HD 93250—Weight Champion Among the Stars?

R. P. Kudritzki

The earliest O-stars have masses around 100 M⊙. Dr. Rolf-Peter Kudritzki from the Institute for Theoretical Physics in Kiel, FRG, now believes that one of the stars he recently observed on La Silla may be even heavier.

The O3-stars in the η Car complex belong to the most luminous and most massive stars in our galaxy. According to Conti and Burnichon (1975, *Astron. Astrophys.* **38,** 467), these stars form the very hot end of the main sequence. However, the integral parameters of these objects, like mass, luminosity, effective temperature, etc. are rather uncertain. This is mainly due to the absence in their spectra of neutral helium lines, which are the usual temperature indicators for O-type stars.

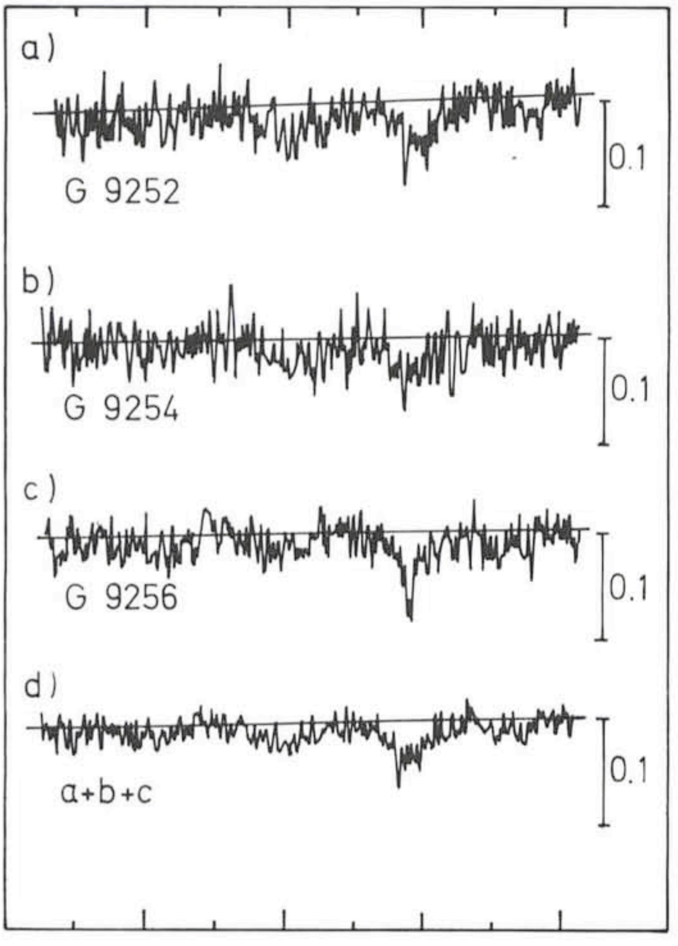

Fig. 1: *Intensity tracings of three 12 Å/mm plates (emulsion Kodak IIIa-J) of HD 93250 at 4470 Å. Tracing (d) is the superposition of the single plates (a), (b), (c). All tracings show the weak and shallow He I λ 4471 line.*

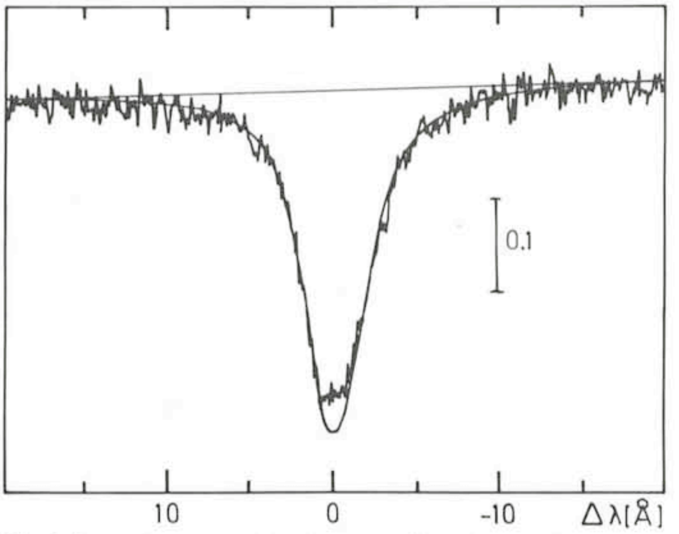

Fig. 2: *Intensity tracing of Hγ (superposition of three plates). The smooth curve is the computed profile of the final non-LTE model. In the line core the observed profile is filled up by the emission of the Carina nebula around HD 93250.*

To overcome this difficulty, we started a new observing programme in March 1978, using the coudé spectrograph at the ESO 1.52 m telescope. Contrary to earlier observers, we used Kodak IIIa-J plates instead of the more common IIa-O

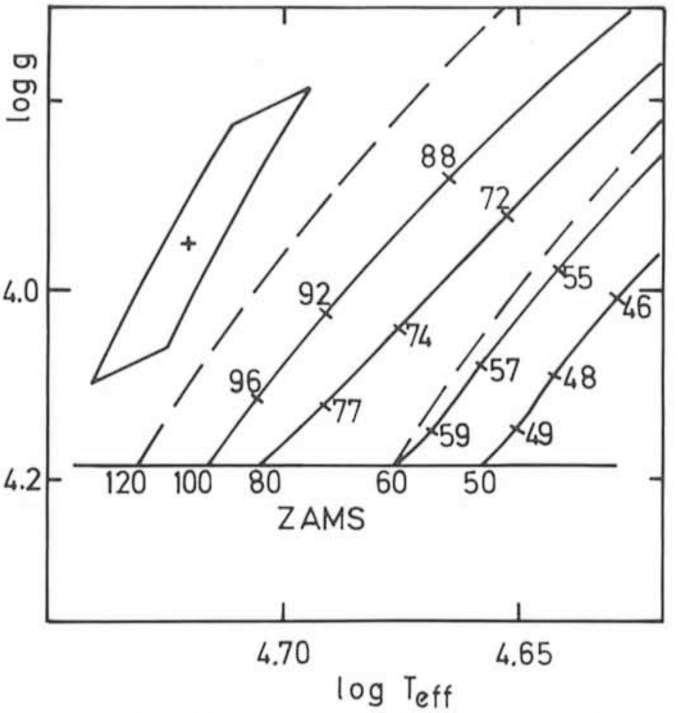

Fig. 3: *Position of HD 93250 (+) in the (log g – log T_{eff})-diagram and corresponding error box. In addition, the zero age main sequence (ZAMS) and evolutionary tracks are shown. The full drawn lines are tracks including mass-loss (de Loore et al., 1978,* Astron. Astrophys. **67,** *373), and the dashed lines represent tracks without mass-loss. Numbers refer to masses in solar units.*

plates. And indeed, the application of this low-noise, high-contrast spectroscopic emulsion allowed, for the first time, the identification of a very weak He I λ 4471 line in the spectrum of an O3-star. This is demonstrated by figure 1, which shows three spectrograms (12 Å/mm dispersion) of the O3-star HD 93250 at this wavelength. The fourth tracing is the superposition of the three spectrograms.

According to our theoretical non-LTE calculation, the red neutral helium line λ 5876 should be at least twice as strong as λ 4471. We therefore took some red spectrograms of HD 93250, which, as expected, allowed us to identify λ 5876.

The detection of these neutral helium lines makes it possible to determine more precisely the effective temperature and the gravity and, from these, the radius, luminosity and mass. To do so, we carried out detailed non-LTE calculations. The fit of the line spectrum of neutral and ionized helium as well as of hydrogen (fitting the profiles, not only the equivalent widths, see figure 2) yields T_{eff} = 52500 K, log g = 3.95 (cgs) and normal helium abundance. The position in the (log g, log T_{eff})-diagram, when compared with evolutionary tracks (also including mass-loss), indicates that HD 93250 is a very massive object with more than 120 $M_\odot$ (see fig. 3). This is supported by the distance of HD 93250 (3000 ± 400 pc), which is obtained from its membership in the very young open cluster Tr 16 (Feinstein et al., 1973, *Astron. Astrophys. Suppl.* **12,** 331). By comparison with the flux of our final non-LTE model, we then obtain R ≈ 19 $R_\odot$,

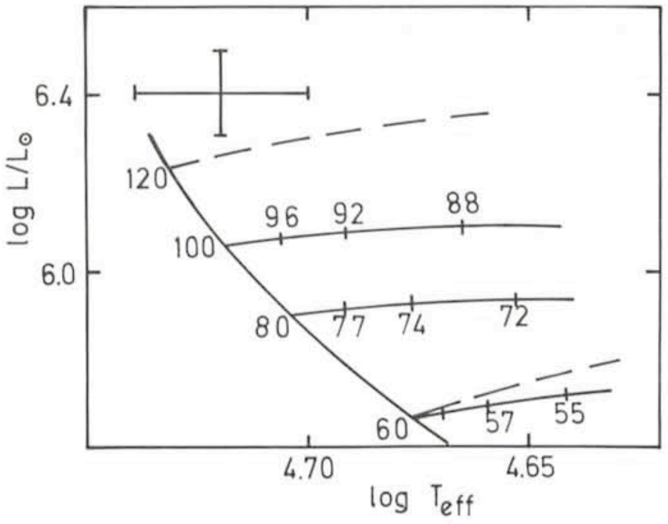

Fig. 4: *Position of HD 93250 in the HRD. The evolutionary tracks are the same as in figure 3.*

log $L/L_\odot$ ≈ 6.4 (see fig. 4). If we compute the mass from the gravity and the radius, we obtain $M/M_\odot$ ≈ 120.

So, even when taking into account realistic errors for all of these quantities, it appears unavoidable to conclude that HD 93250 is in fact a main-sequence star, more than *one hundred* times heavier than the Sun!

The International Ultraviolet Explorer (IUE)

A. Heck, F. Beeckmans, P. Benvenuti, A. Cassatella, J. Clavel, F. Macchetto, M.V. Penston, P.L. Selvelli, and D. Stickland.

European and American astronomers received a beautiful new telescope when the International Ultraviolet Explorer was launched earlier this year in a collaboration between NASA, ESA and SRC. IUE is the first space telescope to be operated like a telescope on the ground, by "visiting" astronomers together with observatory staff members. Dr. André Heck, together with the VILSPA Observatory staff based at the ESA Villafranca Satellite Tracking Station, ESTEC and the UK IUE Project, informs us about the satellite and the fantastic observations that have been made with it. During one session, simultaneous observations were made with the IUE and with three ESO telescopes at La Silla.

The Satellite

The IUE satellite, launched successfully on January 26, 1978, is a joint undertaking on the part of NASA, the United Kingdom Science Research Council (SRC) and the European Space Agency (ESA). It has been developed as a general facility for observing the ultraviolet spectra of astronomical sources over the wavelength range from about 1150 Å to 3200 Å. NASA provided the spacecraft plus the optical and mechanical portions of the scientific instrument, while the SRC provided the television cameras used to record the spectroscopic data. ESA's contribution has been the deployable solar-cell array and the operation of the European ground station at Villafranca del Castillo, near Madrid in Spain. A second ground station is located at NASA's Goddard Space Flight Center, Greenbelt, U.S.A.

The scientific aims of the project, unchanged since the earliest studies of its feasibility, are:

- to obtain high-resolution spectra (R ~ 10^4) of stars of all spectral types in order to determine their physical characteristics more precisely;
- to study gas streams in and around some binary systems;
- to observe faint stars, galaxies and quasars at low resolution (R ~ 250) and to interpret these spectra by reference to high-resolution spectra;
- to observe the spectra of planets and comets as these objects become accessible;
- to make repeated observations of objects known or newly found to show variable spectra;
- to define the modifications of starlight caused by interstellar dust and gas more precisely.

The scientific aims of IUE are achieved by both high-resolution spectra (~ 0.2 Å) of bright objects and low-resolution spectra (~ 8 Å) of fainter objects. Determining the equivalent widths of faint lines used to measure chemical abundance, or the profiles of stronger lines used to study gas motions, requires a spectral resolution of at least 0.2 Å.