The OCCASO Survey: Open Clusters Chemical Abundances from Spanish Observatories

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ABSTRACT

Galactic Open Clusters (OCs) are crucial to investigate the formation and evolution of the Galactic disc. However, complete information is available for only ~ 5% of the 2100 known OC in the Milky Way.

Therefore, OCs are one of the main targets in space missions (Gaia, Kepler), and in large ground-based spectroscopic surveys . However, these ground-based surveys are mainly sampling the Southern hemisphere OCs (GES, GALAH), or do not have an specific program for homogeneously sample OCs (APOGEE).

We aim to complement these surveys obtaining detailed abundances for more than 20 chemical species in around 30 Northern OCs.

I. INTRODUCTION

In order to take advantage of the potential of OCs to investigate the Galactic disc, large and homogeneous samples are needed:

- Radial velocities + proper motions
- Ages from homogeneous datasets
- Detailed chemical abundance from homogeneous analysis

The **Gaia-ESO Survey** (GES) is aiming to complement the high precision astrometric measures from Gaia, with radial velocities and detailed chemical abundances.

The **OCCASO Survey** is developed in parallel to GES and replicating GES-UVES (high resolution) observational strategy and analysis, in order to make them **compatible**. In this way one can take the results from the Northern and Southern OCs together for scientific purposes. See Figure 1.

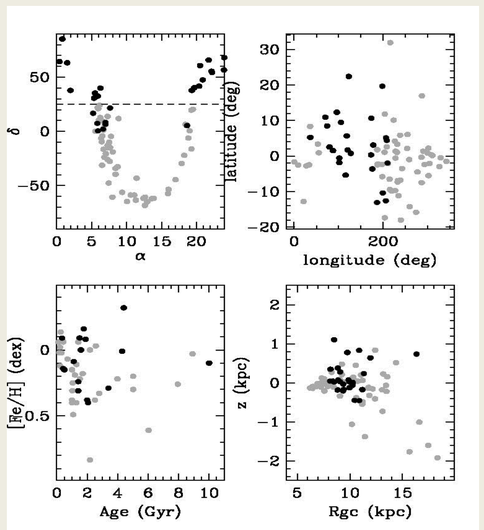

Figure 1. Distribution of GES targets (grey) and OCCASO targets (black) in equatorial and Galactic coordinates, in the metallicity-age plane, and in the Galactocentric radius-z plane.

II. OBSERVATIONS

Observations are distributed in **three instruments** in La Palma and Calar Alto observatories:

- HERMES@Mercator(1.2m) *R~85000*
- FIES@NOT(2.5m) *R~67000*
- CAFE@CAHA(2.2m) *R~60000*

Granted **Long Term Programme** with **NOT&Mercator**: 5 nights/semester in each telescope until summer 2015.

The observational strategy involves:

- **30 OCs** older than 0.5 Gyr
- **≥6 Red Clump stars** in each cluster
- Signal to noise ratio **SNR≥70**

Completed first year and a half of observations, yielding to **95 stars** observed in **18 different clusters**. Observations are **completed for 11 clusters**.

Telescope	NOT	Mercator	2.2mCAHA
Awarded	25	25	13
Observed	20	15	8
Time lost	30%	15%	50%

Table 1. Number of awarded and observed nights, and time lost due to bad weather, in each telescope.

Cluster	Observed stars	$V_{RedClump}$
NGC 752	7	9
NGC 2099	7	12
NGC 2682	8	10.5
IC 4756	6	9
NGC 6633	4	8.5
NGC 6705	7	11.5
NGC 6791	6	14.5
NGC 6819	6	13
NGC 6991	6	10
NGC 7762	6	12.5
NGC 7789	7	13
King 1	4	14.5
NGC 559	1	14
NGC 1817	5	12.5
Berkeley 17	3	14.5
NGC 2420	5	13
NGC 6939	5	13
NGC 7142	2	14

Table 2. OCs observed so far, in green the completed ones, in orange the started ones. Second column lists the number of stars already observed. Third column shows the V magnitude of the Red Clump.

III. ANALYSIS METHODS

To obtain atmospheric parameters and detailed chemical abundances, we use methods based on **equivalent widths**, and **spectral synthesis** methods.

The idea is to execute the analysis using several methods, check the results obtained, and perform an homogenization to make the analysis more robust. This is the strategy that GES-UVES is following. For now we are using three methods also used by GES nodes.
We have completed the analysis from one equivalent width method (GALA), and started with three spectral synthesis methods (FERRE, MATISSE, iSpec). See Figure 2.

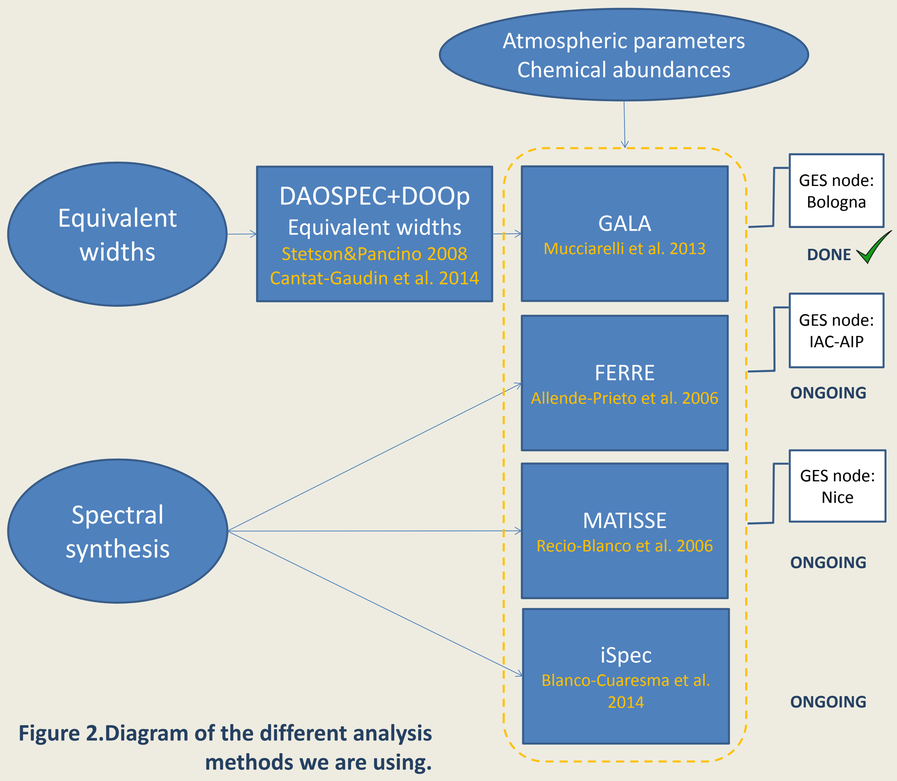

Figure 2.Diagram of the different analysis methods we are using.

IV. CONSISTENCY

To guarantee homogeneity, **internal consistency** among the different instruments has been checked. We have observed 13 stars with the three instruments and checked the differences in the results of physical parameters, radial velocities and abundances. See figure 4 for NOT-Mercator comparisons.

Consistency with GES is also checked with the only cluster in common observed until now, **NGC 6705**. See figure 3 for comparison of effective temperature, surface gravity, microturbulent velocity and iron abundance.

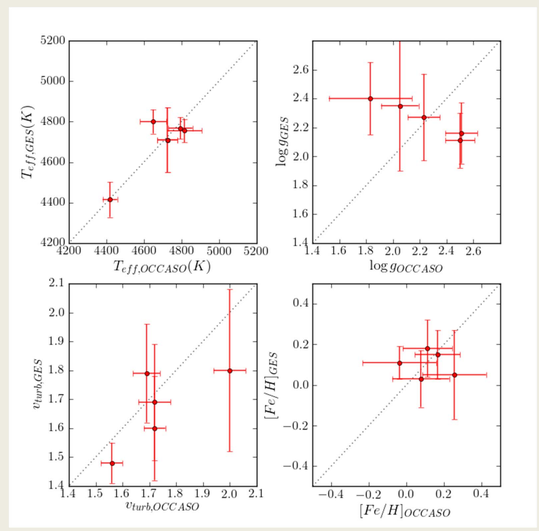

Figure 3. Comparison of physical parameters and iron abundance of the cluster NGC 6705 with GES.

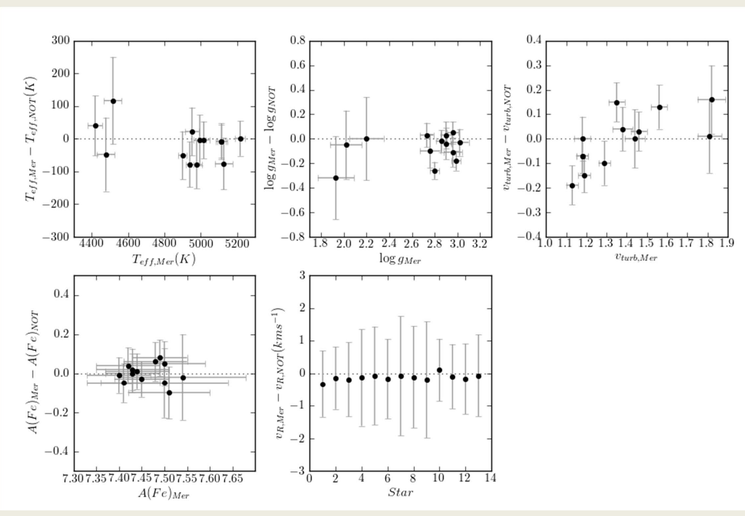

Figure 4. Differences between NOT and Mercator results: effective temperature, surface gravity, microturbulent velocity, iron abundance and radial velocity.

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