Bull. Astr. Soc. India (0000) **00**, 000–000

Large-scale wind structures in OB supergiants: a search for rotationally modulated Hα variability

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Received ?; accepted ?

Abstract. We present preliminary results of a long-term spectroscopic monitoring of a sample of bright OB-supergiants aimed at establishing the incidence of co-rotating, large-scale wind structures by detecting rotationally modulated variability in Hα. Dramatic line-profile variations operating on a daily (and in some cases on a hourly) timescale are observed. A detailed period analysis has been so far carried out for 2 stars, and revealed in both cases the existence of cyclical Hα variations consistent with rotational modulation. In the case of HD 14134, the same periodicity is found in the contemporaneous light curve.

Keywords : stars: early-type – stars: supergiants – stars: emission-line – stars: winds, outflows – stars: rotation – stars: individual: HD 14134, HD 24912.

1. Introduction

The UV line-profile variability displayed by OB stars is widely believed to be induced by the rotational modulation of azimuthally extended wind streams (co-rotating interaction regions; Kaper et al. 1996, 1999), whose formation is probably triggered by large-scale photospheric perturbations (Cranmer & Owocki 1996). Establishing a cyclical pattern of variability in Hα would give further support to the idea that the origin of this phenomenon

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is deep-seated and causally linked to some kind of photospheric activity (pulsations and/or magnetic fields). Our observations circumvent the limitations of previous surveys, i.e., poor temporal sampling or limited number of targets (Ebbets 1982; Kaper et al. 1997).

2. Observations

Our data were obtained at the 40-inch telescope of the Vainu Bappu Observatory during 36 nights in 2001-2002 (S/N$\sim$200-300, 1.45 Å pixel^{-1}). Our 22 targets are drawn from a magnitude-limited (V<7.5) sample of early-type supergiants (O7.5-B9) without close companions and with evidence for an emission-like Hα profile. Our survey primarily targets B stars and can be thus regarded as complementary to others that concentrate on O stars (Kaper et al. 1998). The program stars were typically observed once or twice each night. Coordinated B- and I-band photometric observations were also carried out for 6 stars with the 24-inch telescope of the Bell Observatory operated by the Western Kentucky University (USA).

3. Results

Our photometric observations support the periodic nature of the variations suggested for some stars by *Hipparcos* data and also demonstrate the remarkable long-term (years) coherency in the patterns of variability. All stars with a wind-like Hα feature display conspicuous evidence for line-profile variability. Most changes take place on a daily timescale, although significant hourly variations are sometimes observed. A detailed period analysis has been carried out for 2 stars, and revealed in both cases the existence of cyclical Hα variations operating on timescales consistent with rotational modulation ($\sim$12.5 and 2.06 d for HD 14134 and HD 24912, respectively). For the latter, the same periodicity was found in data obtained almost one decade ago (de Jong et al. 2001). This demonstrates the long-lived nature of the mechanism modulating the changes. Rotation is the most likely candidate in this single star. For HD 14134, the same periodicity (within the uncertainties) is found in the contemporaneous light curve (Fig.1). As can be seen in Fig.2, the star undergoes an emission-like episode at maximum light. This suggests that the 2 types of variability diagnose the same physical phenomenon and may be causally linked.

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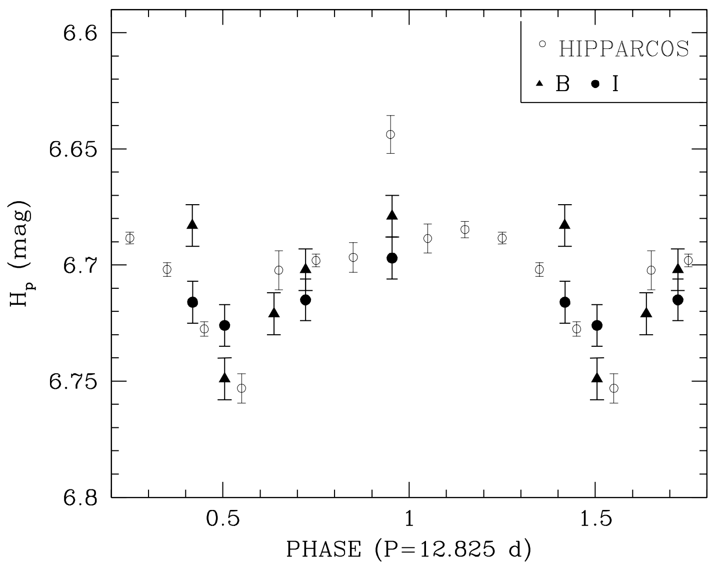

Figure 1. Folded *Hipparcos* light curve of HD 14134 assuming a period of 12.825 d. Maximum light is arbitrarily set to $\phi = 0$. Our *B*- and *I*-band observations are overplotted as triangles and filled circles, respectively (the points are vertically shifted by a constant value to match the *Hipparcos* data).

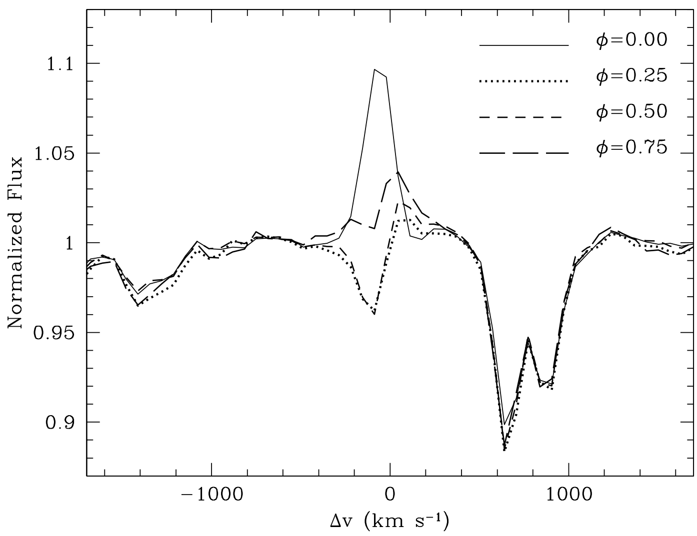

Figure 2. Phase-averaged Hα profiles of HD 14134. We used the same ephemeris as in Fig.1 (a period of 12.5 d is seen in Hα, but we adopt here the more robust 12.825-d photometric period; the 2 values are identical within the errors).