The Open Clusters in the Gaia-ESO Survey

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THE GAIA-ESO SURVEY

The Gaia-ESO survey (GES, PIs G. Gilmore & S. Randich) is a public survey on FLAMES@VLT. It started on December 31, 2011 (P88) and will go on for 4(+1) years using 50 nights per semester. The GES will target all Milky Way stellar populations (solar neighborhood, bulge, halo, thin and thick discs) and it is meant to complement and build on the information coming soon from the Gaia satellite. This effort will result in precise astrometry, kinematics, and chemical abundance data for more than 10^5 stars in the MW field and in clusters (see Gilmore et al. 2012 and Sofia Randich's talk at this Meeting for a detailed description).
We describe here the part of GES centred on open clusters and young associations.

MOTIVATION

Most (all?) stars form in associations or clusters, so a complete understanding of star formation, galaxy formation and evolution necessarily implies studying clusters. The main goals of the OC-GES are to study:

- OC formation and destruction
  - requires internal kinematic, with radial velocities known to better than 0.5 km/s, to be coupled with Gaia astrometry
  - limited to close clusters (Dsun<1.5 kpc), to maximise Gaia impact
- Stellar evolution
  - clusters are templates from pre-main sequence to white dwarfs, for masses 0.1-100 Msun
  - requires temperature, gravity & information on rotation, accretion, binarity, abundances to calibrate evolutionary models
  - complemented by asteroseismology & Gaia astrometry
- Disc formation and evolution
  - with OCs we cover R_{GC}=5-20 kpc and can study chemical evolution as function of distance, age
  - requires precise, homogeneous metallicity & detailed chemical abundances
  - complemented by photometry for distance, age & Gaia astrometry

THE SAMPLE

We require a large, significant number of objects well sampling the distribution in age, metallicity, position in the MW, mass. We selected :
- about 60 "old" OCs (age = 0.1-8 Gyr) covering the whole disc and with (expected) [Fe/H] from -0.5 to +0.5 dex
- about 30 "young" OCs, associations and star forming regions (also with massive stars) } some of them massive

See Fig. 1 for the older sample properties.

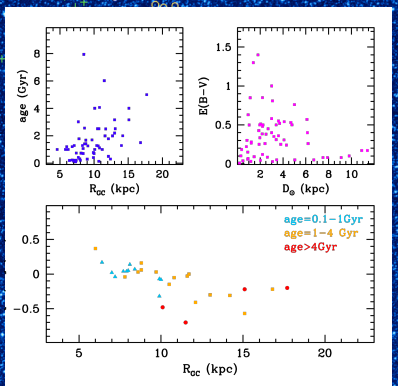

Fig. 1 – Distributions of the properties of the "old" OC sample (based on literature)

CLUSTERS & STARS SELECTION

Clusters selection criteria : clusters sampling the whole age/[Fe/H]/position/mass range ; not embedded ; with stars in the range V≈9-19 ; not too reddened ; not already present in ESO archive (or observed only partially) ; with optical photometry available in a field of view matching the FLAMES one (literature and/or private data and/or surveys, like e.g. IPHAS & VPHAS+).
Stars selection for each cluster : homogeneous & unbiased as far as possible ; based on photometry with input from proper motions and radial velocities if available/relevant ; information on membership crucial for the few UVES fibres ; targets are "all" stars or a significant fraction of the whole cluster population and evolutionary phases (see Figs. 2 & 3 for examples).

OBSERVATIONS & ANALYSIS

We use FLAMES & the following setups:
-UVES 580nm + HR15n / HR09b for clusters with stars mainly of FGKM spectral types
-UVES 520nm + HR03, HR05a, HR06, HR09b, HR14a for clusters with OBA spectral types

UVES is used on the brightest targets (to V=16.5) on the red clump, the main sequence or pre-MS.
GIRAFFE is used down to V=19 (a good match of the Gaia astrometry, which reaches V≈20).
The astrometric system for all targets is the 2MASS one (fibre positioning proved to work fine).

We will deliver atmospheric parameters, [Fe/H], detailed abundances (species depending on spectral type), radial velocities for all targets; rotational velocity and information on accretion when relevant ; photometric data ; coordinates.

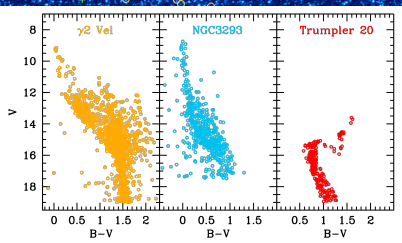

Fig. 2 – Stars observed in three objects; note the dominance of pre-MS, young MS, and old MS plus evolved stars, moving from left to right.

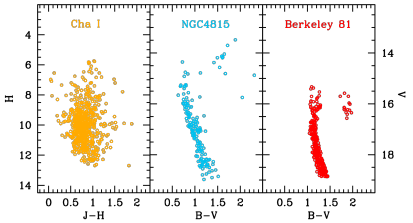

Fig. 3 – Stars observed in three objects: a star forming region and two intermediate-age OCs.

Cluster	age	distance	[Fe/H]
Chamaleon I	1-3 Myr	160 pc	-0.1
ρ Oph	3 Myr	120 pc	≈0
NGC 6530	2 Myr	1250 pc	
γ2 Vel	5-10 Myr	350 pc	
NGC 3293	10 Myr	2.7 kpc	+0.15
NGC 6705	0.25 Gyr	1.9 kpc	+0.10
NGC 4815	0.5 Gyr	2.5 kpc	
Berkeley 81	1 Gyr	3.0 kpc	-0.15
Trumpler 20	1.4 Gyr	3.0 kpc	-0.1

FIRST RUNS & RESULTS

-Done 10 observing runs (to mid October).

-Obtained data for 9 clusters (see Table on the left, where properties are taken from literature).

-Pipeline reduction tested & in place.

-Quality control under way.

- Abundance analysis started : several methods tested and compared.

-Different working groups for FGK and late spectral type stars, early spectral type stars, pre-MS stars, non standard objects.

For information on the GES :
Gilmore G., Randich S., et al, 2012, The Messenger, 147, 25
& see also:
http://www.eso.org/sci/observing/PublicSurveys/