Potential Members of Stellar Kinematic Groups within 30 pc of the Sun

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Age dating of individual stars in general is a very difficult task. Usually groups of stars or stellar clusters provide us with age-controlled sample of stars. For instance, a globular cluster is considered to be the source of an old sample of coeval stars in the halo with rather uniform metallicity. On the other hand, an open cluster provides us with a relatively young sample of stars with a similar age in the Galactic disk.

Some open clusters are located closer to the Sun than the nearest-by star-forming regions, such as Taurus and Chamaeleon dark clouds located at about 140 pc of the Sun. Due to the proximity, spatial localization alone is not a stringent criterion for the membership for these clusters. At least the proper motion and mean radial velocity have been used to define a kinematic group. Nearby streams of stars identified this way are called "stellar kinematic groups (SKGs)". At least eleven SKGs are known to date [1]. Owing to the success of *Hipparcos* in measuring parallaxes and proper motions of stars in the solar neighborhood, and to ground-based observational efforts to obtain radial velocities of nearby stars, three-dimentional velocity information is available for a set of nearby stars brighter than about $V = 11$ measured by *Hipparcos* within about 40 pc of the Sun.

A sample of age-controlled young stars in the very solar neighborhood has a wide range of applications. For instance, the direct detection of sub-stellar companions and planets is possible only around these young stars with the present-day technology, since brown dwarfs and planets shine only by the release of their gravitational energy. For instance, Gl 229A, the main star of Gl 229B, was selected as a target for the brown dwarf search, based on its kinematic youth as a young disk star [2,3]. However, the age of Gl 229AB system is not known precisely enough to estimate the mass of Gl 229B. Since the luminosity of a brown dwarf or a planet depends on both its mass and age, the knowledge of the age is essential in obtaining the mass from its luminosity. Other than that, age controlled samples are useful for the studies of stellar properties such as chromospheric and coronal activities, magnetic field strength, rotation, and the presence of circumstellar disks around them.

We analyze the kinematic histories of stars within 30 pc of the Sun, for which three-dimensional spatial coordinates and three-dimensional velocity vectors, are available. From this sample, we extract members of stellar kinematic groups (SKGs) in the following manner. First, we consider in the three-dimensional velocity space centered on the local standard of rest, a sphere with a radius of 8 km s^{-1} centered on the mean velocity vector of a particular SKG. Around each SKG velocity center, we have found significant excess of stars compared to background field stars. For each candidate, in the three-dimensional spatial coordinate space, its trajectory is traced back in time by the age of the relevant SKG, to obtain the estimated distance from the SKG center at the time of the SKG's birth by the epicyclic approximation and harmonic vertical motion. It often happens that a star is a candidate member of multiple SKGs. Then we rank the candidacy to multiple SKGs based on the smallness of distance separations. This way, we have kinematically selected 238 candidates. Then we further impose at least one of the following qualitative criteria to be a member: spectral type A or B, variability, or EUV and X-ray emission. We have finally selected 137 candidate members of SKGs out of a sample of 966 stars [4].

SKG	Age (Myr)	# of members
TW Hydra	8	13
η Cha	8	6
Cha-Near	10	7
β Pic	12	8
Tuc-Hor	30	7
IC 2391	45	17
AB Dor	50	18
Pleiades	120	0
Castor	200	19
Ursa Major	300	33
Hyades	600	9

References

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