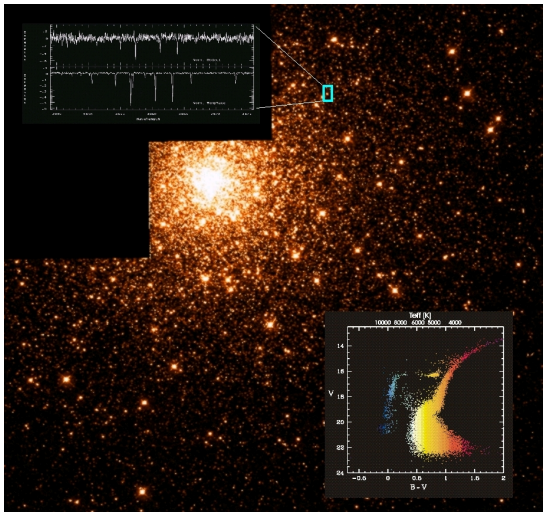
Stellar and Galactic Physics

Stellar Clusters: Rosetta stone of stellar and galactic evolution



Stellar clusters are at the crossroad between stellar and galactic astrophysics. On one hand, thanks to them, the main stages of stellar evolution can be analyzed in detail. On the other hand, they are crucial pieces of Galaxy formation, from the oldest epochs of the Universe (globular clusters), to the present star forming regions. Even our Sun is believed to have formed in an open cluster of the Galactic disc. Lectures on stellar cluster studies, starting with basic knowledge of stellar physics and Galactic stellar populations, will be presented. Practical analysis of different observational data from international projects like the ESA Gaia space mission or the Gaia-ESO Survey.

Theory

by A. Recio-Blanco and P. de Laverny

How did the Galactic halo formed in the first epochs of the Milky Way? Did the Galactic disc formed inside-out? Did our Sun migrated from its birth place? How does the live of a star depend on its mass? The common point of all these questions is that they can be addressed through the study of stellar clusters. From Galileo's observation of the Pleaides reported in the *Sidereus Nuncius* in 1610, to the present day 3D chemo-dynamical vision of the Gaia space mission, stellar clusters lie at the core of astronomical and astrophysical studies.

Because clusters are clumps of stars sharing the same age, metallicity and chemical composition, they are ideal benchmarks for models of stellar evolution. In addition, clusters are (at least partially) disrupted over time as they move through the Galaxy, becoming crucial building blocks of the Galactic disc and halo formation. Some 4600 million years ago, the Sun was born in a cluster, and the stars that were born together with the Sun, the so-called solar siblings, might be currently dispersed all over the Galactic disc.

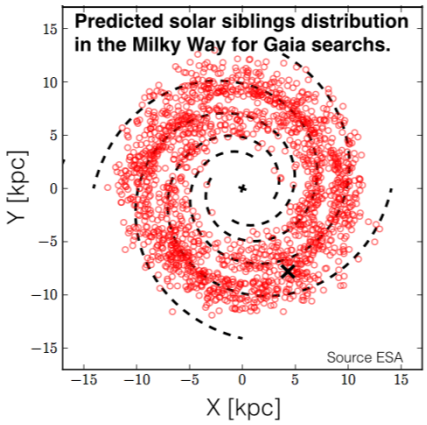
The theoretical part of this METEOR will allow to address different crucial aspects of the stellar and galactic physics through the concrete illustration of stellar cluster studies. It will be organised as follows:

- The HR diagram and the stellar evolution
- Globular clusters and the Galactic Halo
- Open clusters and the Milky Way disc
- The cluster of our Sun: searching for solar siblings
- International projects studying stellar clusters

Applications

by A. Recio-Blanco

Thanks to their crucial role in astrophysics, stellar clusters are perfect examples to illustrate the modern observational techniques and data like photometry, spectroscopy and astrometry. Practical studies on chemical and physical properties of stellar clusters based on very recent Gaia mission and Gaia-ESO Survey data will be performed by the students. They will address questions like the 3D view of a stellar cluster with Gaia data, the chemical gradients of the Galactic disc thanks to VLT spectroscopy and the fit of stellar evolution models to a colour-magnitude diagramme.



See also

Astrophysics: A very short introduction, J. Binney, 2016
Encyclopedia of Astronomy & Astrophysics: Star Clusters, G. Djorgovski
The origin of the Galaxy and Local Group, J. Bland-Hawthorn, K. Freeman, F. Matteucci, 2013

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