A setup for Gaia-DR1:
The star formation history of our thin disc environment

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The first Gaia Data Release (Gaia-DR1, 14 September 2016) primes the pump and paves the way for a new golden age of the galactic astronomy. Gaia-DR1 will provide new parallaxes and proper motions for about two million well-behaved Tycho-2 stars placed in the solar neighborhood. This TGAS (Tycho-Gaia Astrometric Solution) catalogue is being obtained using the first year of Gaia data and Tycho positions as priors.

The aim of the work presented here has been to evaluate the capabilities of Gaia and future on-ground spectroscopic surveys to derive the dynamical age and place of birth of the Young Local Associations (YLAs). Test particle simulations in realistic galactic potentials and different scenarios for the accuracy on astrometric and spectroscopic data, allow us to quantify our future capabilities to trace back in time the star formation history of our thin disc environment.

YLA, what are they?
The Young Local Associations (YLA) are groups of young (mainly low-mass) stars in the solar neighborhood (r<100pc).
Groups: They share common properties when looking at the X-ray, optical spectroscopy and kinematic data
Young: spectroscopic ages between 10 – 100 Myr
Why Important? They offer us new insights into the star formation process in the solar neighborhood (low-density environments)

Derivation of a dynamical age for each association. Do they match with HR ages?
Star formation in low density environments
Triggered star formation?

Centers of the associations back in time
Do they have a common origin?
Unified in spiral arm: shock wave?
Molecular cloud compression?

Realistic Galactic potentials and orbits back in time
We use two Galactic potentials to perform the back in time integration:
1. Bar model: As in Romero-Gómez et al (2015), axisymmetric component (A&S91) + 2 Ferrers bars (mass of 10^10Msolar and c=50 km/s/kpc)
2. PERLAS model: As in Antoja et al (2011), Pichardo et al (2003), axisymmetric component (A&S91) + spiral arm (Amplitude 5% and we study 2 pattern speeds: c=20 and 30 km/s/kpc, PERLAS-20 and PERLAS-30, respectively)

Simulation of the evolution of the YLA in the solar neighborhood

Effect of the data scenarios and type of orbits on the determination of age and place of birth

Challenging and exciting near future
• We will really improve the membership detection with TGAS data, detecting new members and new YLAs in the solar neighbourhood.
• Requirements: 1) we need good radial velocities (critical factor to determine dynamical age and place of birth), RAVE will be used as starting point;
2) Available catalogues such XMM, WISE … crossmatched with TGAS will be used for the detection of young population and new members.
3) New observing proposals are needed for chemical tagging
• Appropriate full sky clustering multivariate analysis is proposed to attach this challenging project for the evaluation of the star formation in the solar neighbourhood.

The YLA as seen by Gaia
- Better astrometry (distances and tangential velocities)
- Detection of new members (Grand Challenge)
- Complementary on-ground HR data and chemistry

Our experiment:

- N < Y >
- Galactic reference
- Gaia+ 1900 13 seed membership 0.5

The YLA as seen by Gaia (IN, SUN, OUT)

Y (kpc) 15 10 5 0 -5 -10 -15
X (kpc) -15 -10 -5 0 5 10 15

Challenging and exciting near future

- Three different initial conditions for YLA:
  IN: YLA born in the inner disc
  SUN: YLA similar to TW Hya YLA
  OUT: YLA born in the outer disc
- Two spiral loci:
  Solid line: at present (t=0)
  Dashed line: at birth (t=100Myrs)
- Orbits back in time in the PERLAS-20 model in the four data scenarios

Note how “Before Gaia” the YLA never converges to a single point, while with TGAS-Tyc and TGAS-Hip the convergence is good and with Gaia+ we can determine the place of birth with good accuracy.