The Gaia-ESO Survey

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INAF-OSSERVATORIO ASTROFISICO DI ARCETRI

Overview

Large ESO public spectroscopic survey of 10^5 galactic stars in the MW field and in open clusters

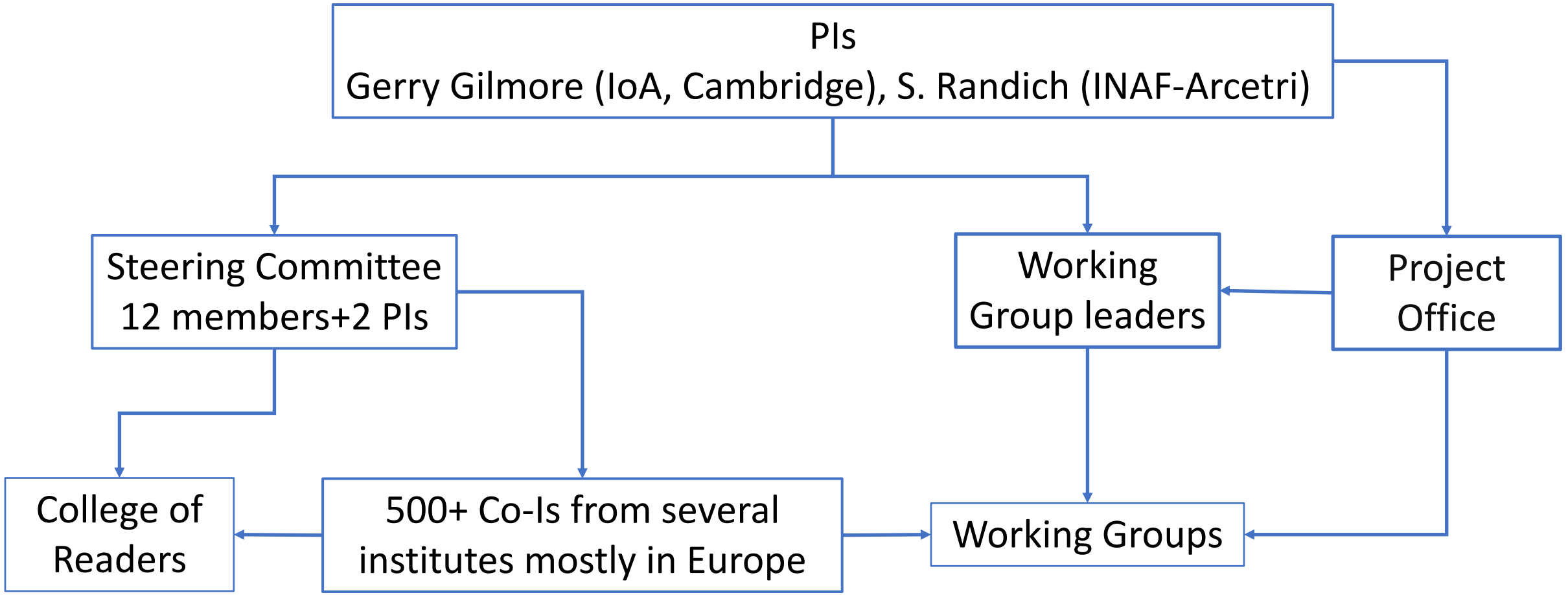
Gaia + Gaia-ESO	=	6D phase space Stellar parameters Chemistry

<u>Scientific drivers</u>:

- The dynamical evolution of star clusters
- All phases of stellar evolution
- The formation and evolution of the Galactic disc
- Properties and origin of the Bulge and the Halo

(see Gilmore et al. 2012, Randich & Gilmore 2013)

The Gaia-ESO Consortium



The INAF Contribution

Manpower and Managment

Institutes with major involvment: OAA, OABO, OACT, OAPA, OAPD

Managment roles: co-PI (S. Randich), members of steering committee (G. Micela, A. Vallenari), WG leadears (A. Bragaglia, E. Flaccomio, A. Lanzafame, E. Pancino)

People with key roles in target selection, data reduction and data analysis: K. Biazzo, F. Damiani, E. Franciosini, A. Frasca, L. Magrini, L. Morbidelli, L. Prisinzano, G. Sacco + postdocs and PhD students

Several co-Is with minor involvment

Financial contributions

PREMIALE VLT 2012 (P.I. S. Randich)
PRIN INAF 2014 (P.I. S.Randich)

Mostly used to fund postdocs involved in the target selection and data processing

Meetings

- All hands science workshop in Catania
- Science meeting on young clusters in Palermo
- Two technical meetings on data processing in Firenze

Scientific exploitation

29 papers (37 % of the papers from the GES consortium) led by INAF author

Only regret

Not having our own data archive!

Observations and Status

Targets:

- Field stars in the disc, halo and Bulge
- Open clusters of all ages
- Large sample of calibrators

+

Re-processing and Re-analysis of a large sample of archival data

Instrument: FLAMES at VLT

- GIRAFFE (R=16,000-25,000)
  - ✓ Targets: 10^5 (V< 19 mag)
  - ✓ Setups: HR10/15/21 (Cool Stars)
    HR3/5a/6/9B/14 (O/B/A)
- UVES (R =47,000)
  - ✓ Targets: 8000
  - ✓ Setups: 520, 580

Observations

- Period: 12/2011-01/2018
- Nights: 340
- Mode: Visitors

Status

- Observations completed on January 2018
- Five Internal data releases
- Three public data releases
- Last internal release will be completed in March

Target selection: Open clusters

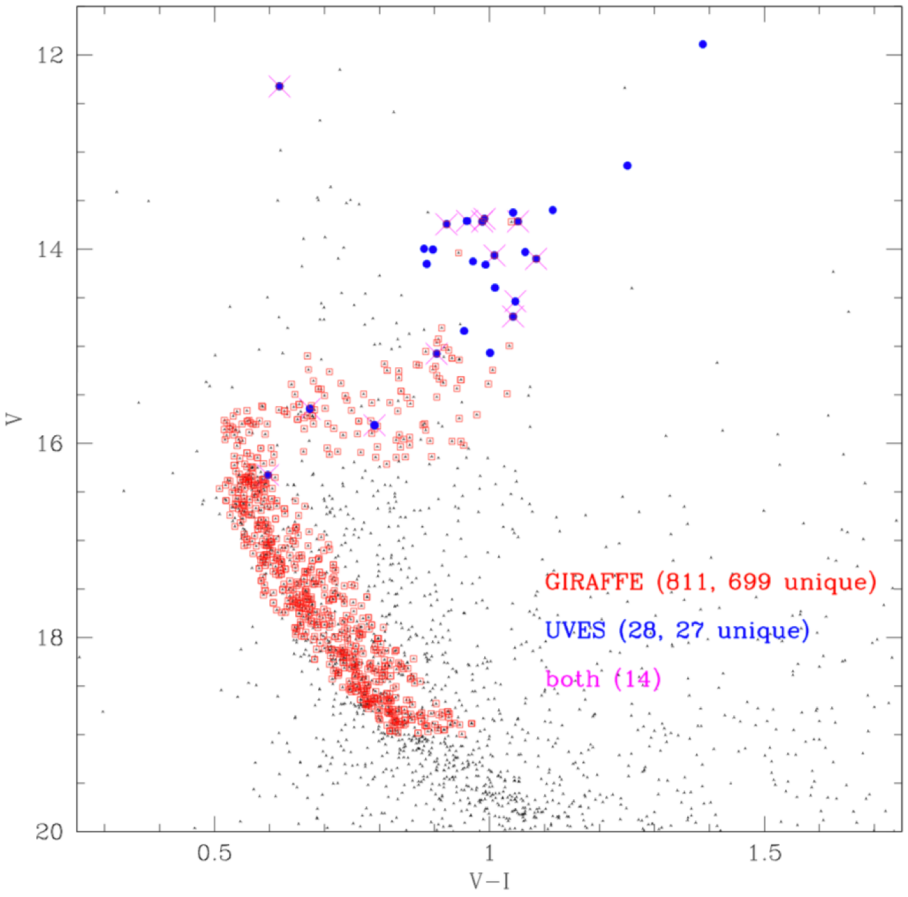
Cluster Sample

- Number: 62
- Age: 1-8000 Myr
- Galactocentric radius: 5.5-9.0 kpc
- Number of Stars: 200-2000
- Spectral types: from M to O

Target Selection

- Giraffe
  - ✓ Strategy to obtain a sample as much as possible complete and unbias
  - ✓ Based on Photometry
- UVES
  - ✓ Strategy to obtain a sample of cluster members suitable for chemical analysis
  - ✓ Based on spectroscopy and photometry

NGC 2243

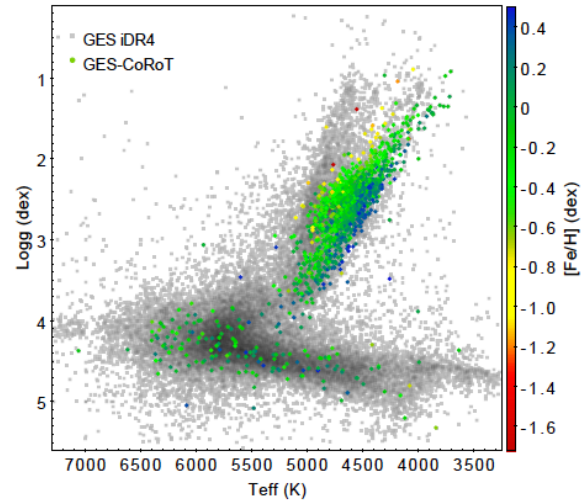


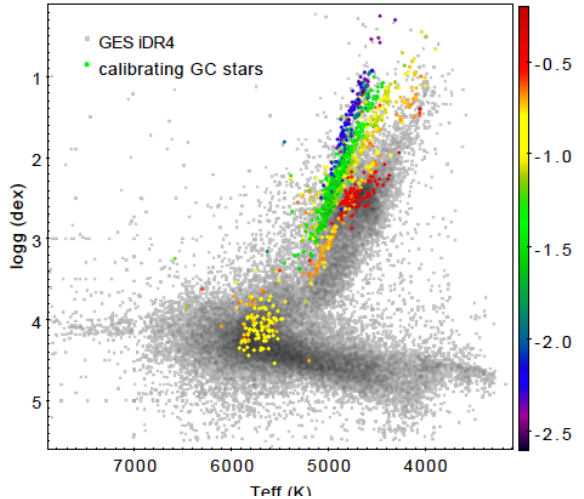
Target Selection: Calibrators

Goals

1. Internal calibration of the survey
2. Cross-Calibration with Gaia
3. Cross-Calibration with other surveys

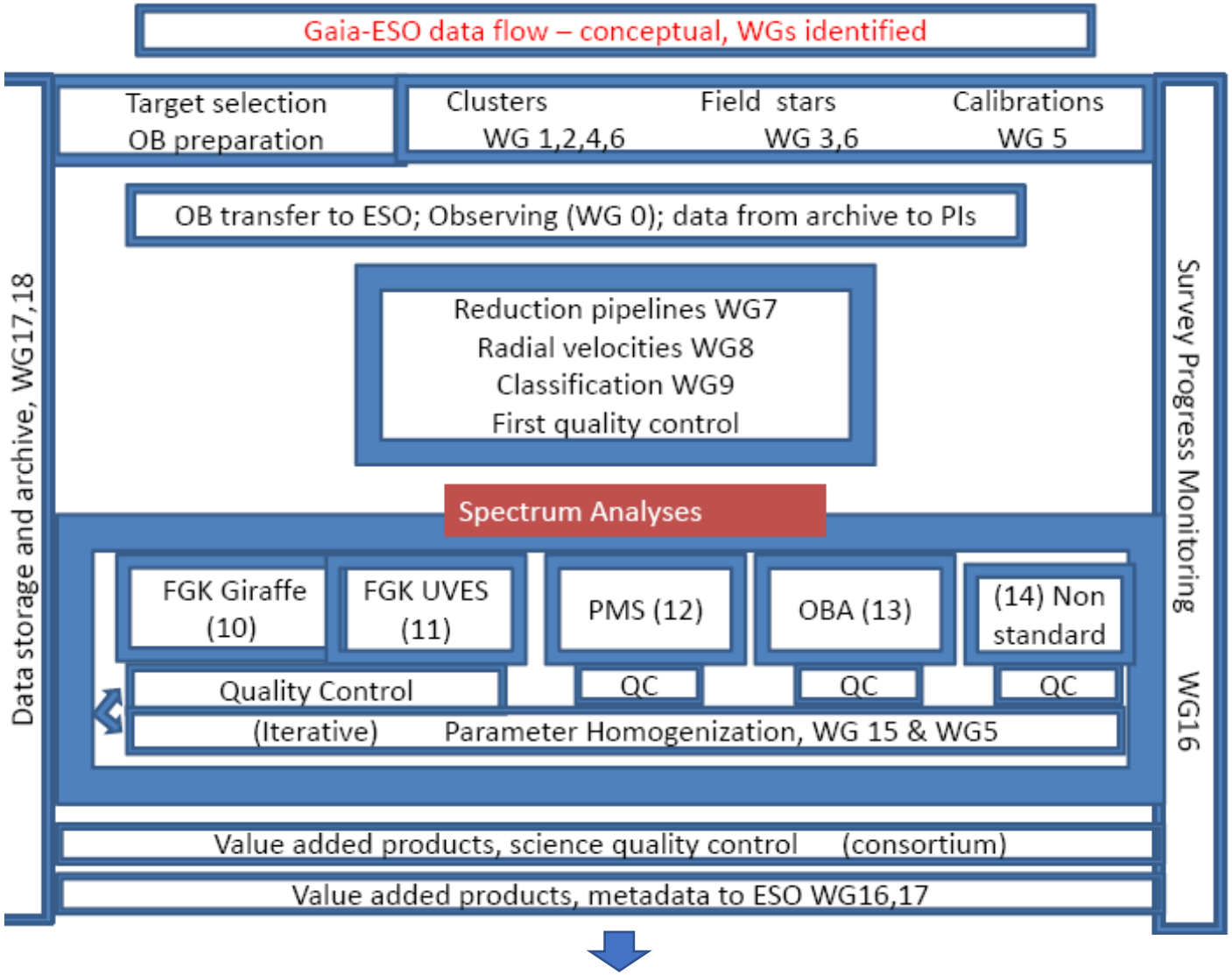
- (Gaia) RV Standars
- (Gaia) Benchmark stars
- Astereosimologic benchmarks from COROT and Kepler
- Very well know Globular and Open clusters





(From Pancino et al. 2017)

The data analysis workflow



Distributed

Centralized
- Cambridge for GIRAFFE
- Arcetri for UVES

Distributed
- Several nodes
- Multiple pipeline
- Common model atmospheres
- Common line list
- Common grid of spectra

Science Archive at RoE

Multi-nodes approach: Successes and Issues

Successes

1. Capability to analyse spectra covering large ranges of temperatures, gravities and metallicities;
2. Capability to derive a wide range of astrophysical parameters;
3. Better understanding of systematics in data analysis;
4. Development of new tools for data analysis;

Issues

1. Long data analysis cycle with a high chances of delays
2. Simple errors propagate through the workflow and are difficult to address

Solutions

1. Robust managment structure (project office, wikipage, meetings)
2. Strict rules on data format and documentation
3. Independent quality control

Implementing these solutions require manpower and time

Scientific exploitaition: Bottom-up approach

All Co-Is have access to the full dataset of homogenized parameters and are free to publish on any topic. They have to share their project and post their paper before pubblication on a wikipage, follow some rules about authorship and the use of data.

SUCCESSES

1. Several papers covering a wide range of topics
2. Several papers lead by PhD students and postdocs
3. Several CO-Is were stimulated to develop new tools for the analysis

What could have been done better

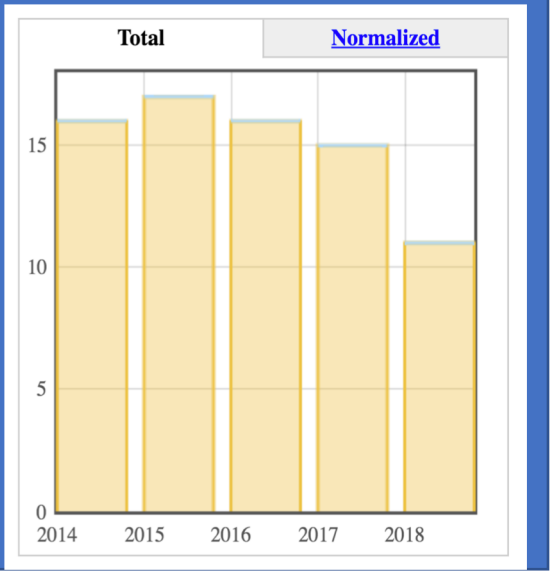
1. Stricter rules about how to share projects on the wikipage
2. Key projects driven by the steering committee

ISSUES

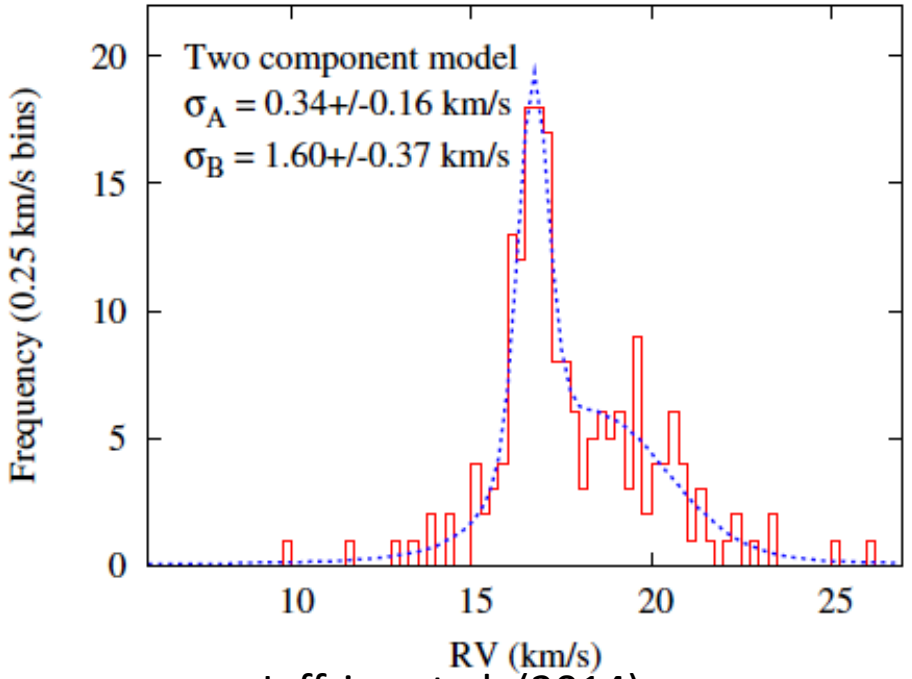
1. Publications somewhat fragmented (e.g. Papers focusing on the properties of one cluster)
2. Some overlap among differnt papers

GES consortium publications

Refereed paper: 75
Citations: 1667

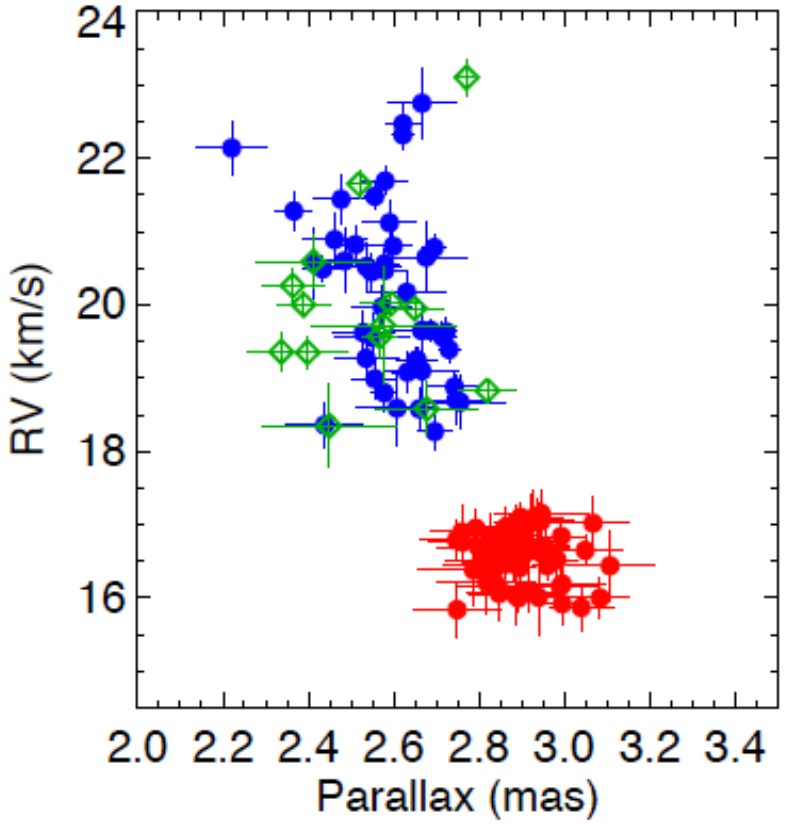


Selected scientific results: cluster dynamics



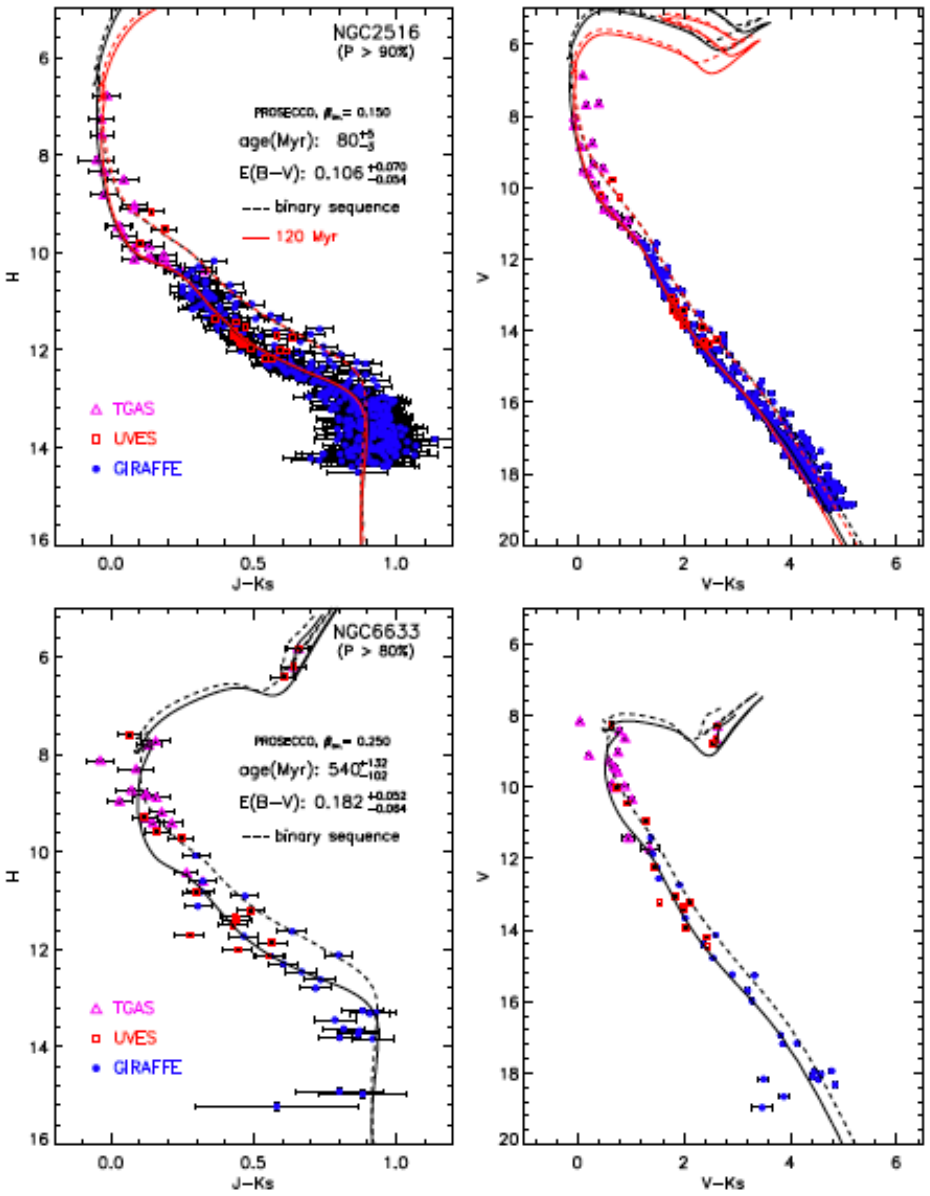
Jeffries et al. (2014)

Kinematic study of young star clusters revealed a structure more complex than previously thought



Franciosini et al. (2014)

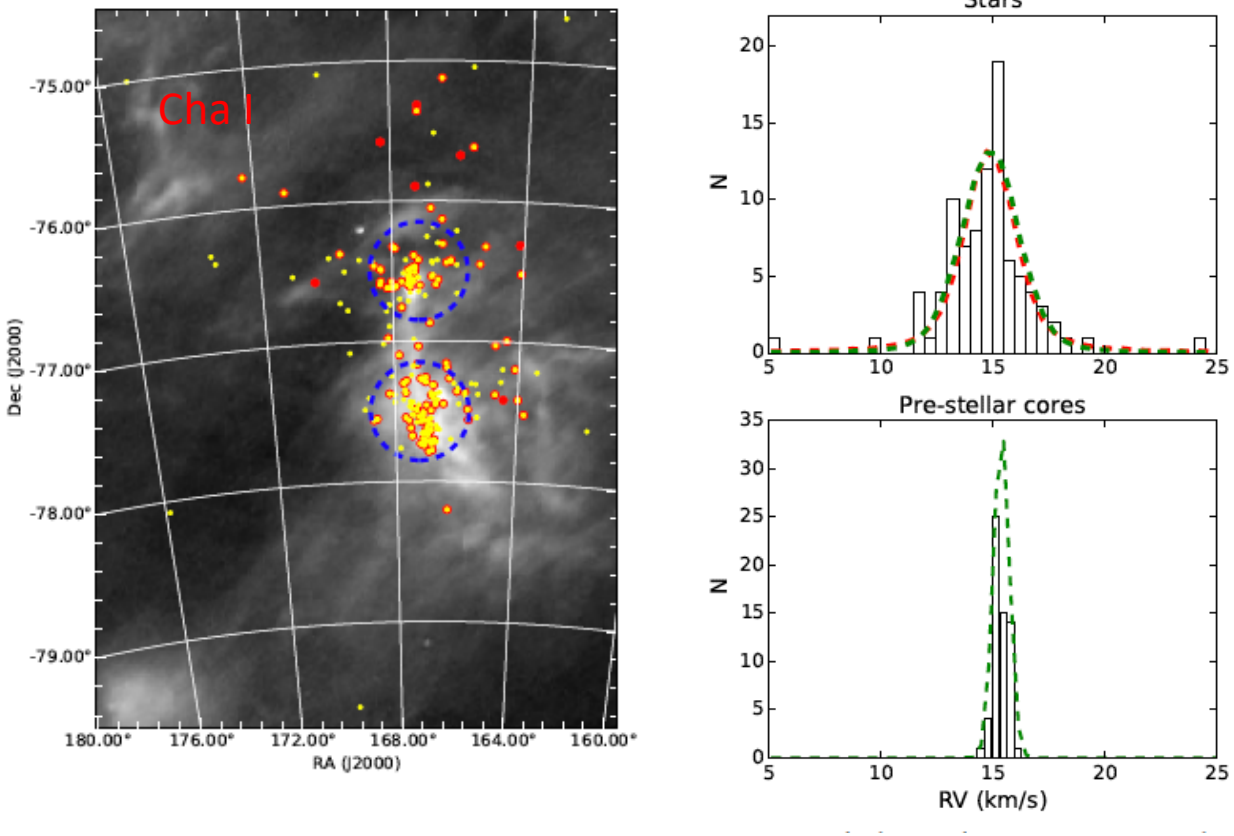
Selected scientific results: OC as age calibrators



Using GES + Gaia data to place open clusters on the same age scale

(Randich et al. 2018)

The future: dynamics of embedded star clusters with MOONS



(Sacco et al. 2017)

MOONS will be able to:

1. Studying the dynamics of embedded objects
2. Going to lower mass

See Katia Biazzo Talk!