THE HISTORY OF THE SUN’S BIRTH CLUSTER

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DID THE SUN BORN IN AN OPEN CLUSTER?

Disk stars are born in stellar clusters (Lada et al. 1993)

- Radio nuclei ($^7$Be, $^{26}$Al, $^{26}$Cl, $^{53}$Mn)
- Coplanarity of solar system planets
- Orbits of Kuiper belt objects

Supernova explosion in the vicinity of the newborn Sun

Close encounter with another star
WHY IS IMPORTANT TO STUDY THE ALREADY EXTINCT SUN’S BIRTH CLUSTER?

• To understand the open cluster evolution in the Milky Way.

• How the radial migration of open clusters affects the metallicity gradient in the Galaxy.

• To predict the current phase-space distribution of solar siblings
  * Better constraints on the initial conditions of the Sun’s birth cluster
  Better understanding of the current features of the Solar system

In all the cases we need realistic simulations
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A high order integrator: *Rotating Bridge* (Martínez-Barbosa et al. (2015) MNRAS, 446, 823; Gonçalves et al. in prep.)

\[ \begin{align*} 
&\frac{d}{dt} \begin{pmatrix} x_i \\ v_i \end{pmatrix} \\
= &\begin{pmatrix} 0 \\ -\frac{GM_c}{R_c^2} \end{pmatrix} \\
\end{align*} \]
INITIAL MASS AND RADIUS OF THE SUN’S BIRTH CLUSTER

INITIAL PHASE-SPACE COORDINATES OF THE SUN’S BIRTH CLUSTER

Methodology:

1. We selected 5000 galactocentric positions and velocities from a 4D gaussian centered at the current Sun’s phase-space coordinates.

2. We computed the orbit of the Sun backwards in time.

3. We obtain a set of birth phase-space coordinates.
The Sun does not migrate on average. No migration outwards. Only very specific Galactic configurations allow considerable radial migration. 

\[ x_i = 9 \text{ kpc} \]

(Martínez-Barbosa et al. (2015) MNRAS, 446, 823)
THE EVOLUTION OF THE SUN’S BIRTH
CLUSTER IN THE GALAXY

\[ M_c = 1023 M_\odot; \quad R_c = 2 \text{ pc}; \quad N = 1700 \]
THE EVOLUTION OF THE SUN’S BIRTH CLUSTER IN THE GALAXY

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miércoles, 3 de diciembre de 14
ASTROMETRIC PROPERTIES OF SOLAR SIBLINGS

Mc = 510 M☉
Rc = 0.5 pc
N = 875

Martínez-Barbosa et al. in prep
$M_c = 510 M_{\odot}$

$R_c = 0.5$ pc

$N = 875$
NUMBER OF SOLAR SIBLINGS GAIA WOULD OBSERVE

- No transient structure
- No Gaia errors
CONCLUSIONS

Gaia will revolutionize our understanding of the Milky Way however...

It will be very difficult to search for solar siblings!

Next challenge: develop techniques to look for solar siblings among the vast Gaia catalogue.
THANK YOU