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KINEMATICS AND DYNAMICS OF YOUNG STELLAR GROUPS

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We describe briefly the application of a dynamical method, based on six-dimensional kinematics of the stars to find the birthplaces and the ages of groups of young stars. We refer also to other possible problems in which the method can find application.

Modern astrometric missions, as Hipparcos and others, have given rise to a revival of the use of kinematics and dynamics in the investigation of the motions of both isolated and groups of stars. This because accurate positions, paralaxes and proper motions provided by these missions are one of the elements necessary to set up the velocity vector of a star, the other being the radial velocity, preferentially obtained from high resolution spectroscopy. These data then allow to fix in some reference system the full six-dimensional kinematics of the star. In our work with young stellar groups of the Galaxy (the Milky Way), we have endeavored to use as initial conditions to calculate the orbits of the stars only data satisfying such requirements.

Turning to dynamics, we calculate the orbits of the stars in the general (assumed stationary) gravitational field of the Galaxy. This can be modeled through a potential taking into account the contributions of the main structural components of the Galaxy: bulge, disk, stellar halo, dark halo. Having available the orbits, it is possible to study a series of problems. Since 2002 our group at the Observatório Nacional in Rio de Janeiro has adopted this approach to investigate, by tracing back in time the orbits, the place of formation and mean dynamical age of young unbound groups of stars. This approach is particularly well suited for groups or minor associations consisting of pre-main-sequence stars in view of the difficulty to get age estimates for them by means of isochrone fitting. Characteristic of these groups is their small internal random motions which gives them a certain coherence in velocity space easing their detection. However, it is necessary to take into consideration that the observationally initially proposed group may contain false members, the so-called interlopers. Our approach is very efficient in detecting such intruders. Thus by applying our method to a group of stars we are capable of furnishing an independent calibration of its age based only on dynamical considerations.

We note that our method can also be used in other astrophysical contexts. Thus, for instance, it can be employed to investigate whether a star or groups of stars may have shared a common origin with another system, such as a cluster or an association. It can be applied as well to calculate and follow the trajectory of a runaway star to find its birthplace, a location which could be linked to the explosion of a supernova according to some scenarios of binary star systems evolution.

The following is a list of some of our works:

1. Study of the β Pic moving group (Ortega et al., 2002, ApJ, 575, L75)
2. Study of the Chamaleon complex (Jilinbski et al., 2005, ApJ, 619, 945)
3. Study of the TW Hya association (de la Reza et al. 2006, AJ, 131, 2609)
4. Study of the AB Dor group (Ortega et al., 2007, MNRAS, 377, 441)
5. A formation scenario of yong groups in the Scorpio Centaurus OB association (Ortega et al. 2009, AJ 137, 3922)
6. Study of the group Mamajek 2 (Jilinski et al, 2009, ApJ, 691, 212)
7. A dynamical study of suspected runaway stars as tracers of supernova explosions (Jilinski et al. 2010, ApJ, 721, 469)

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