

# Statistics of initial velocities of open clusters

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**Abstract.** Galactic clusters have well organized directions of their velocities at the instant of birth measured with respect to the local circular velocity. Preferential directions survive more than 100 Myrs. This can only be explained by star formation triggered by spiral arms.

**Keywords.** Open clusters, star formation, spiral arms

We made use of our large database of galactic clusters, which contains distances, proper motions and radial velocities, to determine the initial velocities of these objects (direction in the galactic plane, and amplitude). In a previous work (Dias *et al.* 2005) we showed that the birth of open clusters occurs in the spiral arms. By integrating backwards the galactic orbits of the clusters for a time equal to their age, we retrieved the birthplaces as a function of time and we determined the rotation speed of the spiral pattern. Now we use the same method to retrieve the initial velocities, and we measure the angle of the initial velocity perturbation with respect to the direction of circular motion. We find that the clusters are not born with random velocities, but with velocities that are organized in a few preferential directions with respect to the spiral arms. The existence of preferential initial directions allows us to directly observe the epicyclic frequency by plotting the orientation angle of the residual velocity (after the removal of the normal circular velocity) as a function of age (left side figure). The right side figure shows the histogram of initial directions for clusters in a narrow range of galactic radius  $0.95R_0 < R < 1.05R_0$ . Our results show that a preferential direction of birth velocity can survive for times longer than 100 Myr. This can be explained by star-formation in spiral shock waves, but it excludes some other star formation mechanisms such as star formation induced by supernovae.

## References

Dias, W.S. & Lepine, J.R.D. 2005, *ApJ* 629, 825

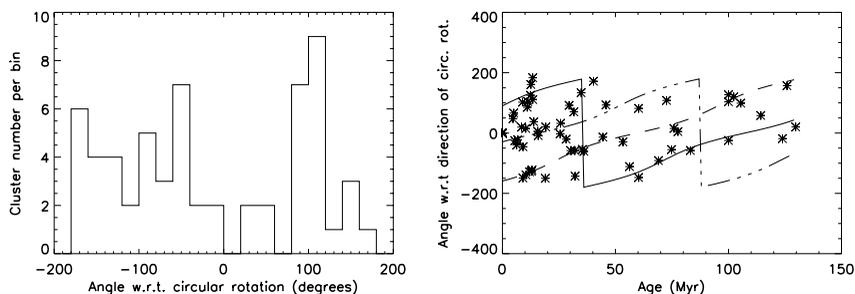


Figure 1. Histogram of initial directions (right), and direction as a function of age (left).