

Probing the structure of the Galactic Disk by open clusters

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WEBDA database of open clusters (07) is adopted, which is operated at the [Institute for Astronomy of the University of Vienna](#). The total sample consists of 970 open clusters, among which 920 OCs have known distances to the Sun, 911 OCs have age determinations, 911 OCs have reddening. The number of clusters in each age range is 510 (young: $age \leq 200\text{Myr}$), 305 (mediate: $200\text{Myr} \leq age \leq 1\text{Gyr}$), and 96 (old: $age \geq 1\text{Gyr}$).

Motivations:

We aim at deriving **disk** properties like

1. Disk scale length
2. Scale height of the Extreme Thin Disk
3. Height above the Galactic plane of the Sun.

Methodology

1. Statistical analysis of open cluster properties: Galactic longitude; Galactic latitude; Distance to the Sun; Age; Reddening; Galactocentric distance; Distance from Galactic plane.

2. The observed open cluster sample can not be representative of all OCs in the Milky Way because of uncompleted data. **Monte Carlo simulations** are adopted to estimate the completeness fraction of the sample.

Results:

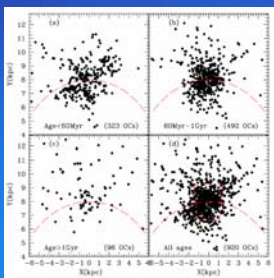


Fig1: Spatial Properties
Red dashed lines: solar circle.
Extreme young OCs: trace spiral arms.
Old OCs tend to locate outside solar circle.
Fan-shaped area: is used to do completeness simulation.

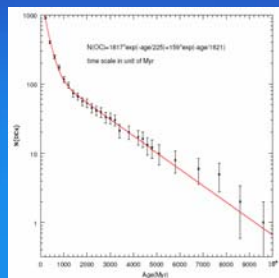


Fig2: Two time scale :
Young OCs: 225Myr;
Old OCs: 1.8Gyr.
Bonatto et al (2006):
Young OCs: 123Myr;
Old OCs: 2.4Gyr.
Janes & Phelps (1994):
Young OCs: 200Myr;
Old OCs: 2Gyr.

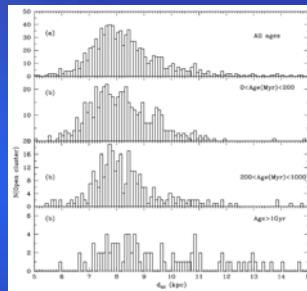


Fig4: Galactocentric Distance
A peak around the Sun;
old OCs: flat distribution.

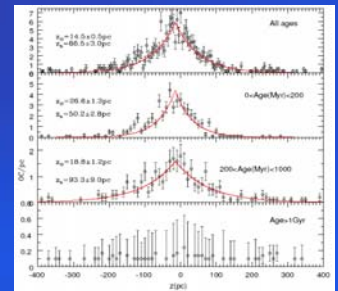


Fig5: Height over the Galactic Plane, scale heights increase as OCs' ages increase, scale height of young OCs is $50.2 \pm 2.8\text{pc}$.
Kharchenko et al (2005): $56 \pm 3\text{pc}$.
Chen et al (2003): 57pc .
Janes & Phelps (1994) : $\sim 55\text{pc}$.

Completeness Simulation

Reason to do completeness simulation:

We define the contrast

$$\delta_c = \frac{\sigma(0)}{\sigma_{bg}} = 1 + \frac{\sigma_{0,K}}{\sigma_{bg}}$$

Only the OCs with $\delta_c \geq 2$ are counted as detectable.

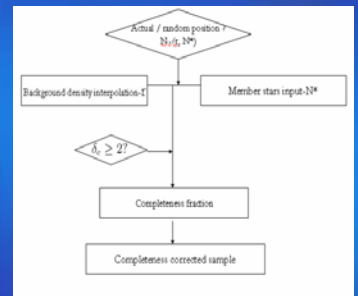


Fig6: Simulation procedure

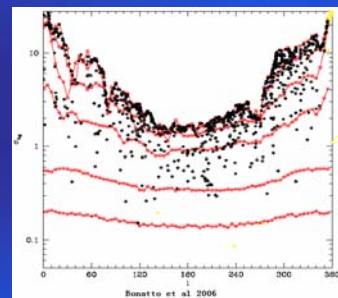


Fig7: Background star density (to the north of the Galactic plane). Stars brighter than $J = 15$ in circular areas with 1 degree in radius (2MASS).

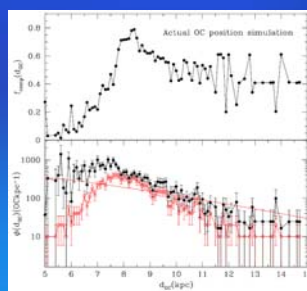


Fig8: Actual position simulation result
Red dots: observation.
Black dots: completed sample.
Disk scale length $R_D : 2.8\text{kpc}$.

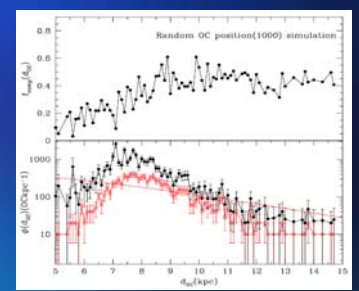


Fig9: Random position simulation result, red dots: observation; black dots: completed sample. Disk scale length $R_D : 2.8\text{kpc}$.
Disk scale derived from stars:
Chang et al (2002): $R_D \sim 2.8\text{kpc}$;
Vaucouleurs & Pence: (1978): $R_D \sim 3.5\text{kpc}$.

Summary

Old open clusters (age > 1 Gyr) : $\langle |z| \rangle \sim 394.5\text{pc}$, and locate far from the disk plane and outer part of Galactic disk.
The young open clusters are distributed on the Galactic plane almost symmetrically with scale above the Galactic plane of 50.2pc .
Two age scale: 225Myr for young OCs, and the other consists of longer-lived clusters with an age scale of 1.8Gyr.