THE PECULIAR BINARY SYSTEM HR 8891 (ET AND)

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Contributions to photometry (*), spectroscopy (†) and mapping (°)

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1. Introduction

ET And is a binary system with a B9 Si star as the main component (P_{orb} = 48.308^d, e=0.46). Controversial claims in the literature concerning pulsation with periods ranging from few minutes to few hours and with variable amplitudes indicated a challenging target and motivated us to organize several photometric and spectroscopic observing campaigns. The problem with pulsation of ET And is that $T_{\rm eff}$ and $log\,g$ put this star in the cool domain of Slowly Pulsating B-type (SPB) stars, but the pulsation periods would be too short by a factor of about four, relatively to the shortest hitherto known periods for SPB stars.

2. Rotation and pulsation

Period and shape (P_{rot} = 1.618^d, a_{rot} = 23 mmag(B)) of the rotation light curve did not change during the last three decades. Second, there are strong evidence that the short time scale variations attributed in the literature to ET And are due to pulsation of the main comparison star HD 219891 (HR 8870, A5 V). If this suspicion can be corroborted, a serious conflict between observation and current theory of stellar opacities will be eliminated and HD 219891 can be identified as a new δ Sct type variabel. Two pulsation periods (P_1 = 2.38^h, a_1 = 4.1 mmag(B), P_2 = 3.55^h, a_2 = 1.8 mmag(B)) are sufficient to reproduce the observed amplitude spectrum to a noise level of 0.3 mmag.

A full account on our photometry is being prepared for publication (Weiss et al. 1993, A&A in prep.).

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3. Atmospheric parameters and abundances

The spectrum of ET And ranging from 4000Å to 7500Å was observed in 17 overlapping segments with the AURELIE Coudé spectrograph (resolution = 0.15Å) of OHP. First, we tried to fit the observed Balmer line profiles (Hα to Hδ) with the help of Kurucz ATLAS 9 atmospheres and obtained an optimum fit for $T_{\rm eff}$=11 500 K, log g=3.5, and v sini=80 kms^{-1}, in good agreement with photometrically derived estimates.

The abundance analysis indicates a 2 dex overabundance of Si. No significant enhancement of the iron-peak elements was found. The light elements, like He, C, Mg, are underabundant by a factor of about 10, and even more so in the case of He. The heavy elements, like Sr, Y, and Zr are overabundant and follow the even-odd abundance pattern.

A detailed spectroscopic analysis of ET is being prepared for publication (Kuschnig et al. 1994, A&A in prep.)

4. Silicon and Helium surface mapping

A series of 170 AURELIE spectra was available for mapping ET And. Instead of using the approximation formula for local line profiles we synthesized the spectral region for Si (4194Å to 4206Å), and for He (4022Å to 4027Å). The inversion from observed line profiles to the surface distribution was done with an interpolation in order to derive the local line profiles for any given point on the stellar surface. An angle of inclination i=80° gave the best fit to the observed line profiles.

The resulting image for silicon shows a strong equatorial spot-like concentration. The structure in longitude is particularly well reproduced because of the coverage of 20 phases. The largest local overabundance found is about 4 dex compared to solar.

The helium map is essentially defined by two spots close to the equator. They are found in a region were silicon is relatively depleted. Only in the two strongest He spots comes the abundance close to solar.

Also this part of our investigation is being prepared for publication (Piskounov et al. 1994, A&A in prep.).

5. Acknowledgments

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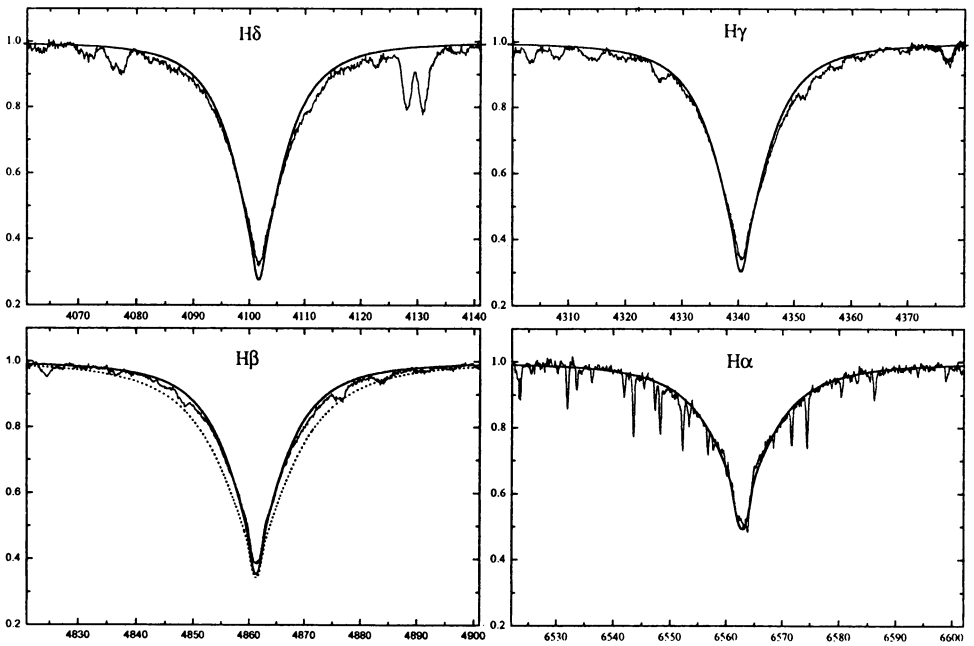

Fig. 1. Comparison of observed and computed Balmer line profiles ($T_{\rm eff}$=11 500K, *log* g=3.5 (solid line), *log* g=4.0 (dotted)

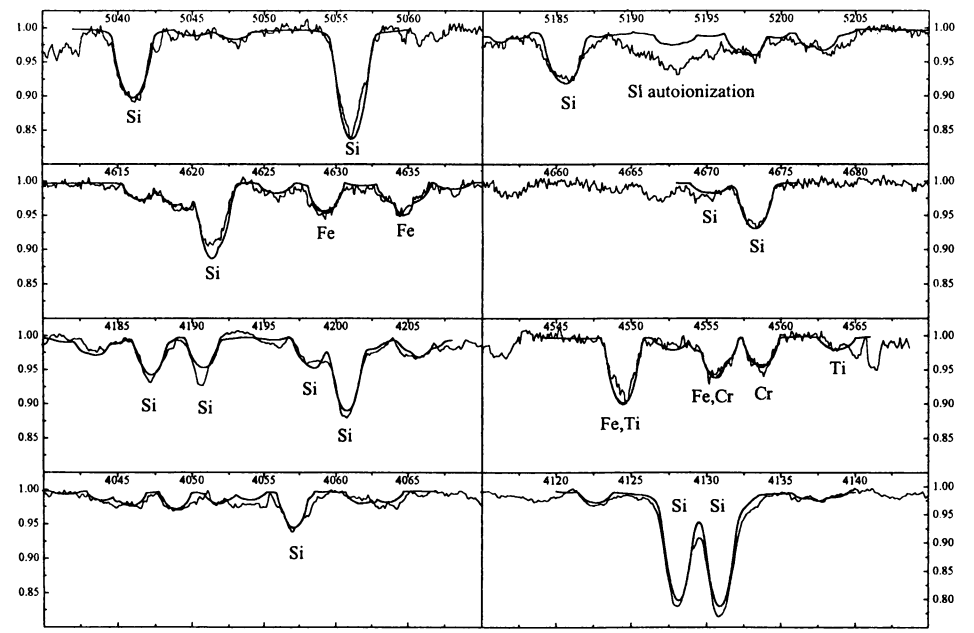

Fig. 2. Synthesized spectral regions, $T_{\rm eff}$=11 500, *log* g=3.5, v*sin*i=80kms^{-1}

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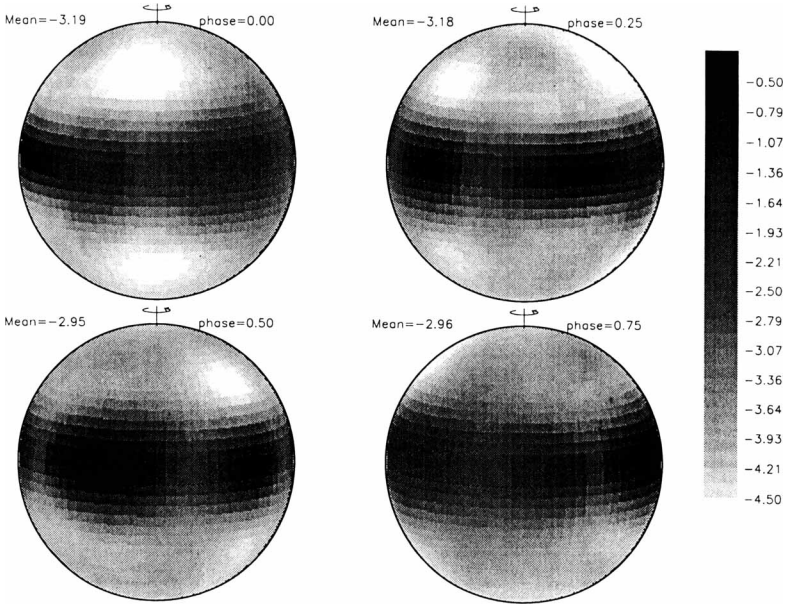

Fig. 3. Silicon surface distribution map for ET And

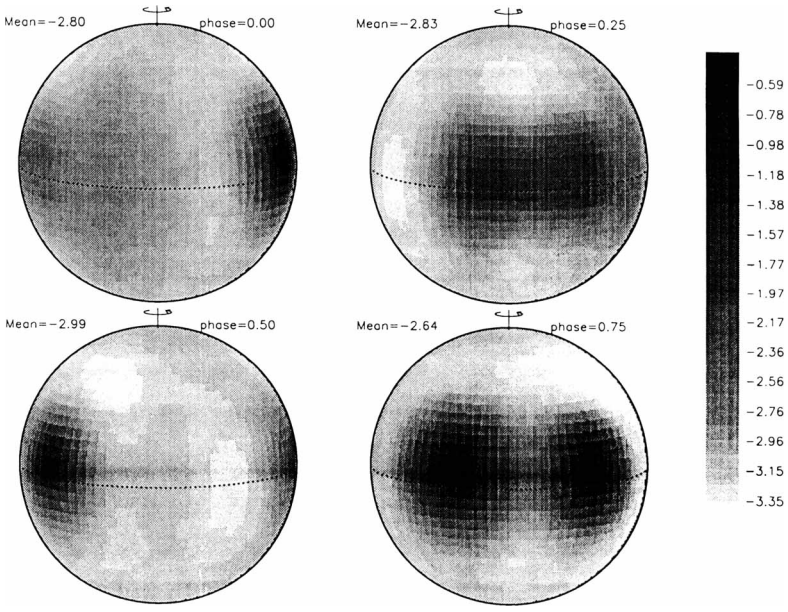

Fig. 4. Helium surface distribution map for ET And

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