Overview of Gaia-ESO Survey results based on high-resolution spectra of FGK-type stars

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The Gaia-ESO Survey

http://www.gaia-eso.eu

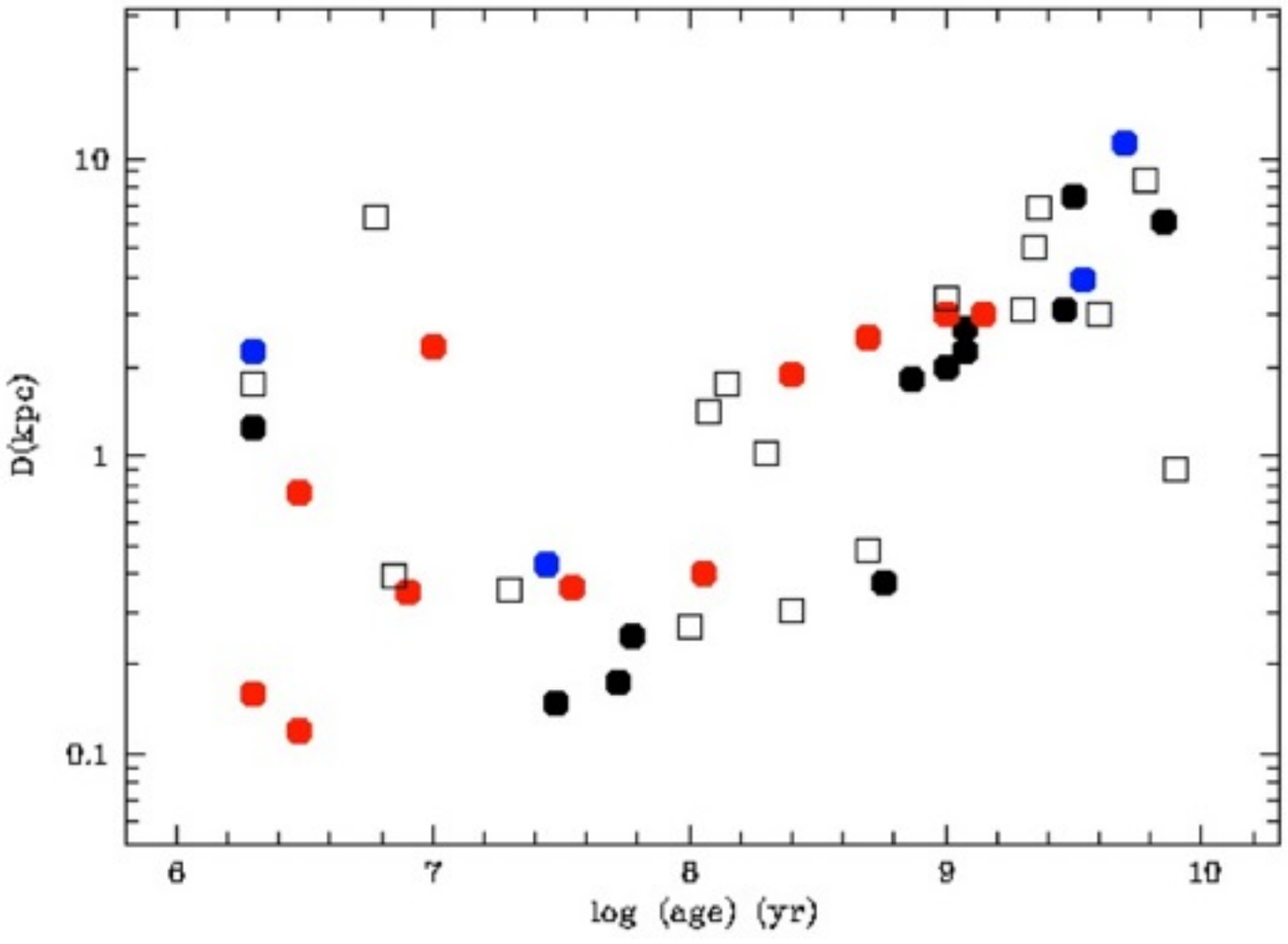
- Public spectroscopic survey
- FLAMES @ VLT (Giraffe + UVES)
- > 10^5 Galactic stars
- 300 nights (4-5 years, since Dec. 2011)
- 416 co-Is (105 Institutes) as of Nov. 2014
- co-PIs: Gerry Gilmore & Sofia Randich
- All Galactic components: halo, thick disk, thin disk, bulge, globular and open clusters

(Credit: ESO/Y. Beletsky)

Targets

1. Open Clusters

- 80 clusters in the age, distance, [Fe/H], total mass space
- From ~Myr to ~Gyr
- Young clusters (<100 Myr): MS and PMS with Giraffe, OBA-type with UVES
- Older clusters: UVES for clump giants, sometimes MS, and Giraffe for all other (down to M-dwarfs)
- RVs, atmospheric parameters, abundances, activity, rotation…

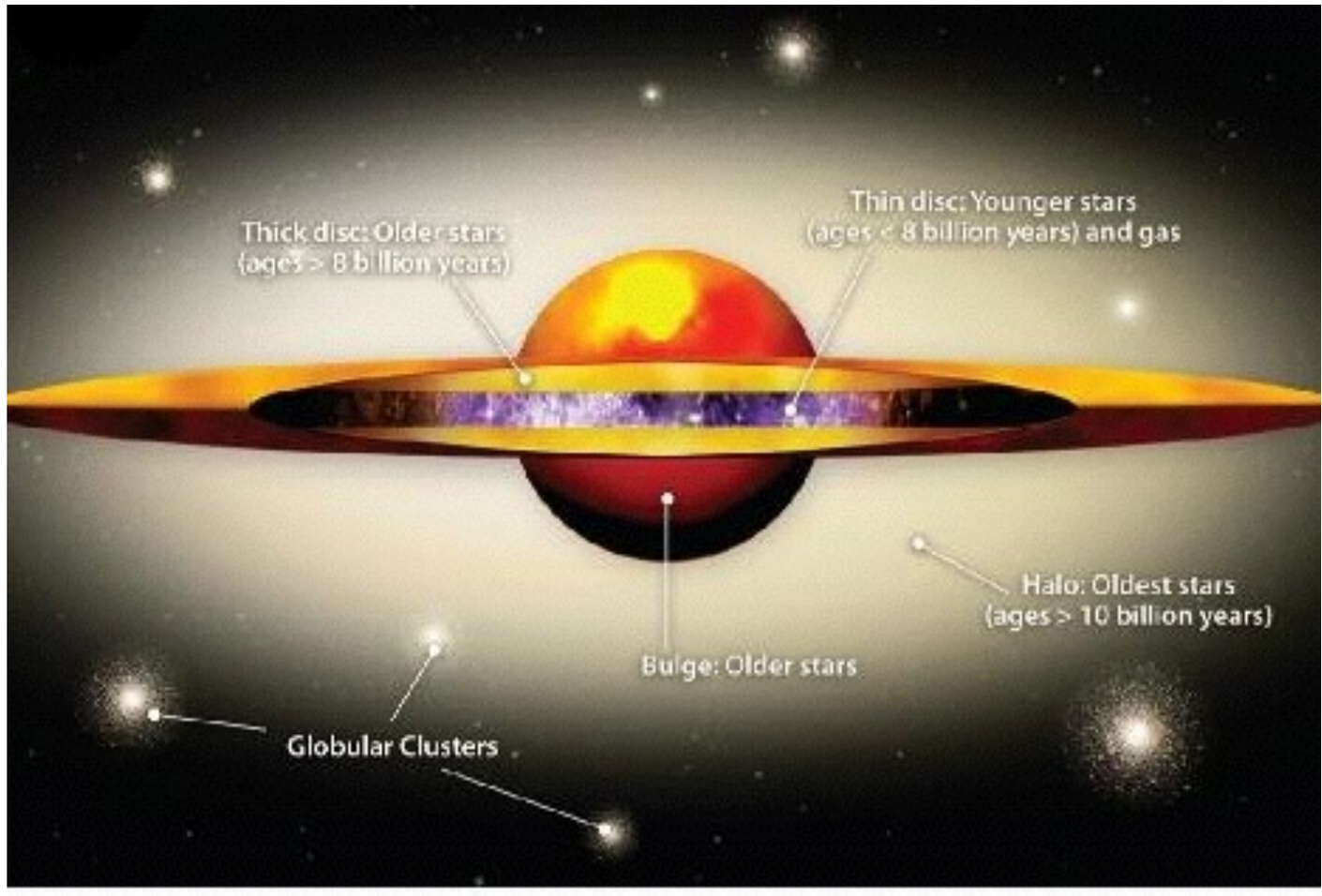


OCs observed and protected for P94/95
(S. Randich)

Targets

2. Milky Way Fields

- Thin disk dynamics (Giraffe for RVs)
- Thick disk/Halo (Giraffe): F-dwarfs (2-4 kpc) and K-giants (streams, outer disk)
- Bulge (Giraffe): K-giants
- Solar neighbourhood (UVES): ~5000 FG-dwarfs within 2 kpc
- UVES are parallel observations

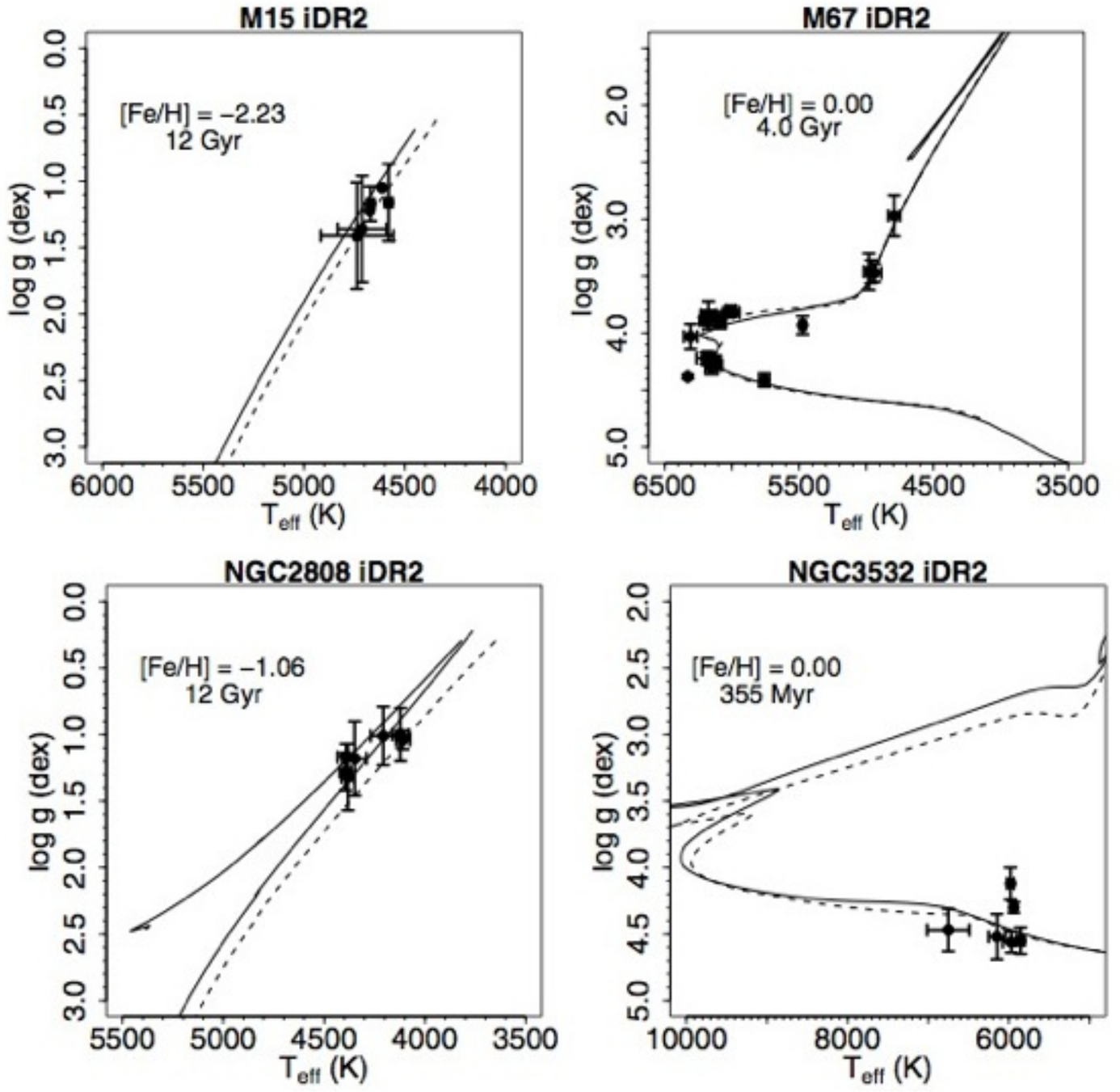


(Credit: Amanda Smith, IoA, Cambridge)

Targets

3. Calibration

- Internal (results from different types of stars and spectra)
- External (anchor the scale on well studied stars and clusters)
- Open and globular clusters
- Stars in CoRoT fields
- Gaia benchmark stars

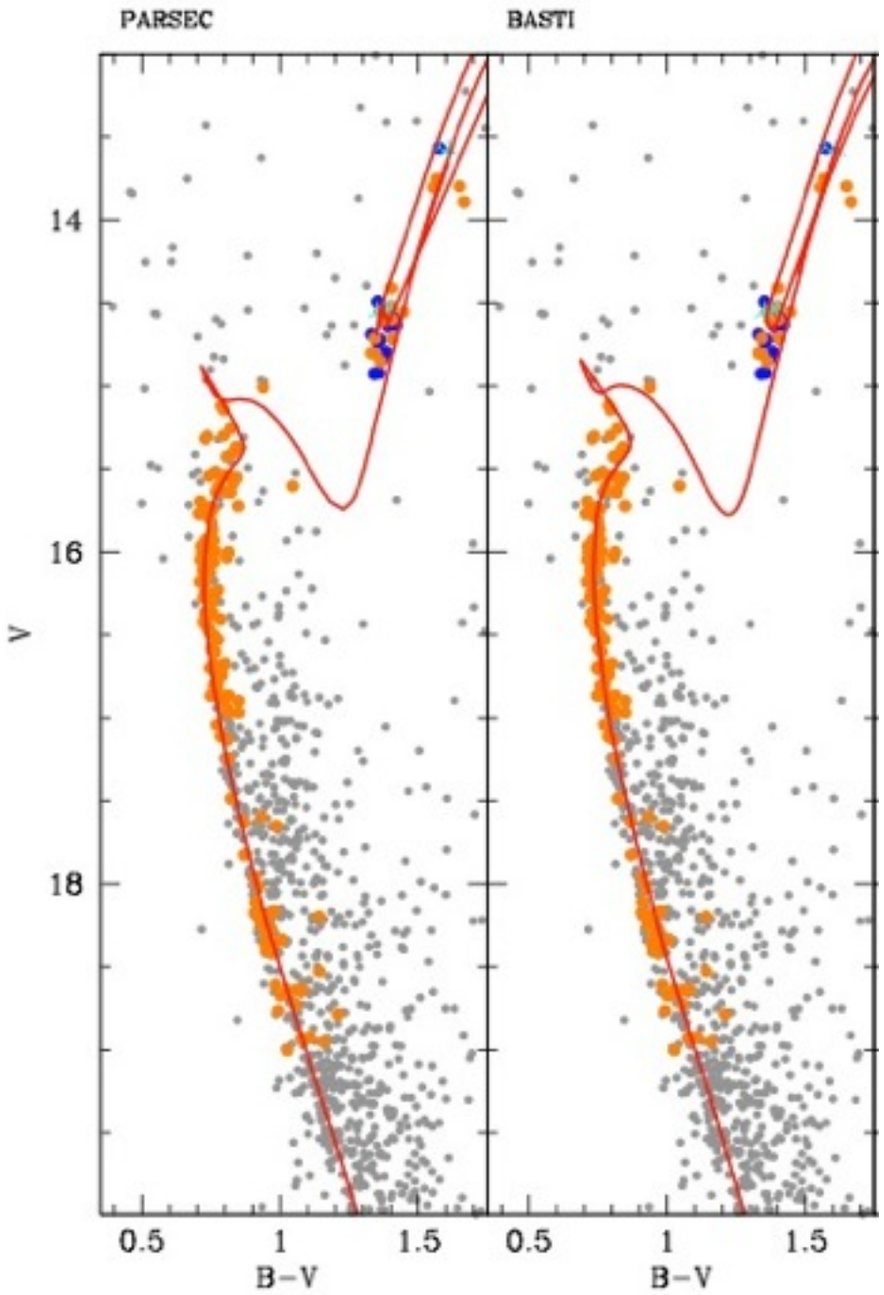


(Smiljanic et al. 2014)

Scientific Aims

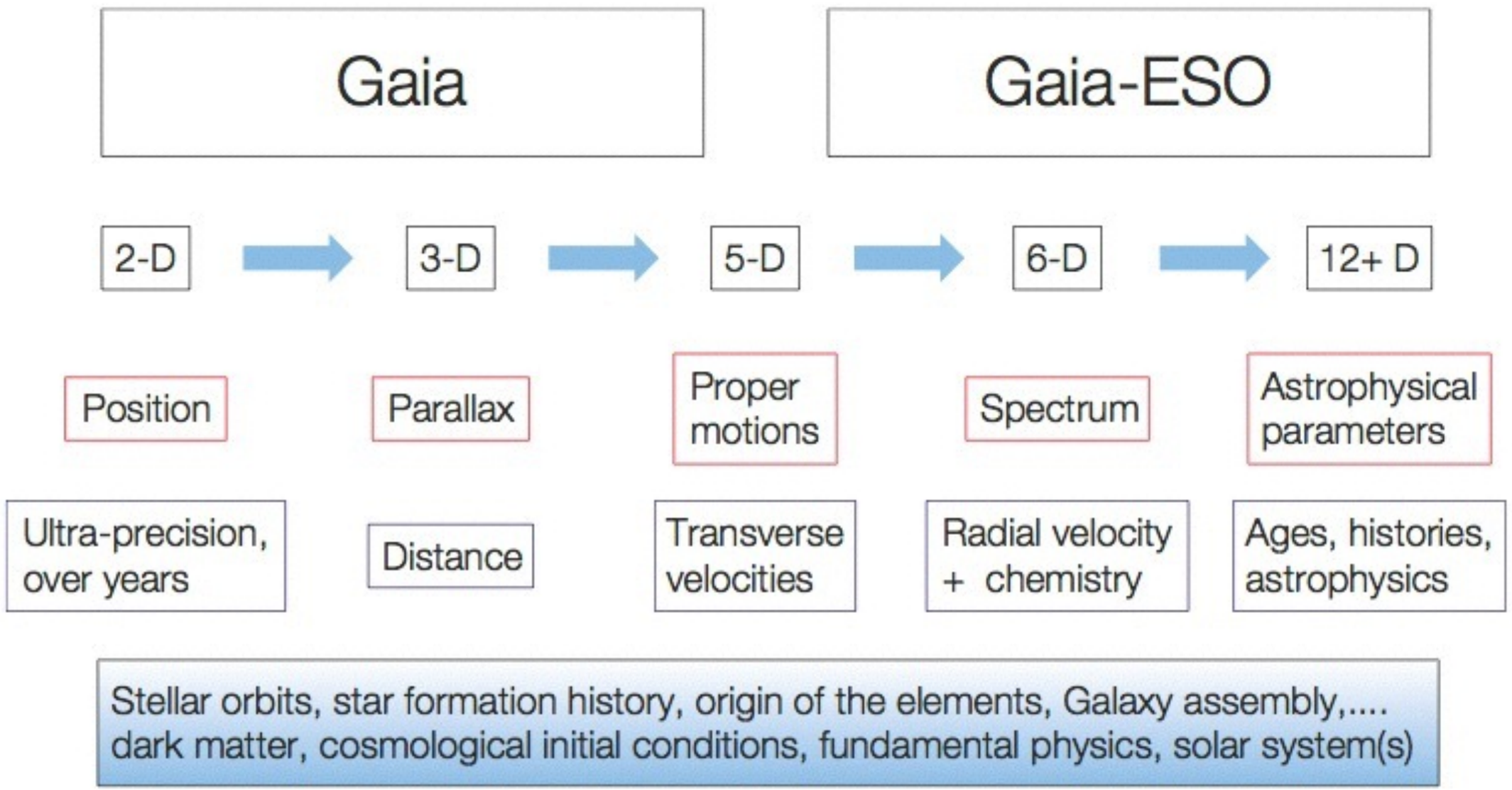
http://www.gaia-eso.eu

- All Galactic components!
- Homogeneous overview of kinematics and abundances
- The evolution of clusters: from birth to disruption
- Stellar evolution
- Formation and evolution of thin and thick disks
- Formation and nature of the bulge
- Abundance gradients vs. age: from inner to outer Galaxy
- And more!



(Donati et al. 2014)

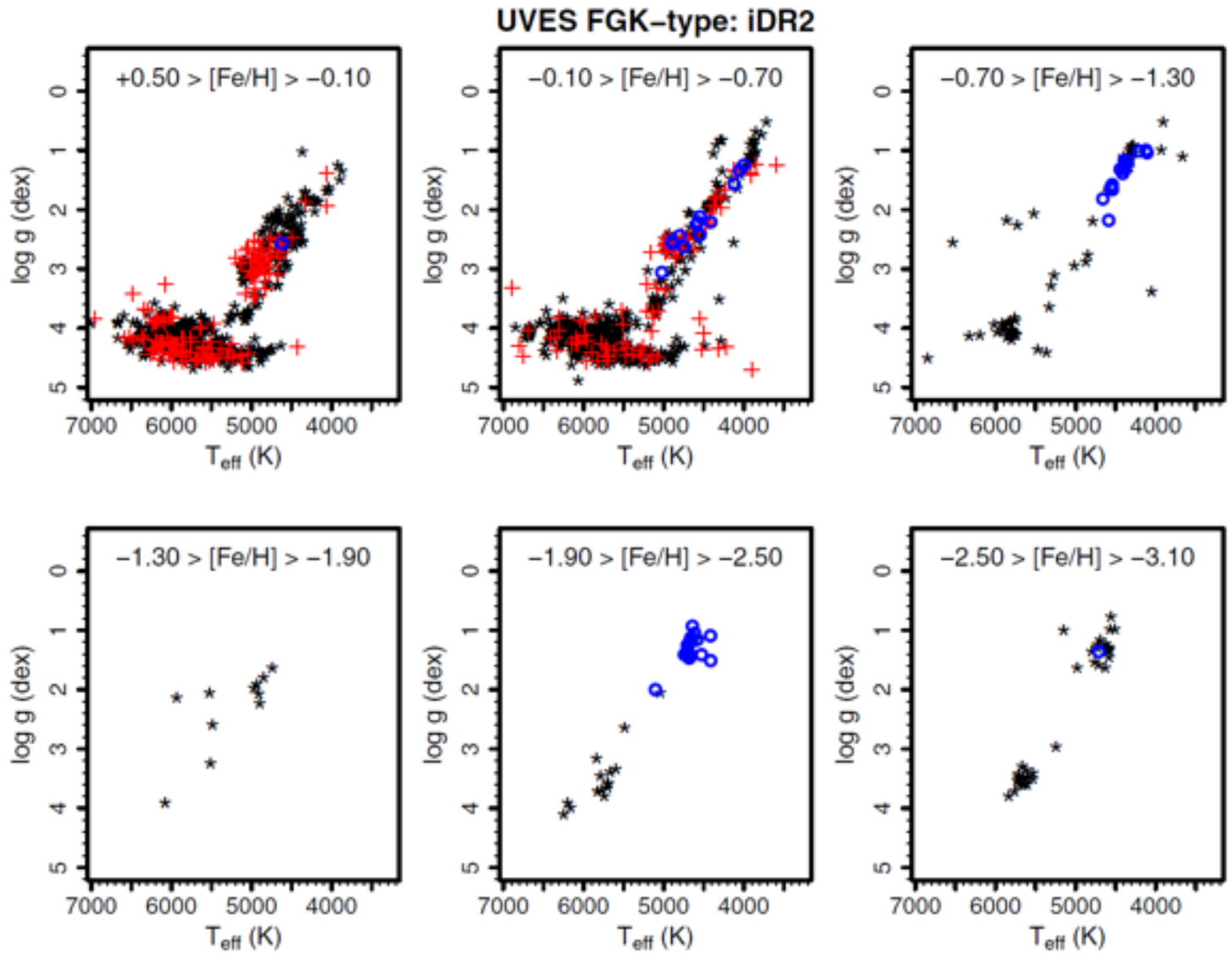
Gaia-ESO & Gaia



(Gilmore et al. 2012)

UVES Spectra of FGK-type Stars

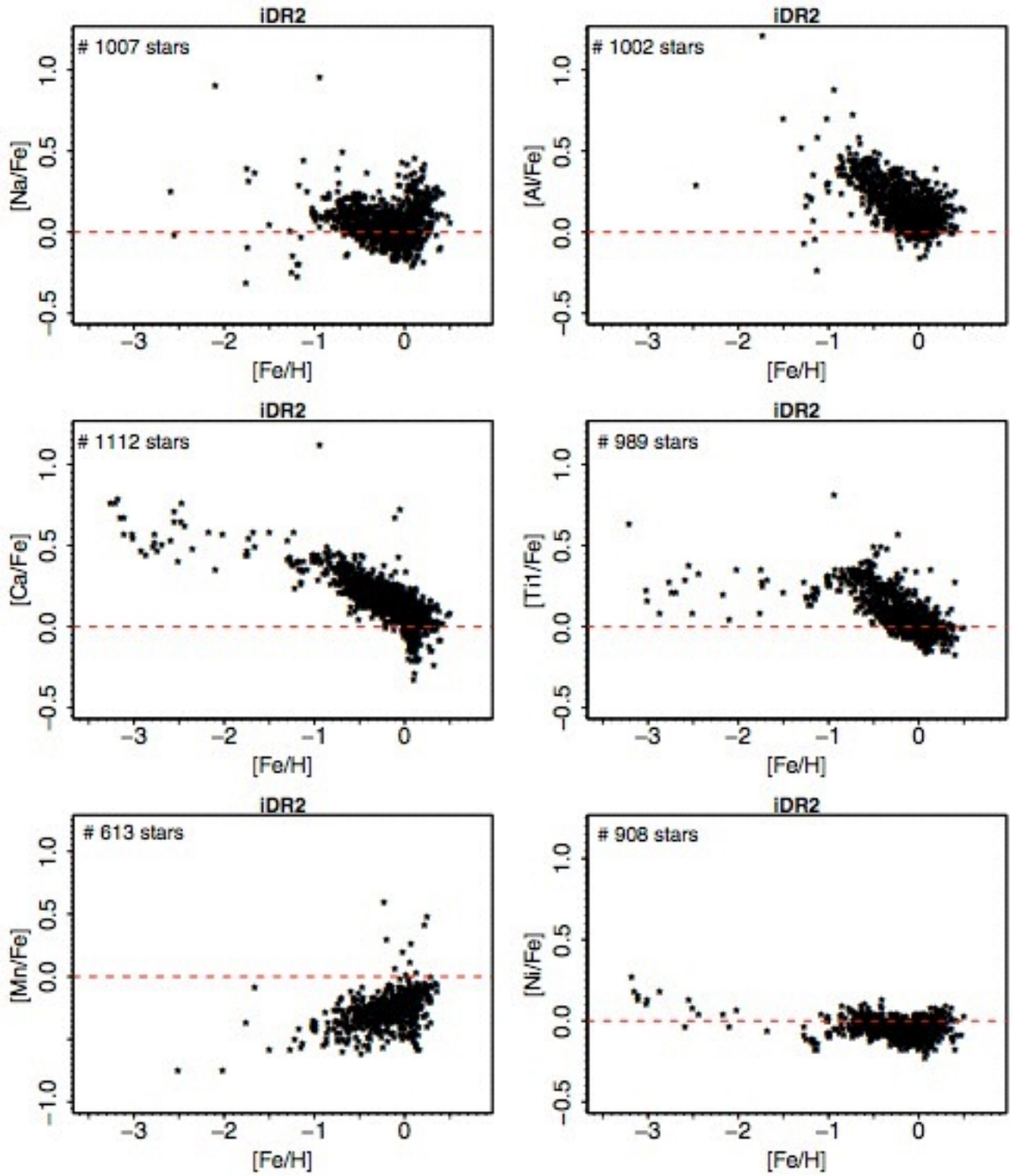
- Solar neighbourhood, open cluster giants, calibration targets
- Analysis completed: iDR2 (up to June 2013) + iDR3 (July-Dec. 2013)
- ~2000 stars
- Median precision: 55 K for T_{eff}, 0.13 dex for log g, 0.07 dex for [Fe/H]
- Estimate of accuracy (vs. reference stars)
- Estimate of precision (method-to-method dispersion)



(Smiljanic et al. 2014)

Abundances

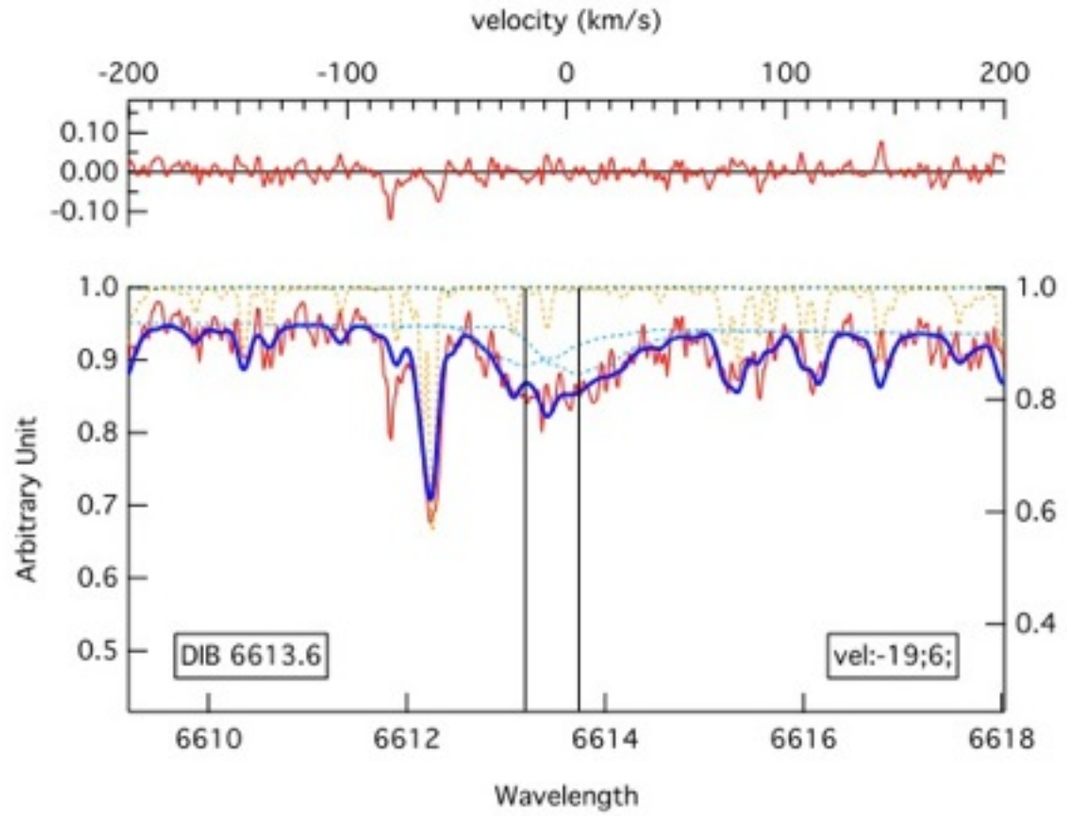
- Abundances for 24 elements (should increase to 33)
- iDR2 (1300 stars): 1079 stars with >15 elements, 1203 with > 10 elements
- C, N, O, Na - stellar evolution
- (Na), Al - hydrostatic burning + neutron capture
- Mg, Si, Ca, Ti - alpha elements
- Sc, V, Cr, Mn, Fe, Co, Ni - iron group elements
- Cu, Zn - SNIa or SNII, with neutron capture?
- Y, Zr, Mo, Ba, Nd, Eu - s- and r-process

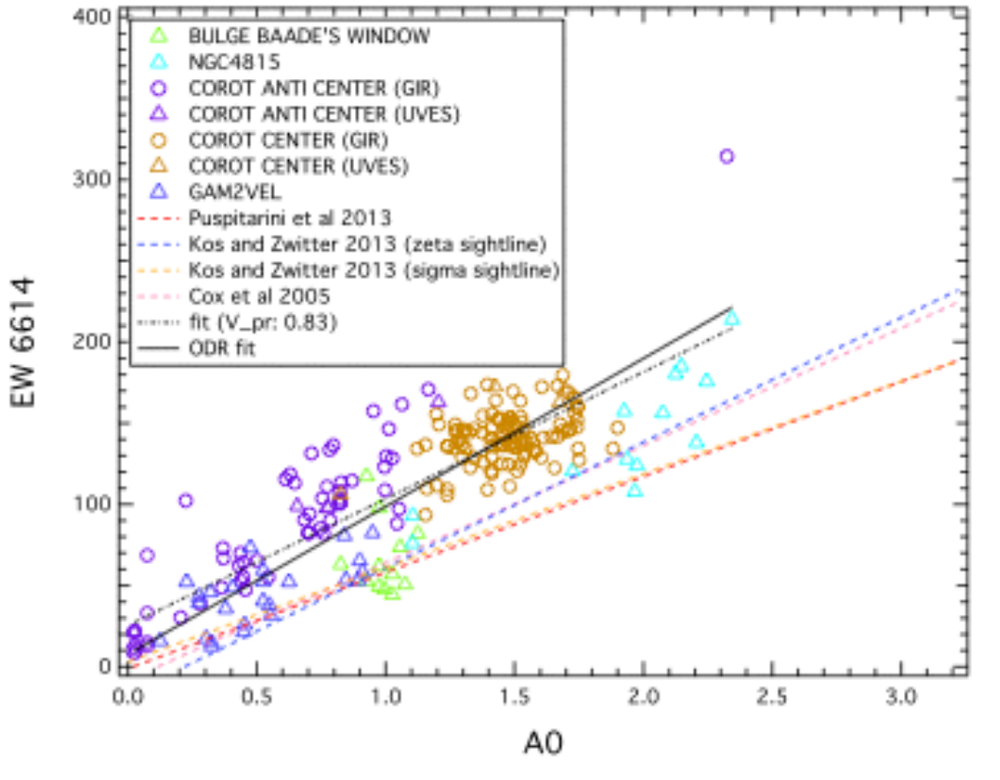


(Smiljanic et al. 2014)

Science

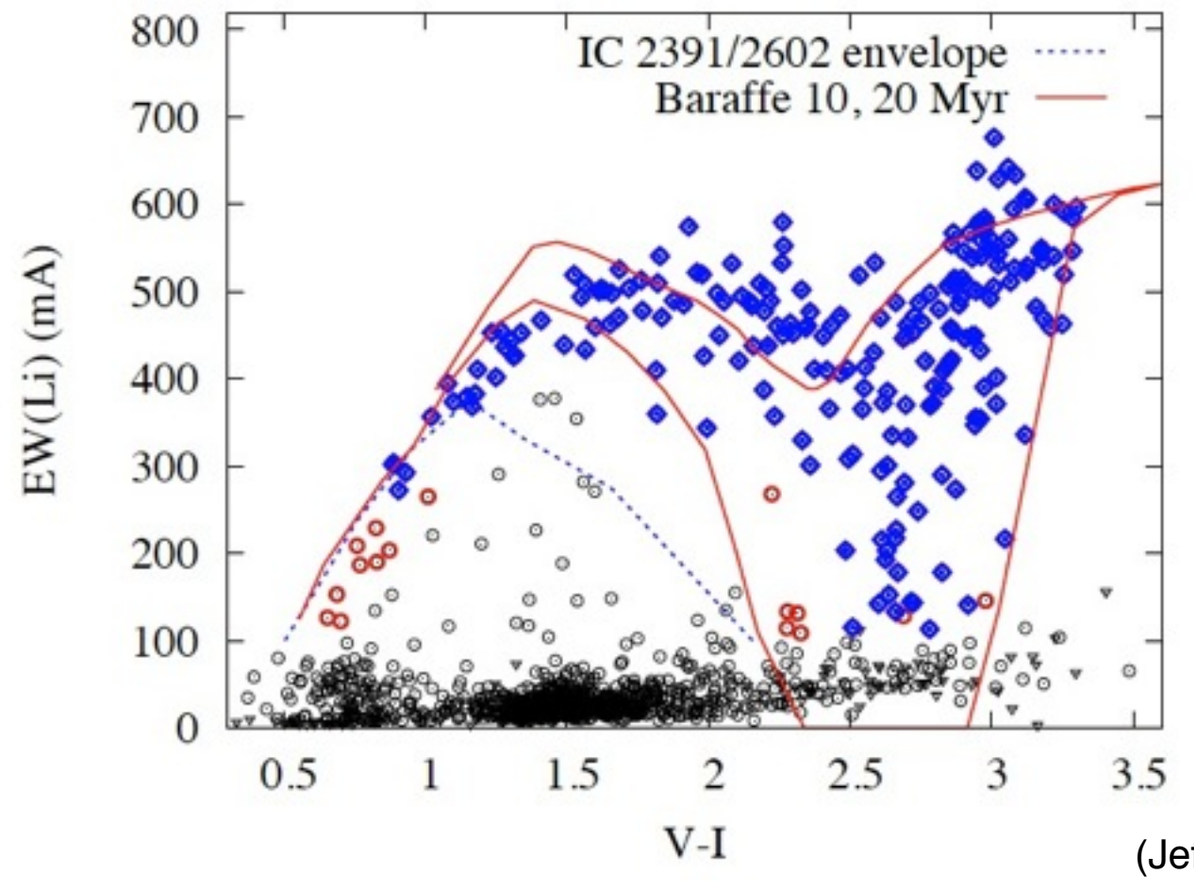
- 3 refereed papers outside Gaia-ESO consortium (on globular clusters)
- 16 refereed publications in 2014
- 13 papers in 2015 (2 published, 4 accepted, 4 submitted, 3 under internal revision)
- 3 papers selected as A&A highlight
- Topics: analysis description (3), stellar evolution (1), stellar populations (7), open clusters (10), globular clusters (3), spectrum indices (1), emission lines (1), interstellar extinction (1), diffuse interstellar bands (2)

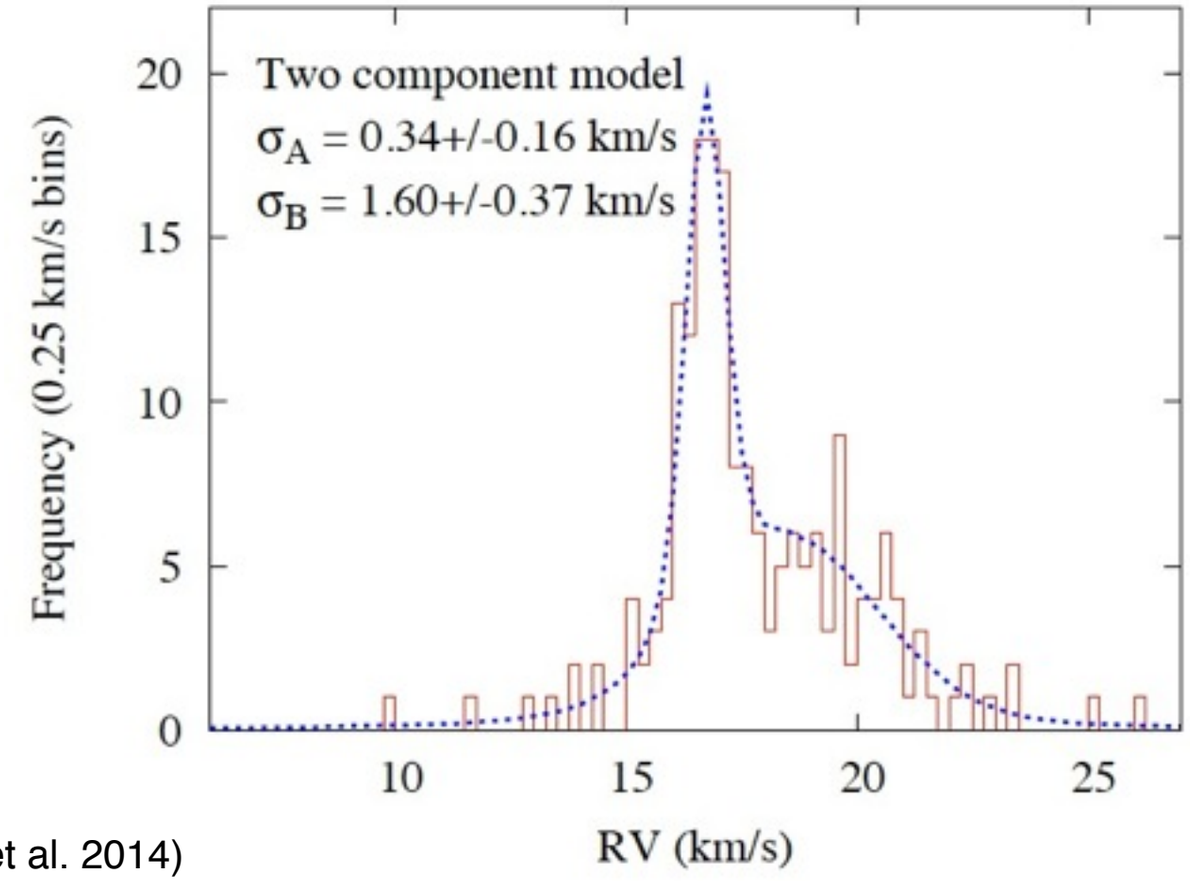




(Puspitarini et al. 2015)

Highlights

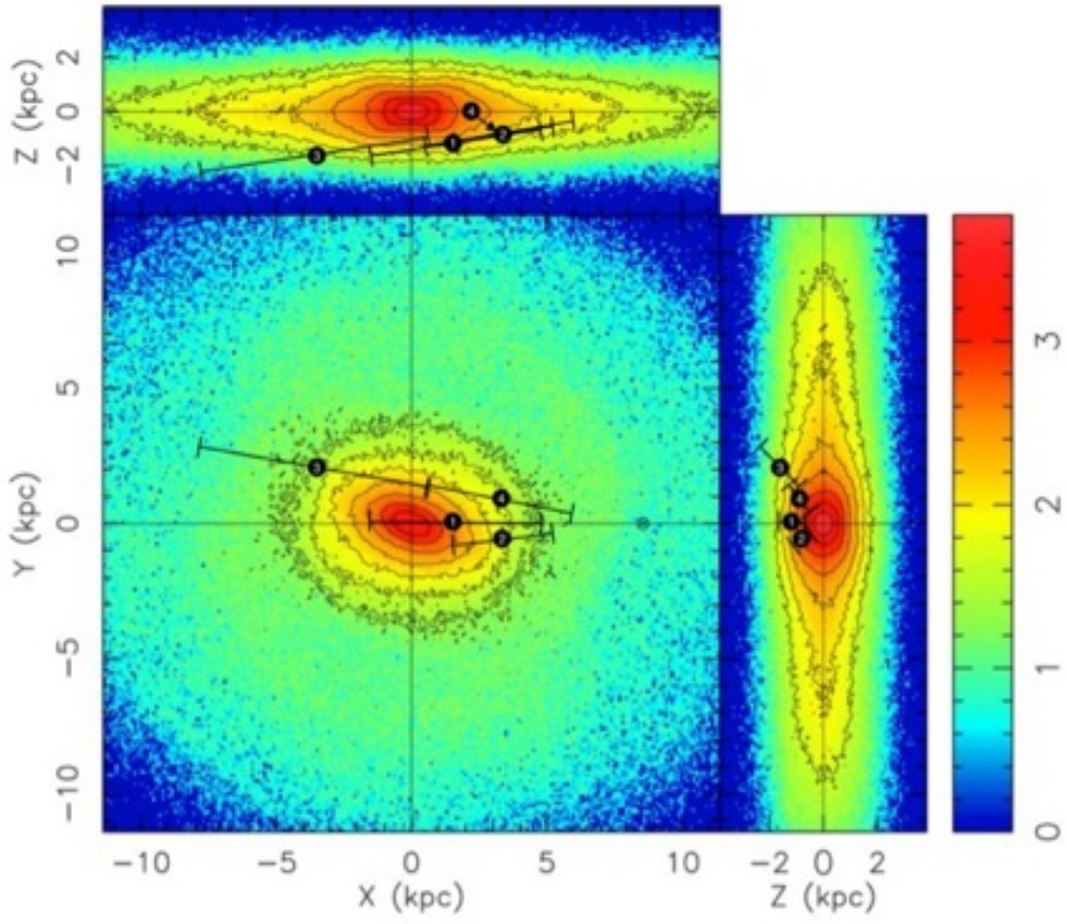




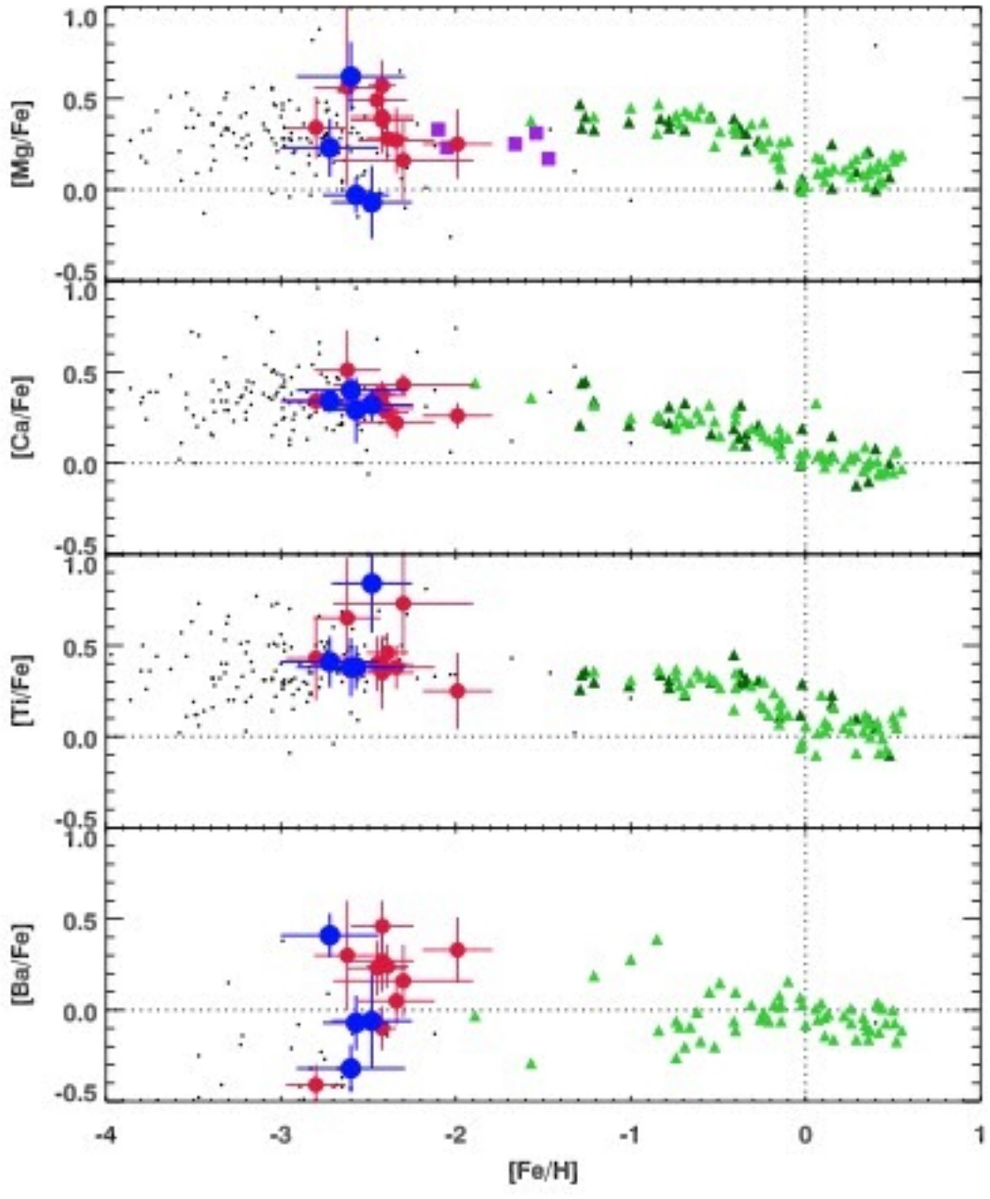
(Jeffries et al. 2014)

- γ Velorum “cluster” in the Vela OB association
- young, low-mass stars around the WC8/O8 III binary γ^2 Vel
- Two kinematic populations. PopA: narrow velocity range, younger, around the binary; PopB: broader, older, dispersed population of the association

Highlights



(Howes et al. 2014)



- Metal-poor stars in the Bulge
- In collaboration with SkyMapper
- Some ΛCDM simulations indicate that most of the surviving first stars should be found in the inner Galaxy
- 4 stars with [Fe/H] ~ -2.5: most metal-poor bulge stars studied with high-resolution spectroscopy

Internal Data Release 4

- Analysis of iDR4 ongoing (all data observed up to July 2014)
- To be completed by June 2015
- ~93000 spectra of ~54000 stars (Giraffe + UVES)
- ~8000 spectra of ~3100 stars in WG11

Public Release 2

- Results of iDR2+iDR3 (all data observed up to July 2013)
- ~1500-1600 stars from WG11
- To be sent to ESO soon
- Reduced spectra + Radial Velocities + Stellar Parameters + Abundances + Rotation + Veiling +…

The Future

- One aspect with respect to other Surveys: we can observe fainter objects (8m class).
- Resolution+coverage: high-quality parameters, multi-element abundances
- Working to improve precision/accuracy of the results
- To expand data products (abundances of more elements, chromospheric activity, …)
- More science output is coming
- Much more with Gaia
- Public release coming: offer a number of data products to the community