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DETERMINATION OF KINEMATIC DISTANCES OF PRE-MAIN SEQUENCE STARS IN LUPUS

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The problem of the determination of distances has always played a central role in astronomy. However, little recent progress has been made in the distance determination of faint young stellar objects such as pre-main sequence (PMS) stars. A precise determination of distances is required to accurately determine the main physical parameters of stars (luminosity, temperature, mass and age) and to trace the evolutionary tracks of young stars. The procedure that we use here to derive individual parallaxes is based on the convergent point strategy which makes full use of the directly observed data: position, proper motion and radial velocity.

1. THE SAMPLE OF PMS STARS

We are dealing with a sample of 205 PMS stars spread over the Lupus star forming region of the PMS stars proper motion catalogue Ducourant et al. (2005). An exhaustive search in the CDS databases for PMS stars in the sample with known radial velocity has been conducted in order to develop our strategy.

2. THE CONVERGENT POINT ANALYSIS

The procedure that we use here to derive the convergent point **CP** $(\alpha_{\rm cp}, \delta_{\rm cp})$ of a moving group with N stars is based on a direct minimization routine in two dimensions that leads to a non-linear least squares problem to be solved

$$\frac{\partial \chi^2}{\partial \alpha_{\rm cp}} = 0 \;\rightarrow\; \sum_{i=1}^{N} t_{\perp_i} \frac{\partial t_{\perp_i}}{\partial \alpha_{\rm cp}} = 0\,, \tag{1}$$

$$\frac{\partial \chi^2}{\partial \delta_{\rm cp}} = 0 \;\rightarrow\; \sum_{i=1}^{N} t_{\perp_i} \frac{\partial t_{\perp_i}}{\partial \delta_{\rm cp}} = 0\,. \tag{2}$$

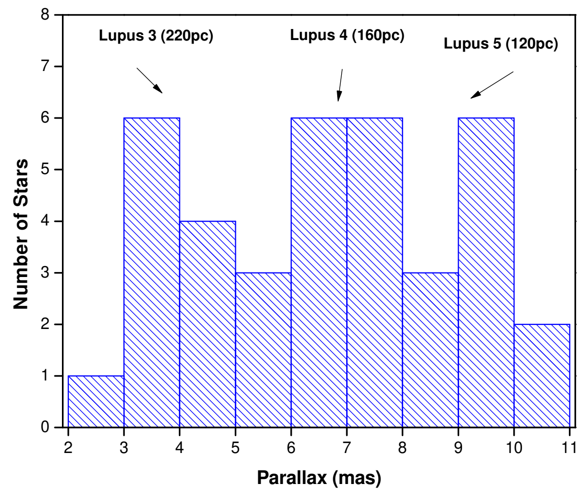

Fig. 1. Parallaxes for 37 group members in Lupus.

The objective function $\chi^{\mathbf{2}}$ is defined as:

$$\chi^2 = \sum_{i=1}^{N} t_{\perp_i}^2 \tag{3}$$

where $t_\perp = \mu_\perp/\sigma_\perp$ and $\mu_\perp$ is the proper motion component of each star directed perpendicular to the great circle that joins the star and the **CP**. We approximate the model at each iteration to a first order Taylor series expansion and use an initial guess of the **CP** position to refine iteratively and obtain by successive approximations the final coordinates of the **CP**. This procedure has been succesfully applied to the TW Hydrae association and the Hyades open cluster in order to check our results.

3. PARALLAX COMPUTATIONS

We identified a moving group with 167 members in Lupus and derived individual parallaxes for 37 group members with known radial velocity (see Figure 1). The achieved results suggest that the different star forming clouds in the Lupus complex lie at different distances showing significant depth effects.

REFERENCES

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