Bull. Astr. Soc. India (2001) **29**, 313–316

Kinematics of Vega-like stars

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Abstract. We have studied the kinematics of Vega-like stars in the solar neighbourhood. Space velocities are computed for 80 Vega-like stars. We analyse the space velocities of these stars in connection with the young stellar associations and star forming regions in the solar neighbourhood. Our preliminary analysis suggests that many of the Vega-like stars are kinematically connected with the members of the above mentioned associations and star forming regions. This would place a strong constraint on the ages of Vega-like stars which are generally believed to be an older population. Details of the analysis and preliminary results are presented.

1. Introduction

Vega-like stars are main-sequence stars that have continuum emission at far-infrared (FIR) wavelengths in excess of that expected from the photospheres of the stars of their spectral type (Aumann et al. 1984). The excess flux is ascribed to thermal emission from orbiting circumstellar dust grains with temperatures of about 100 K (Aumann 1985). Imaging of the dust emission at infrared and submillimeter wavelengths (Holland et al. 1998; Koerner et al. 1998), coronographic imaging of scattered light (Smith & Terrile 1984; Schneider et al. 1999) and polarimetric observations (Bhatt & Manoj 2000) of these stars have confirmed that the dust is indeed distributed in discs.

The evolutionary status of Vega-like stars is still not well understood. The prototype star of this class, Vega, is a fairly old main-sequence star whose age is estimated to be about 400 Myr while β Pic is much younger and is only about 100 Myr old. Vega phenomenon is also found to occur in systems which are fairly evolved in the main-sequence and sometimes even in the postmain-sequence stars (Plets 1999). The dust grains that cause far-infrared excess are believed to be replenished in the disc around these stars by the collisional grinding of planetesimals and cometary bodies (Backman & Paresce 1993).

However, recent studies of the new sample of Vega-like stars have shown that this group is fairly inhomogeneous (Yudin 2000). Many of the stars may infact be very young, either at the end of their premain-sequence evolution or having just entered the main-sequence. Here we present the preliminary results of the kinematic studies of these stars.

2. Sample

Our sample of Vega-like stars is taken from Mannings & Barlow (1997) and Beckman & Paresce (1993). The proper motions and parallaxes of these stars are from *Hipparcos*. Radial velocities are obtained from the General Catalogue of Mean Radial velocities (Barbier-Brossat 2000).

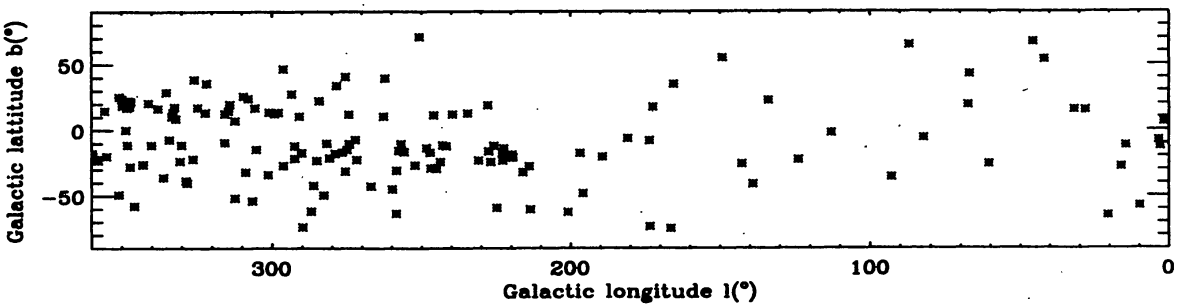

Figure 1. Galactic distribution of Vega-like stars.

3. Analysis

The galactic distribution of Vega-like stars (Fig. 1) clearly shows that most of the stars are concentrated in the direction of Scorpio-Centaurus association. Infact 10 to 15 of these stars are confirmed members of the nearby associations like Scorpio-Centaurus, TW Hydrae, and Tucanae, (De Zeeuw et al. 1999; Webb et al 1999; Zuckerman & Webb 2000). Further, with *Hipparcos* distances, we find that more than 30% of the Vega-like stars have positional coincidence with the above mentioned association.

In Fig. 2. we plot the Galactic prepermotions of the Vega-like stars.

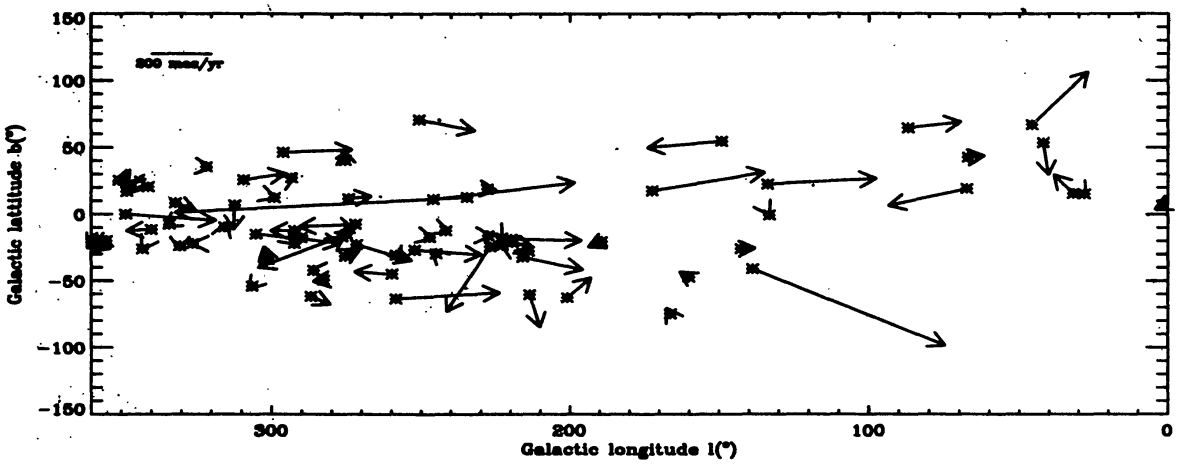

Figure 2. Galactic propermotion of the Vega-like stars.

We have also computed the space velocities (w.r.t. LSR) of Vega-like stars for which the radial velocities are available. The mean (u v w) components of the velocities (in kms^{-1}) of Vega-like stars are (–1.6, +3.8, –3.1). This 3D motion can be compared with the space motions of the recently discovered nearby young associations like β Pic moving group (+0.1, –1.7, –2.9), Tucanae (–0.1, –6.0, +7.6), TW Hydrae (–0.6, –3.2, +2.3) and η Cha (–0.6, –3.2, –2.7) (Zuckerman & Webb 2000 and references therein). The dispersion in the (u v w) components of Vega-like stars (15, 9, 6) are large but comparable to the expansion velocities of large OB associations.

The above analysis shows that many Vega-like stars are kinematically connected with the nearby starforming regions and young stellar associations. Many of these associations are only a few 10 Myr old. Therefore, Vega-like stars, as a group, also include a much younger population, contrary to what is generally believed.

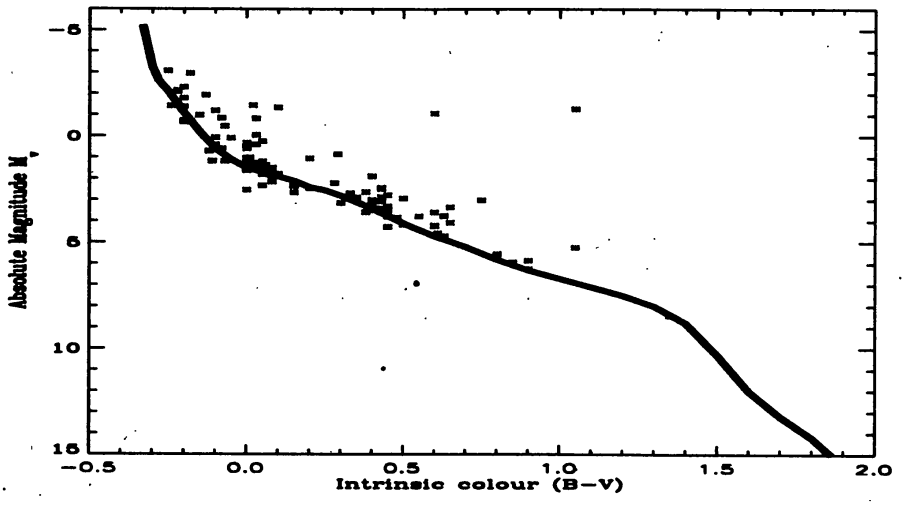

Figure 3. *Hipparcos* colour-magnitude diagram for Vega-like stars.

A *Hipparcos* colour-magnitude diagram (Fig. 3) substantiates this fact. Most of the stars lie above the main-sequence. They are at the end of their premain-sequence phase and are just about to enter the main-sequence.

4. Conclusions

A significant number of Vega-like stars are kinematically connected to the young stellar associations in the solar neighbourhood and are much younger than what was previously thought.

Hipparcos colour-magnitude diagram confirms the youth of these stars.

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