THE GAIA-ESO LARGE PUBLIC SPECTROSCOPIC SURVEY AND ITS LEGACY

WWW.GAIA-ESO.EU (PUBLIC WEBSITE)

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THE BIG ISSUES

History of the Milky Way and its component stellar populations

- Star cluster formation, evolution and disruption
- Stellar dynamics and migration
- Stellar physics/evolution
- Stellar ages
- Origin of elements and nucleosynthesis yields
- One big question \rightarrow many key specific questions

Gaia and spectroscopic surveys from the ground Gaia-ESO is one precursor

SURVEY OVERVIEW (GILMORE+ 2012; RANDICH+ 2013)

- Public Survey first stellar spectroscopic survey on 8m telescope
- **FLAMES@VLT** (GIRAFFE AND UVES) **300 (+40)** nights; 2011-2018
- **10⁵ stars all** stellar-types and evolutionary phases (V<19)
- **all stellar populations** of the MW; **70 OCs** sampling the full parameter space;
- Internal and external (w.r.t other surveys) calibrators
- Homogeneous analysis of ESO archive data

Products:	 Precise (0.25 km/s) radial velocities; rotational velocities Stellar parameters
	 Detailed chemical information (> 20 elements) Steller properties (connection activity mass loss)
	 Stellar properties (accretion, activity, mass loss,)

TEAM (CONSORTIUM)

- **CoPIs:** G. Gilmore, S. Randich
- Steering Group: 12 members + CoPls
- Project Office: 4 people
- 20 WGs with one/two coordinators
- College of Readers
- 500++ Cols, 100++ Institutes across all ESO, most of the major groups with expertise in stellar spectroscopy





ITALIAN TEAM

- 8 INAF institutes + UniPi, UniCt, UniPd
- About 40 researchers
- * permanent staff, post-doc, PhD * about 20 with key roles (builders)
- Overlap with *Gaia* community



INAF LEADERSHIP



- **CoPI** Randich
- Steering: Micela, Vallenari
- PO: Sacco
- 20/61 builders
- Significant contribution to the analysis from OAA, OAS, OAPA, OAPD, OACT
- **42%** of the refereed papers led by INAF

RESULTS

Sample: 202,233 spectra of of 115,614 stars meeting the initial goal

Analysis: 5 cycles completed, one ongoing – excellent data quality

Tools: development of several new codes/pipelines and linelist

Releases: 5 internal ones, 4 to ESO – spectra and advanced products

Reviews to ESO: 8 OPC reports, 2 PSSP reviews: "Congratulations to the Gaia ESO team for the successful outcome of the PSSP review!"

Community growth: 350 initial Cols \rightarrow 500 ++; key roles in new projects/surveys; young researchers; meetings and new collaborations

RESULTS – NEW SCIENCE

- Several **impact results**; from young cluster kinematics, to the structure of the Galactic Bulge, to chemical clocks
- 167 consortium papers, 4000 citations
- Several press releases, A&A highlights/cover pages
- A good number of papers from the broader community



Credit V. Mainieri

Scientific results - a few examples



FUNDS

- INAF unsolicited, Premiale (VLT), PRIN 2014
- INAF fellowship + Astrofit
- 2 PhD INAF

- **PRIN-MIUR** 2012 (Matteucci)
- **FP7-ITN:** PhD (OAPD Vallenari)
- Premiale Mitic (Garilli)
- Main Stream (Sacco)
 → I M€
- ESF RNP GREAT (2009-2015, focus on Gaia) a la carte (9 INAF institutes): <u>brainstorming + 9 meetings Gaia-ESO</u>

PERSPECTIVES

Gaia-ESO is almost completed – final catalogue to ESO Sept. 2021 BUT

- Science exploitation (also in in combination with Gaia data) -> next 2-3 years
- Re-analysis with advanced machine learning techniques
- Main legacy: Public database
- Huge science legacy in particular @INAF for open cluster science (see OC_GAST coordinated by L. Magrini)
- Huge "community" legacy → next projects

Building up on Gaia-ESO



Much larger samples - reddened regions - higher resolution/precision - extra-galactic populations (clusters)

The legacy of Gaia-ESO: the 4MOST Survey of Young Stars (4SYS)

4MOST Telescope:VISTA (4m) FoV: 4.2 degree² Fibers: 2436 Band: 370-950 nm Resolution: 20,000 (HR), ~6000 (LR)



First survey of young clusters using unbiased target selection

Team PI: G. Sacco (INAF-OAA) Co-I: 40 (14 INAF) FTE 2022-2023: 4 per year(1.4 INAF)

Target sample

- Age < 100 Myr
- Distance < 500 pc
- Selection method: Gaia+eROSITA+TESS
- Stars: 140.000

First unbiased survey of young stars. Not only clusters

Timeline

Q4 2021: Final of survey program 2023-2028: Observations

Goals

I.The origin of Galactic field stars 2. The origin and the properties of stars hosting young exoplanets 3. The missing ingredients in Pre-main sequence evolutionary models

CRITICALITIES

- A number of **lesson learned** major ones:
 - 10 years is too long
 - Project office early on
 - Plan "your own" archive
- The stellar spectroscopy community in INAF is strong, active, and competitive → intentions
- Keep forming young researchers (also in synergy with the universities)
- Improve expertise in "new" methodologies: 3D, NLTE models, machine learning, etc. → coordinated effort (e.g., CSI – laboratorio nazionale)
- Improve synergy with theoretical groups

Thanks for your attention!