_{9/2}$	10176.31	4p-4s
		Fe II	$z^4D_{3/2} - d^2F_{5/2}$	10176.71	4p-4s
10177.78	290	Fe II	$z^4F_{5/2} - d^2F_{7/2}$	10178.80	4p-4s
		Cr II	$e^4D_{3/2} - (^5D)5p\ ^6P_{5/2}$	10178.92	Lyα
10189.56	53	[Co II] (1F)	$a^3F_4 - b^3F_4$	10190.60	
10212.85	74	Fe II	$z^4F_{5/2} - d^2F_{5/2}$	10213.83	4p-4s
10280.7	78	Cr II	$e^4D_{7/2} - x^6D_{7/2}$	10281.87	Lyα
10288.23	439	[S II] (3F)	$3p^3\ ^2D_{3/2} - 3p^3\ ^2P_{3/2}$	10289.55	
10312.67	126	He I (74)	$3p\ ^3P - 6d\ ^3D$	10314.1	
10319.43	62	[V II]	$b^3D_2 - c^3F_3$	10320.61	?id
10321.91	425	[S II] (3F)	$3p^3\ ^2D_{5/2} - 3p^3\ ^2P_{3/2}$	10323.32	
10338.00	293	[S II] (3F)	$3p^3\ ^2D_{3/2} - 3p^3\ ^2P_{1/2}$	10339.24	
10371.97	166	[S II] (3F)	$3p^3\ ^2D_{5/2} - 3p^3\ ^2P_{1/2}$	10373.34	

Notes. The following comments are used: not in 98: The feature is not present in the 1998 observation. not in 99: The feature is not present in the 1999 observation. Lyα: Primary H Lyα pumped fluorescence transition. Lyα sec.: Secondary H Lyα pumped fluorescence transition. 4p-4s: A 4p-4s transition, discussed in section 5.5. Si III] : Fluorescence line pumped by Si III (Hartman & Johansson 2000) He II: Fluorescence line pumped by He II (Hartman & Johansson 2000) N IV]: Fluorescence line pumped by N IV] (Hartman & Johansson 2000) rd sh : red shoulder due to extended stellar wind is noticeable out to +400 km s^{-1} bl sh : blue shoulder due to extended stellar wind is noticeable out to –400 km s^{-1} "?" the feature is weak and may not be a true emission line. "?id": The identification is regarded as uncertain. "?E_u": the upper level has an excitation energy > 10 eV, and the excitation mechanism is questionable. "?wl": Plausible identification, but the radial velocity differs from the mean, –45 km s^{-1}, by > 15 km s^{-1}.