Re-composing the galactic puzzles with their small pieces: stellar clusters

Texts

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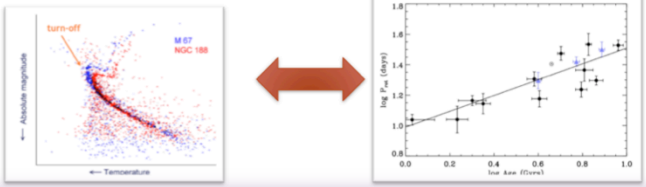
Aims of the project:

- Detecting new clusters, performing deeper surveys of the existing ones
- Detecting tidal tails of star clusters/nearby galaxies and streams in the Galactic halo
- Deriving cluster parameters and metallicity from photometry, both in the the MW and in nearby galaxies
- Deriving stellar ages from gyrochronology

Projects:

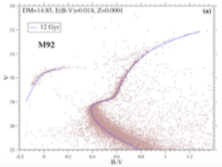
Stellar ages in clusters: a bridge for the field

- Calibrate age indicators in well-known clusters and use them for the whole sample of stars
  - → gyrochronology and age-rotation relation → recalibrating the age-rotation relations also in the old, low-mass regime thanks to the long temporal base-line of LSST
  - → age-activity relations
  - → binary star/isochronal ages techniques



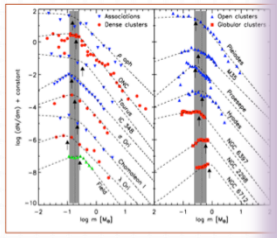
Testing the stellar evolution in a extremely wide range of ages and metallicities

- New constraints on stellar evolution and stellar physics from very young clusters to the old metal-poor populations
- → we aim at testing our current knowledge on stellar evolution using clusters as benchmarks



The Galactic IMF:

- We aim at studying the cluster mass function and the initial mass function (IMF) with its dependence on the environment and metallicity
- We will take advantages of LSST mapping of the local Galactic structure and luminosity function up to 30 kpc, allowing us to estimate changes in the IMF as a function of the position in the Galaxy



Bastian+10

The process of cluster formation and disruption

Open and Globular clusters are fundamental constituents of our Galaxy, both the clusters found now in the Galaxy and those disrupted and now forming the disc and halo field populations

- → Studying the clusters' population at different Galactocentric radii
- → Looking for remnants of destroyed clusters: LSST is expected to find, for instance, more than 100 globular clusters streams

The radial distribution of metallicity in galaxies and its temporal evolution

The cluster populations in the MW and in the Local Group galaxies are tool to investigate the metallicity spatial distribution and its time evolution

→Photometric metallicity will be calibrated with spectroscopic metallicity of nearby objects

→Photometric metallicity estimates from individual giant stars within few Mpc.

- INAF-Osservatorio di Arcetri and Catania; Universities of Pisa and Catania

  Laura Magrini (PI) and Germano Sacco (Young researcher)

  - Supporting staff: S. Randich, E. Pancino, E. Franciosini, S. degl'Innocenti,, P. Prada-Moroni, E. Tognelli, S. Messina, A. Lanzafame
    - Photometry and Astrometry
    - Ground-based spectroscopy: analysis of large datasets
    - Stellar evolution models
    - Stellar ages: gyrochronology, activity
    - Galactic and extragalactic resolved populations
    - Coordination of large projects

- INAF-Osservatorio di Padova, Bologna, Torino

  Antonella Vallenari (co-PI), Rosanna Sordo and Tristan Cantat-Gaudin (Young researchers)

  - Supporting staff: A. Bragaglia, E. Carretta, A. Sollima, S. Lucatello, M. Mapelli, A. Spagna
    - Photometry & astrometry: treatment of big data sets, data mining, calibration, detection and treatment of systematics
    - Stellar spectroscopy
    - Cluster hydro-dynamical models
    - Resolved stellar populations: the Galactic disk, open and globular clusters
    - Coordination of large projects

Our synergies and tools:

- Management roles, expertise in data analysis and in their scientific exploitation: Gaia, Gaia-ESO, Weave
- Spectroscopic follow-up with present/forthcoming instruments and surveys

  → for nearby clusters: catalog of the Gaia-ESO Survey

  → for more distant and reddened objects we will perform new observations with the next generation of instruments and surveys, such as MOONS, WEAVE, E-ELT.

- Theoretical development:

  → updates in our stellar evolution models (e.g. Tognelli+11)

  → hydro-dynamical codes to simulate cluster evolution (e.g. Mapelli+15)

Analysis and time-line

Before the beginning of LSST (2017-):

- Development of algorithms for the identification of clusters (INAF-Padova)→ training on Gaia datasets preparing for LSST
- Bayesian approach to determine clusters' parameters from isochrones fitting (INAF-Arcetri/UniPi)→ developed at the University of Pisa (Randich et al. 2017), updated to use LSST datasets
- Using Gaia-ESO parameters to calibrate photometric metallicities (INAF-Arcetri)→ from Summer 2017 with the end of Gaia-ESO DR5
- Tools for the determination of gyrochronology ages (INAF-Catania) → synergy with isochrones fitting