MIDDLE B-TYPE STAR VARIABLES

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Abstract

General properties of variable stars of spectral type B are discussed.

1. Introduction: The β Canis Majoris Stars

Known pulsational variability among B-type stars has been limited for a long time to the small group of β CMa stars (also known as the β Cephei stars). The main characteristics of the β CMa stars are: 1) periods in the range of 3 to 6 hours; 2) amplitudes in photometry of 0.005 to 0.3 magnitude in the Stromgren "b" filter, and in radial velocity of a few km/s to more than 100 km/s; and 3) phase lag between radial velocity variations and light variations is around 0.25 P.

Pulsations in radial and non-radial modes are invoked to explain the variations, but up to now no mechanism has been found to explain the pulsations of these stars.

2. The Middle B-type Stars

As the first β CMa stars to be discovered lay in a very small area in the HR diagram (spectral types B0 - B2, luminosity classes IV to III), different authors looked for variability among other B-type stars through photometric surveys. The most interesting results are that: 1) many O and B (or Be) stars are variable; and 2) the supergiant B stars are practically all variable.

A new group of variables in the domain of intermediate (or middle) B-type stars (i.e., B3 to B6) has been identified by Waelkens and Rufener (1985).

The main characteristics of the photometric variability of mid-B type variables are: 1) periods in the range between 1 and 3 days; 2) color variations in phase with the light variations; and 3) the amplitudes can be as large as 0.12 magnitude, and they vary from one cycle to another and from year to year (see Figure 1).

Waelkens and Rufener proposed including in this group the 53 Per variables defined by Buta and Smith (1979) as a group of B stars exhibiting line profile variations. Light and radial velocity variations are also observed.

Figures 2 and 3 show some aspects of the variability of 53 Per (B4) itself (Le Contel *et al.* 1989). Although important gaps exist in the data, it clearly appears that the time scale of the variation is longer than one day. Pulsation in non-radial g modes is generally proposed to explain these variations although some difficulties remain.

The variability of middle B stars appears quite different from that of the β CMa stars, so different mechanisms must be looked for. However, some intermediate stars (spectral type around B3) between the two groups show both types of variability: a short period (a few hours) and a longer period (1 to 3 days) variation. A good example (Figure 4) is iota Her (Le Contel *et al.* 1987; Chapellier *et al.* 1987). Unpublished work of Le Contel *et*

al. confirm that a period around 1.6 days is present in photometric and spectrographic data as shown by Roggerson (1984) from satellite observations.

3. How Can Amateurs Help to Clarify These Problems?

One of the main problems in the study of these stars is to determine the periods. The difficulty arises from their length and the large gaps between the observations. This is clearly demonstrated in Figure 3. The fitting of the radial velocity data is as good with a single 2.4-day period as with two periods near 1.5 days.

Only longitude-coordinated observations can solve the problems. Le Contel and Walker, and Walker (both papers presented in this conference) proposed multi-channel photometers to be used in non-photometric sites in order to help amateur groups to participate in these campaigns.

References

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Waelkens, C., and Rufener, F. 1985, *Astron. Astrophys.*, **152**, 6.

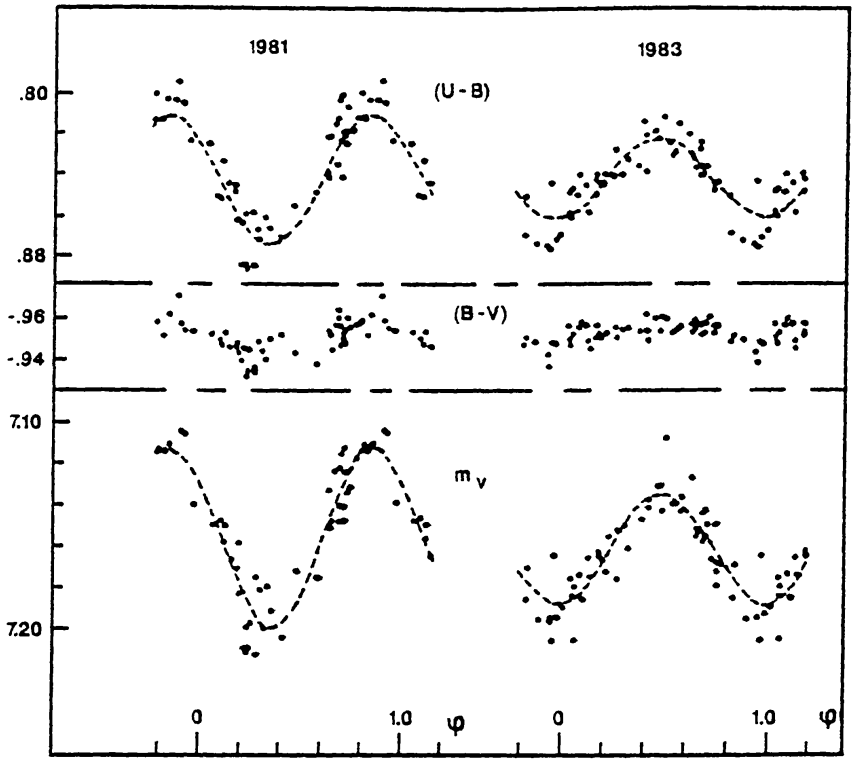

Figure 1. An example of light variations in a middle B-type variable, from Waelkens and Rufener (1985 - figure 3).

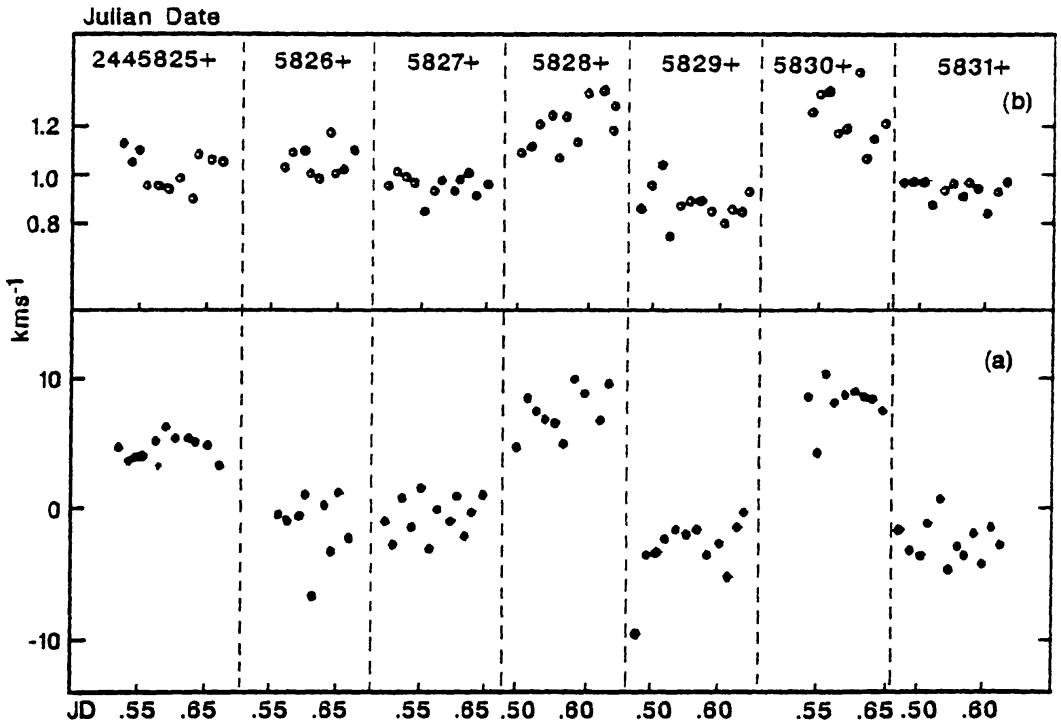

Figure 2. 53 Per (B4 IV). Night-to-night variations in (a) radial velocity, (b) line-intensity ratio.

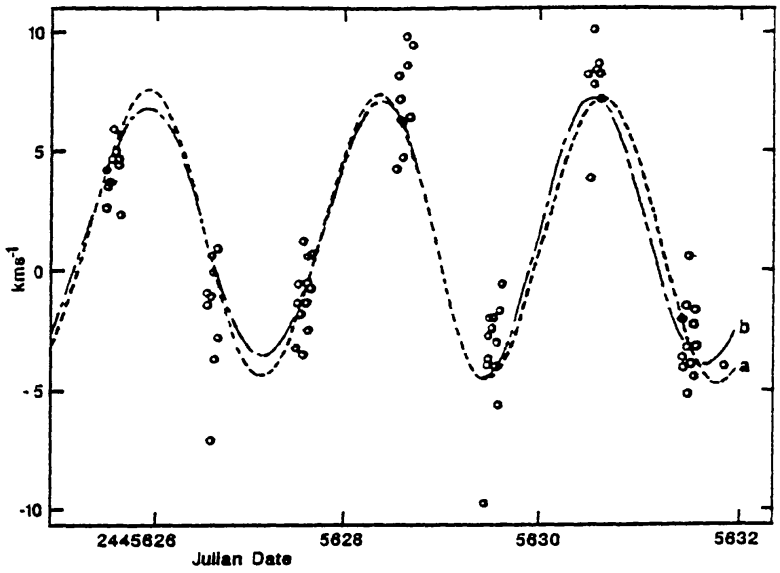

Figure 3. 53 Per. Fitting of the radial velocity data by (a) a single period (P=2.4 d), (b) the same two periods as in photometry.

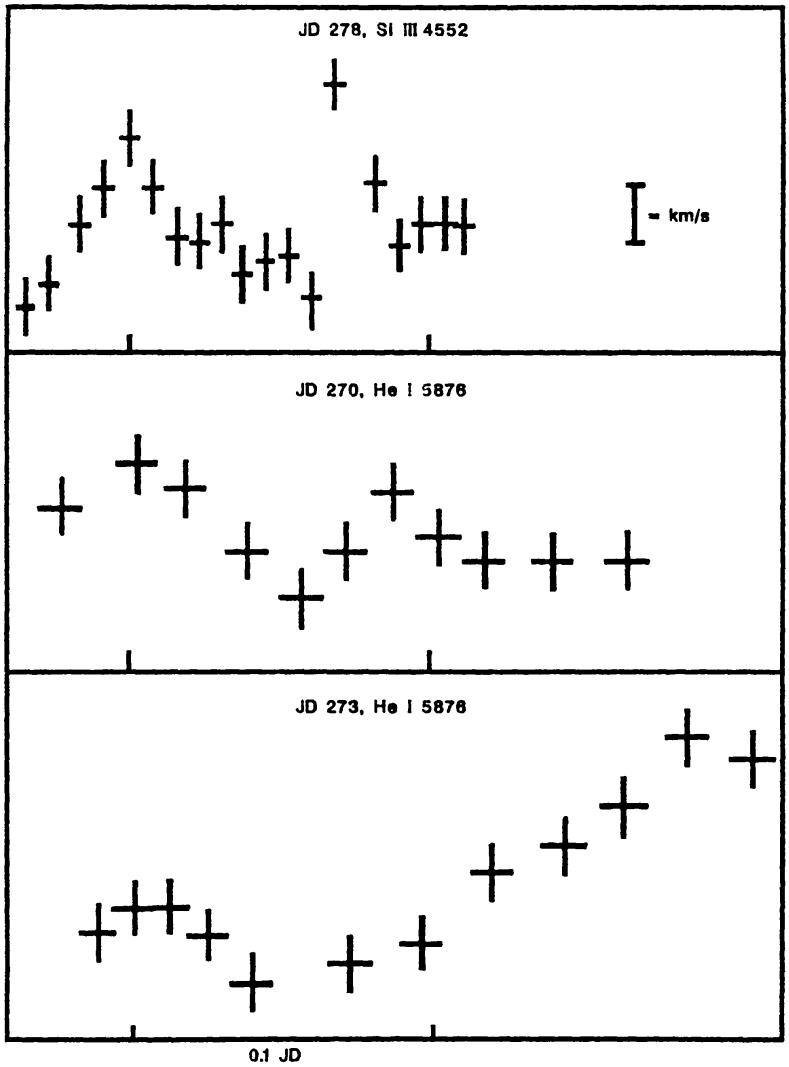

Figure 4. iota Her (B3 IV). a) Short-period variations.

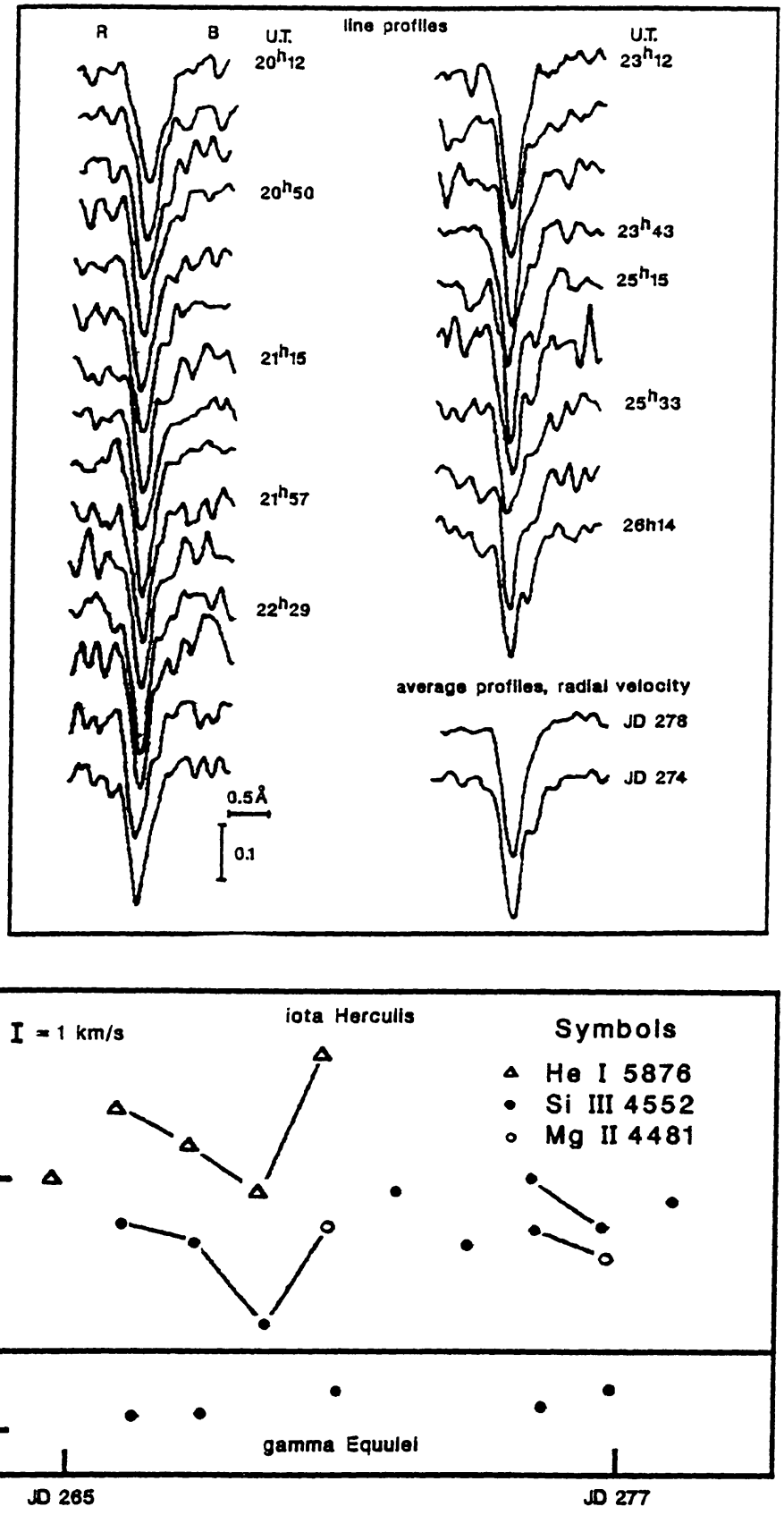

Figure 4 continued. iota Her (B3 IV). b) Night-to-night variations in line profiles, and c) night-to-night variations in radial velocity.