SB 939 - A NEW INTERMEDIATE HELIUM STAR AT HIGH GALACTIC LATITUDES

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ABSTRACT. SB 939 was analyzed spectroscopically for the basic atmospheric parameters T_{eff}, log g and helium content. It was shown to be an intermediate helium star (helium abundance = 22% by number) situated unusually far away from star-forming regions.

1. INTRODUCTION

Slettebak and Brundage (1971) carried out an objective prism survey near the southern galactic pole in order to search for faint blue stars. Star no. 939 (CD-40° 15910) in their list was noted to have a peculiar spectrum. Subsequently, Graham and Slettebak (1973) observed the star once again at higher resolution (39 Å/mm) and assigned a spectral type of B2V, but realized that the He I lines appeared abnormally strong. In order to clarify its nature, we observed SB 939 at high resolution with the ESO-Cassegrain Echelle Spectrograph at the 3.6 m telescope and carried out a spectroscopic analysis in order to determine its atmospheric parameters.

2. EFFECTIVE TEMPERATURE, GRAVITY AND HELIUM ABUNDANCE

The effective temperature is derived from the total flux. UV-fluxes are taken from IUE-observations, visual from Stroemgren colours and unobservable parts of the spectrum from adapted model fluxes (Kurucz, 1979). The model flux distribution with T_{eff} = 17400 K fits the observations very well (see Fig.1). Surface gravity and helium abundance are determined by fitting theoretical line-profiles to the observed Balmer- and He I lines. An excellent match is reached for log g = 3.8 and $y = n_{He}/(n_H+n_{He})$ = 0.22 (number fraction) (see Fig.2+3) This clearly demonstrates the overabundance of helium in the photosphere of SB 939 - it can be regarded as an intermediate helium star. The helium enrichment is only moderate and smaller than in most of the known helium stars. Its radial and projected rotational velocities are very small (v_{rad} = -27 ± 6 km/s, V_{rot} * sini = 0).

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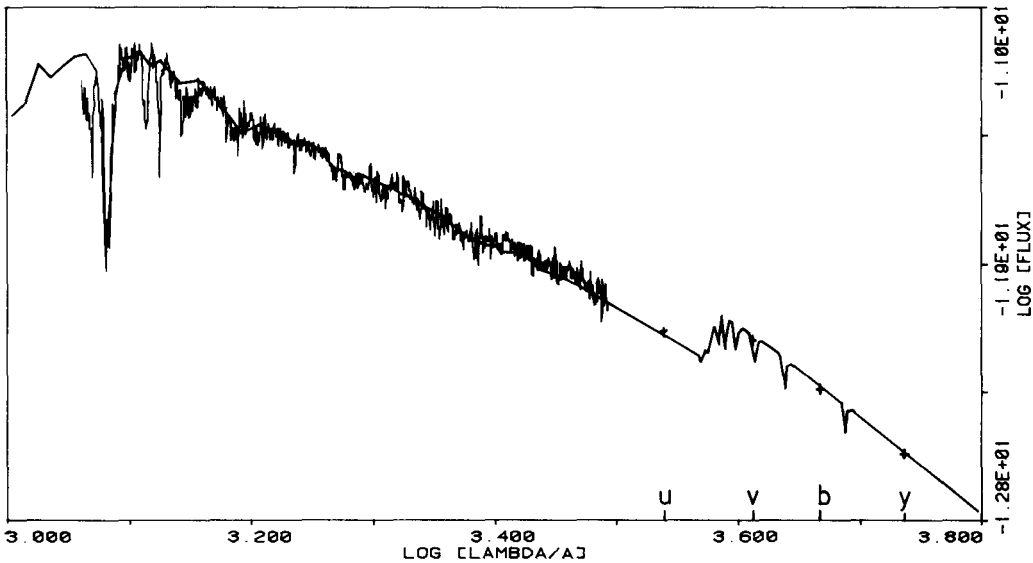

Fig. 1: Energy distribution of SB 939 compared to the flux distribution calculated from the final model (T_{eff}=17400 K).

3. DISCUSSION

All previously known intermediate helium stars are strongly confined to the galactic plane . Walborn (1983) gave a complete list of 20 intermediate helium stars brighter than 10th magnitude. They all have $|b^{II}| \leq 19°$ - consequently, SB 939 (V = 10.3, b^{II} = - 74°) is the first intermediate helium star discovered at high galactic latitudes. We can derive its mass only by comparison with evolutionary calculations (Hejlesen, 1980) since its distance is not known. If the helium anomaly is confined to the surface, a mass of 6.3 solar masses will be derived. Therefore, its distance above the galactic plane (z) is very large: z = 2.7 kpc. Hence, SB 939 is rather a massive star which lies far away from the star-forming regions (i.e. in the galactic plane). SB 939 possibly had been ejected from the galactic plane as a runaway B star (Blaauw, 1961) and subsequently slowed down to its present low velocity.

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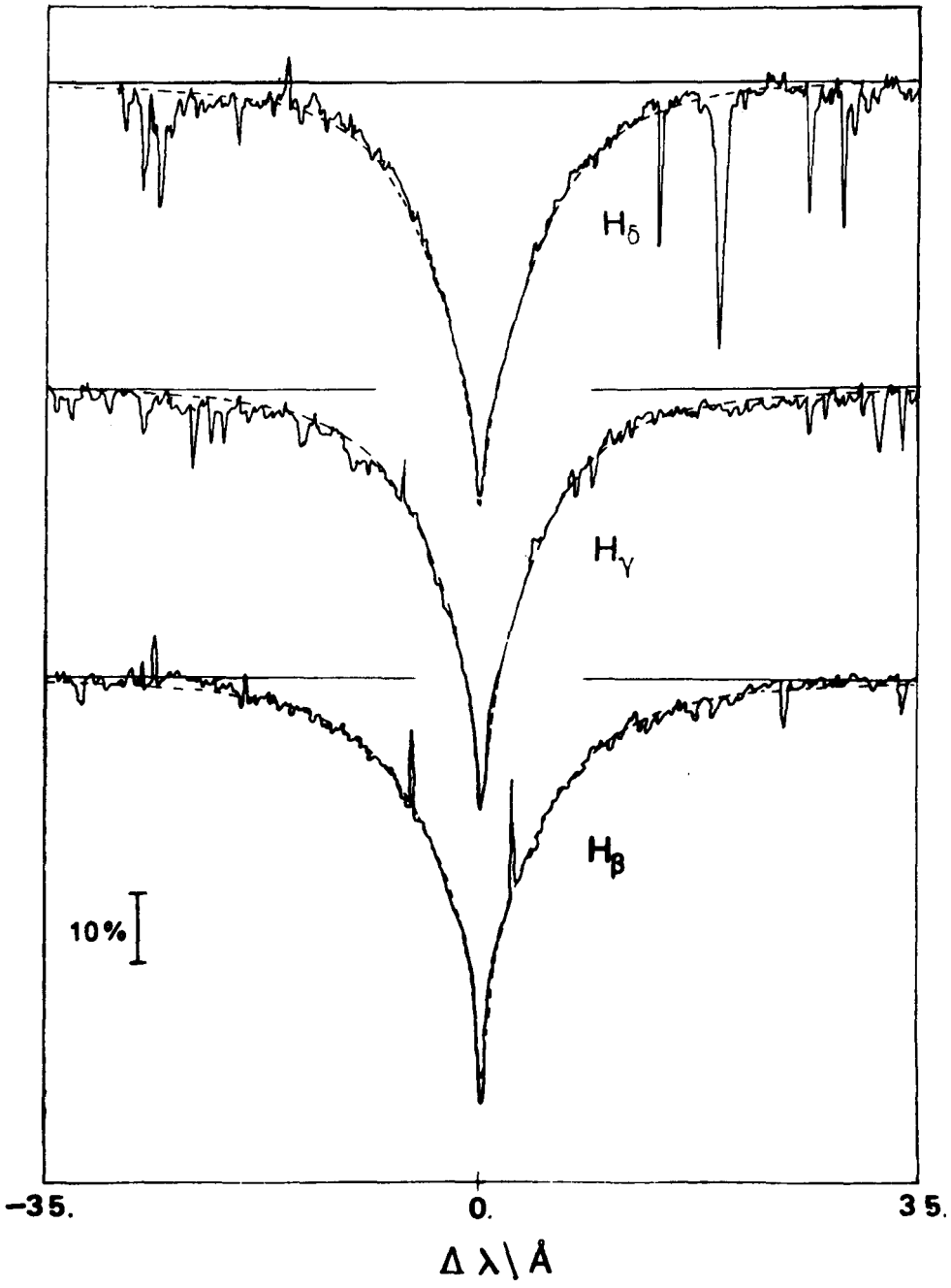

Fig. 2 Comparison of observed Balmer line profiles with theoretical profiles calculated from the final model. 10% continuum height is marked by a vertical bar.

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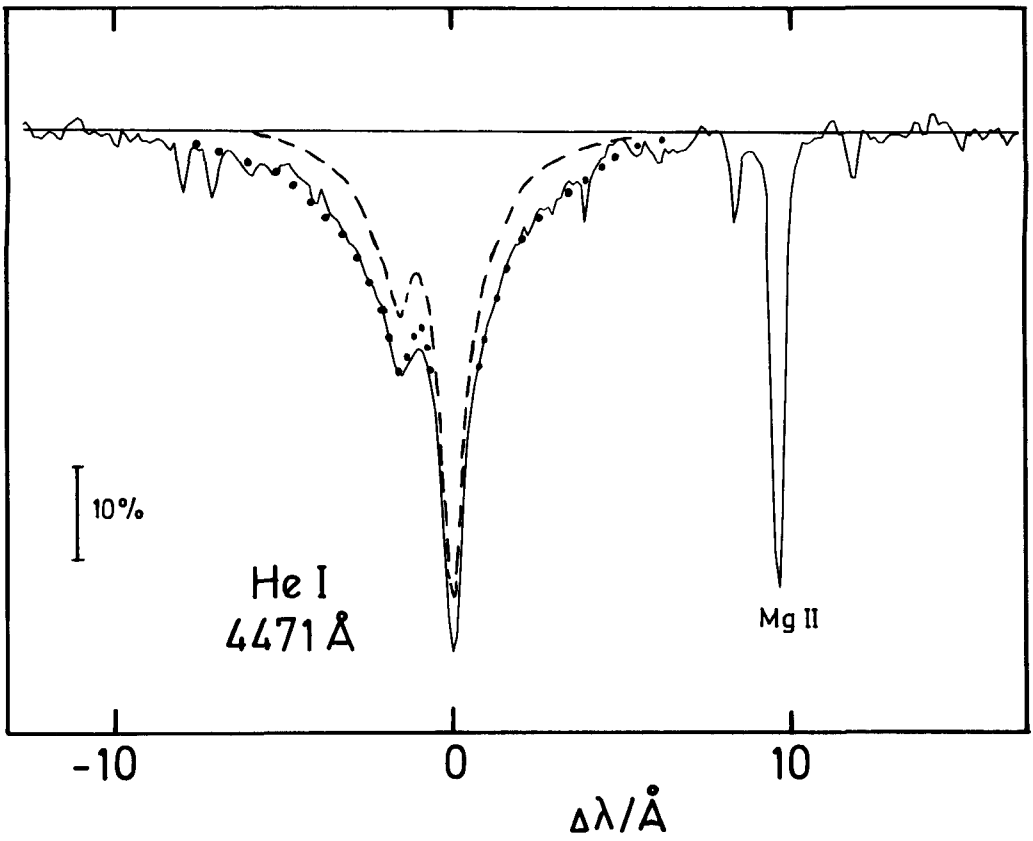

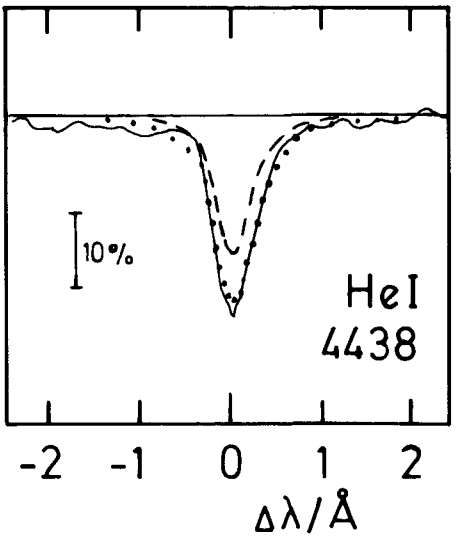

Fig. 3

Comparison of observed He I line profiles to theoretical ones: top: λ 4471 Å, the strongest helium line observed. right: λ 4438Å, the weakest helium line observed. Theoretical profiles calculated assuming normal He abundance (y=0.1) are dashed. Dotted profiles are calculated with y=0.22.

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