

## A Spectral Analysis of HD 165553

Aruna Goswami<sup>1</sup>, N. Kameswara Rao<sup>1</sup>, D. L. Lambert<sup>2</sup>

<sup>1</sup>Indian Institute of Astrophysics, Bangalore 560034

<sup>2</sup>Department of Astronomy, University of Texas, Austin, USA

**Abstract.** High resolution spectra of HD 165553, a star reported to be a spectroscopic binary of spectral type F8 Ib are analysed. The stellar parameters- effective temperature, surface gravity and microturbulence are determined using model atmospheres. A detail chemical composition study indicates a near-solar composition for HD 165553. Comparison of its spectrum with that of  $\gamma$  Cyg, a normal supergiant of spectral type F8 Iab indicates that the star is of a later spectral type; a spectral type G Iab seems more likely for HD 165553.

*Keywords :* star: individual, star: HD 165553, star: variable, star: abundances

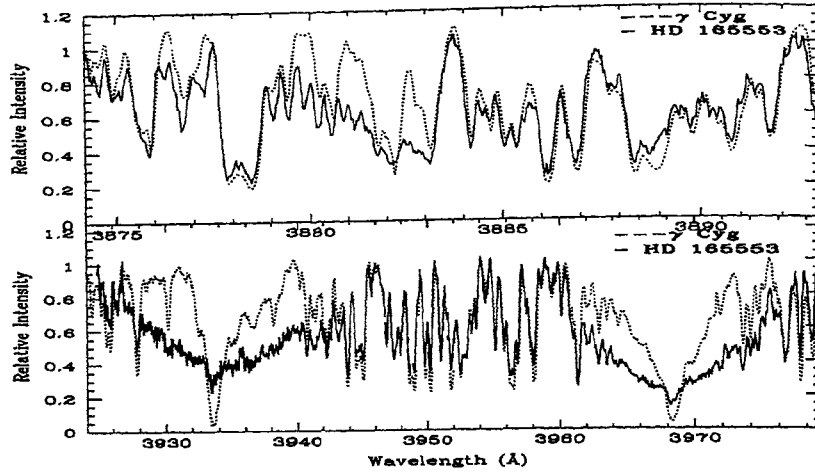
### 1. Observations and Data Reduction

HD 165553, a suspected spectroscopic binary of spectral type F8 Ib was observed, from about 3900 Å to 10000 Å (with gaps beyond about 5600 Å) with the McDonald Observatory's 2.7m Harlan J. Smith telescope and its '2dcoudé' cross-dispersed echelle spectrograph on 2000 June 15. Observations of a Th-Ar hollow cathode lamp provided a wavelength calibration. Data were reduced in the standard fashion using the IRAF software package.

*Radial velocity:* The radial velocity was measured from a set of unblended absorption lines. The mean heliocentric radial velocity was estimated to be  $\sim -4.5 \text{ km s}^{-1} \pm 1.5 \text{ km s}^{-1}$ . Low excitation lines as well as high excitation lines yield more or less similar velocities.

### 2. Spectral Features of HD 165553

The spectrum of HD 165553 is a single line spectrum and is represented by neutral lines of C, O, Na, Mg, Al, Si, Ca, Ti, V, Ni and Zn. Singly ionized lines of iron and several Ti II, Cr II, Y II, Zr II, Ce II and Nd II lines are also quite prominent. Comparisons of some spectral regions with those of  $\gamma$  Cyg, a normal supergiant of spectral type F8 Ib, are illustrated in figure 1. The spectrum



**Figure 1.** A comparison of the spectral regions around  $3800\text{\AA}$  of HD 165553 with those of  $\gamma$  Cyg, a supergiant of spectral type F8 Iab. The strong CN band around  $3883\text{\AA}$  is an indicative of an enhancement of Nitrogen (upper panel). The broad and disc shaped Ca II features in HD 165553 at  $3933\text{\AA}$  and  $3968\text{\AA}$  with central dips at a velocity of  $-6\text{ km s}^{-1}$  are suggestive of interactions with circumstellar material (lower panel). The dotted curves in both the panels represent  $\gamma$  Cyg's spectra and the solid curves represent HD 165553.

of HD 165553 broadly resembles the spectrum of  $\gamma$  Cyg. A number of differences noticed at the spectral features of certain elements indicate that the star is of a later spectral type; a spectral type G Iab seems more likely. Lines of neutral carbon are weaker in HD 165553. Strong profiles of  $H_{\beta}$  and  $H_{\gamma}$  are noticed in the spectrum. Paschen lines around  $8400\text{\AA}$  are weakly present in HD 165553's spectrum. Oxygen features around  $7774\text{\AA}$  are also weaker in HD 165553. A stronger CN band around  $3883\text{\AA}$  indicates an enhancement of Nitrogen. Ca II features at  $3933\text{\AA}$  and  $3968\text{\AA}$  with central narrow dips are broad and disc shaped, the central dips are at velocity  $-6\text{ km s}^{-1}$ .

### 3. Abundance Analysis and Results

From a standard LTE model atmosphere based analysis we have determined the stellar parameters effective temperature  $T_{\text{eff}} = 5800 \pm 200\text{K}$ , surface gravity  $\log g = 1.5 \pm 0.25$  in cgs unit, microturbulence velocity  $\xi_t = 4.1 \pm 0.5\text{ km s}^{-1}$  and metallicity  $[\text{Fe}/\text{H}] = 0.5 \pm 0.1$ . Abundance analysis indicates a near solar composition for HD 165553 similar to those exhibited by bright supergiants. From a close comparison of the star's spectrum with that of  $\gamma$  Cyg the star appears to be of later spectral type. A spectral type G Iab seems more likely for HD 165553.