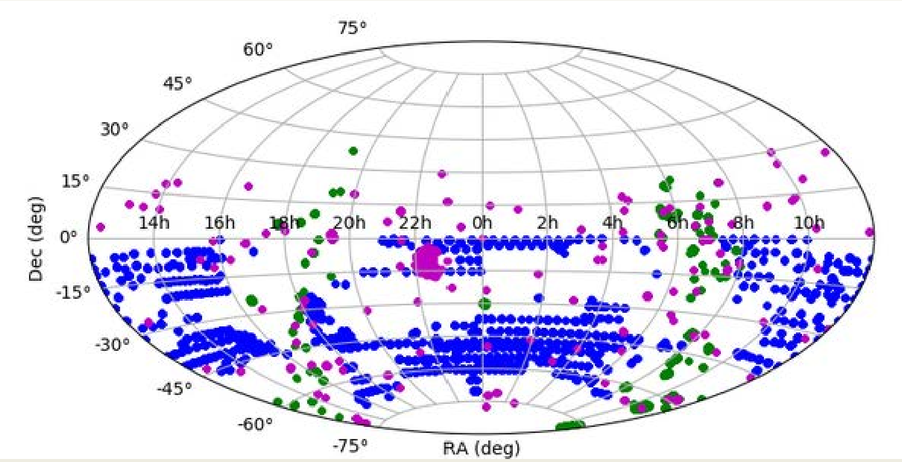
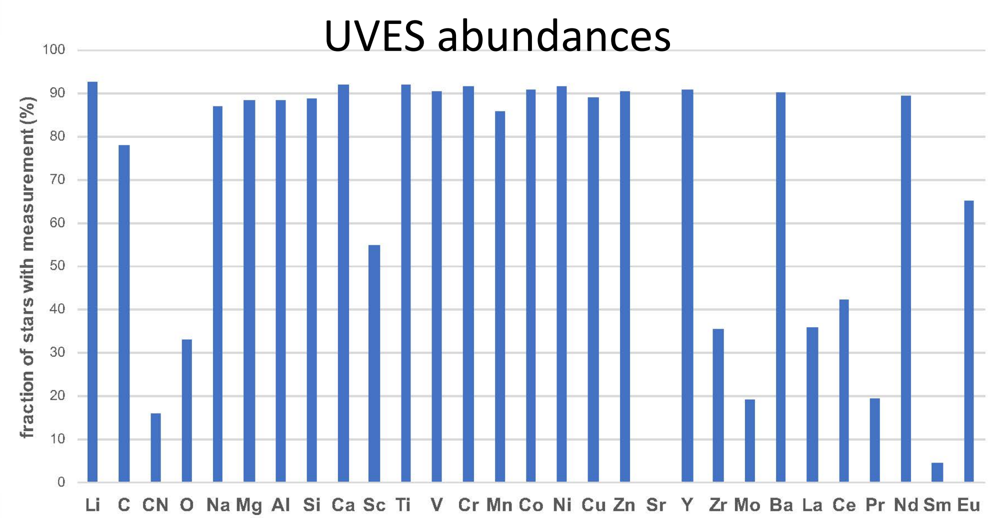
The Gaia-ESO Public Spectroscopic Survey

340 VLT-night survey of Galaxy stellar pops

- Co-PIs Gerry Gilmore, Sofia Randich
- +400 Co-Is, 90+ Institutes across all ESO states
- 100,000+ stars, O to M, all populations, 60 OCs
- ~110 Co-I papers published to date, overview papers ready
- Full data release currently being finalized (ESO, WFAU, Gaia)





Gaia-ESO core philosophy

- Involve all spectroscopic analysis methods
- Identify the dominant systematic variables, and fix them – version control
- Analyse each spectrum by several groups
- Base astrophysical calibrations on open clusters

- Combine node results through optimum statistics: hierarchical Bayesian inference via MCMC

- Identify both systematic (method) errors and random errors ➔ parameter +/- random +/- systematic

calibration concept

- use (open) clusters to ensure hot-cool-RGB-ms consistency of parameters and zero points;
- use (OC+globular) clusters to test metallicity;
- use benchmark stars to interpolate and check

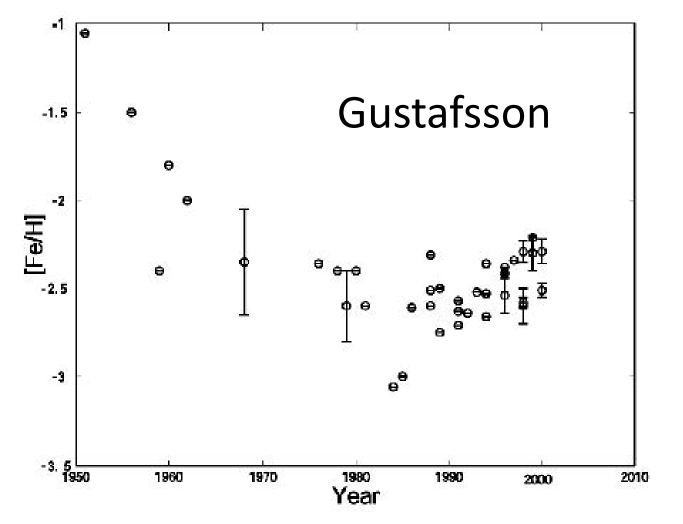
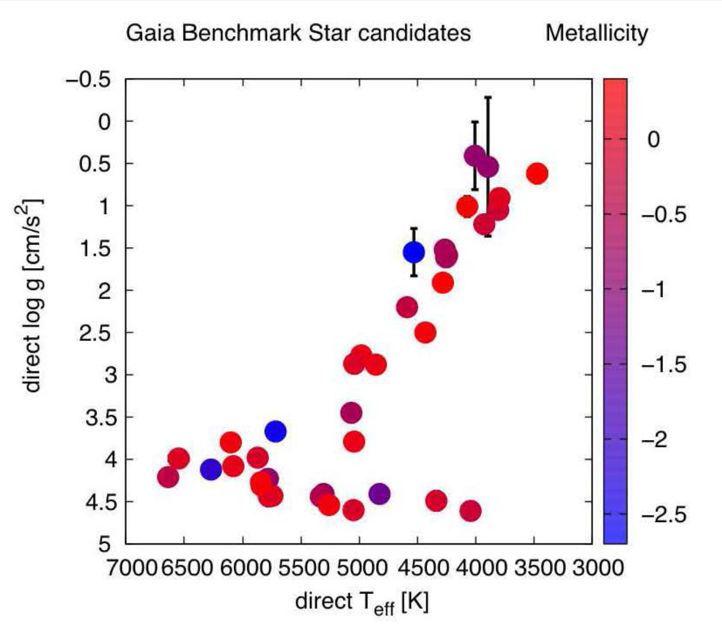
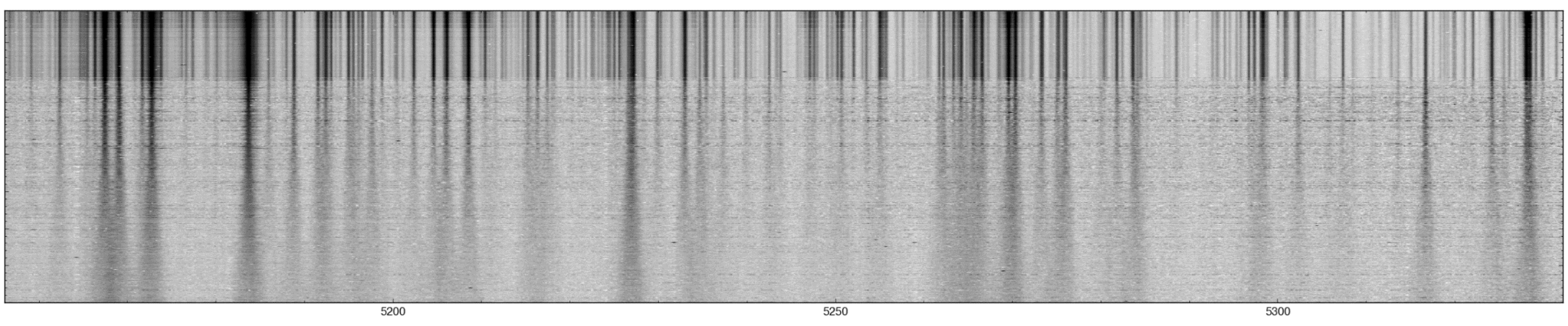


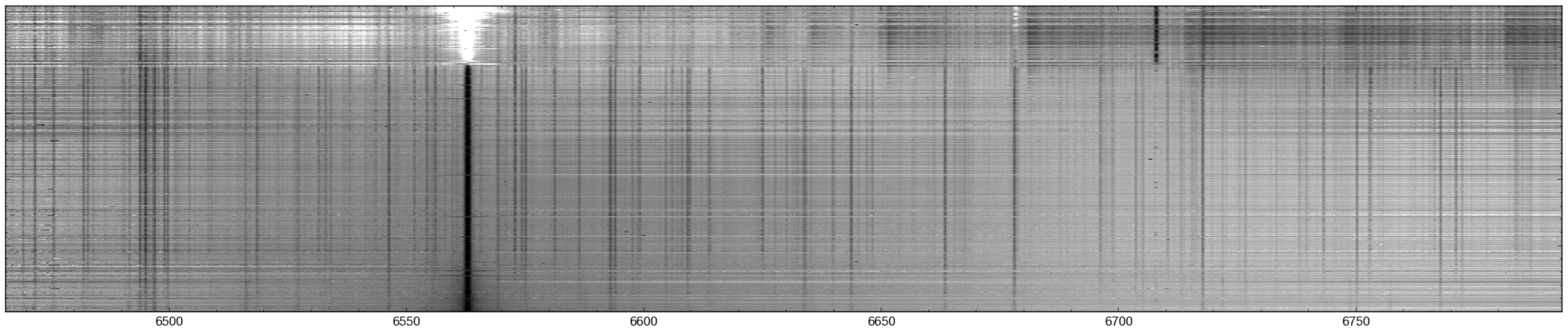
Fig. 1.2. The iron abundance determinations for HD 140283 as a function of time. Estimated errors are indicated when published.



Gaia-ESO Giraffe spectra

a very wide range of parameters is evident
➔ there is no single analysis aproach

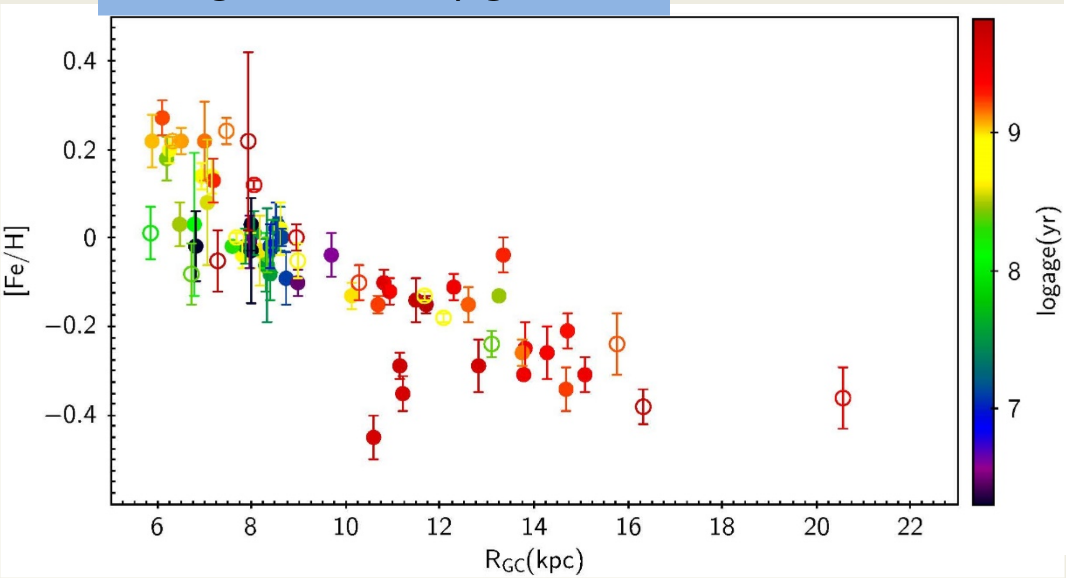




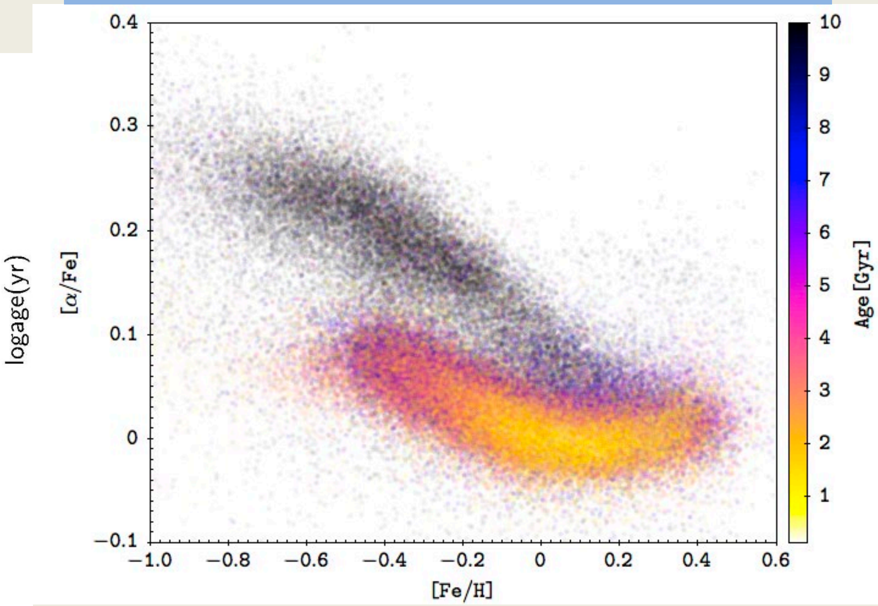
A survey requires complementary skills

Some science – just to show it is there…

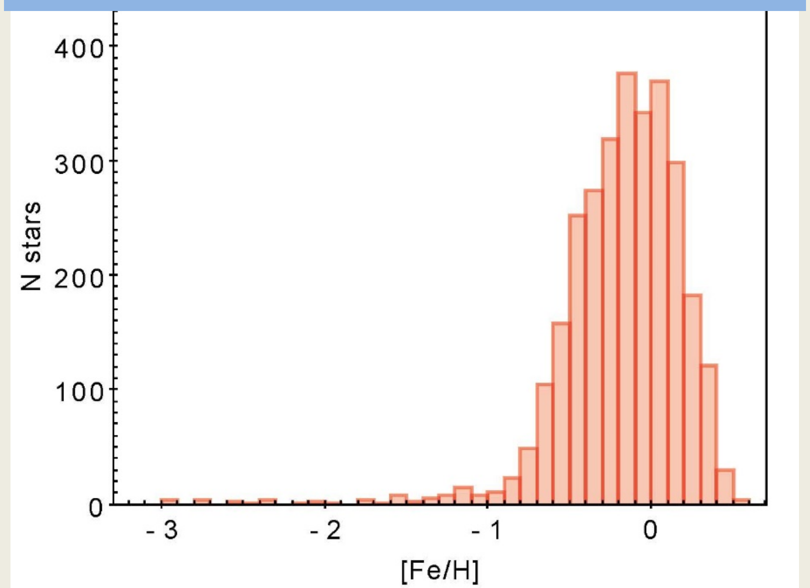
OC age-metallicity gradient



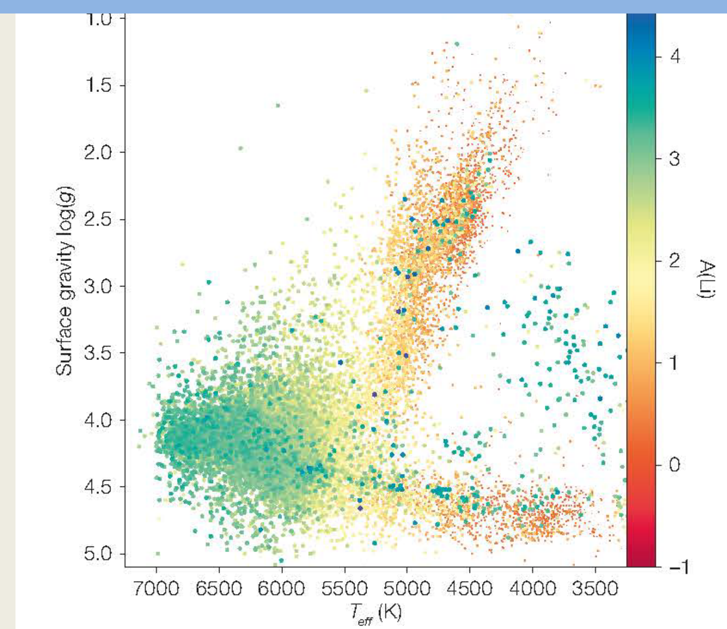
GES OCs calibrate APOGEE [C/N] ages



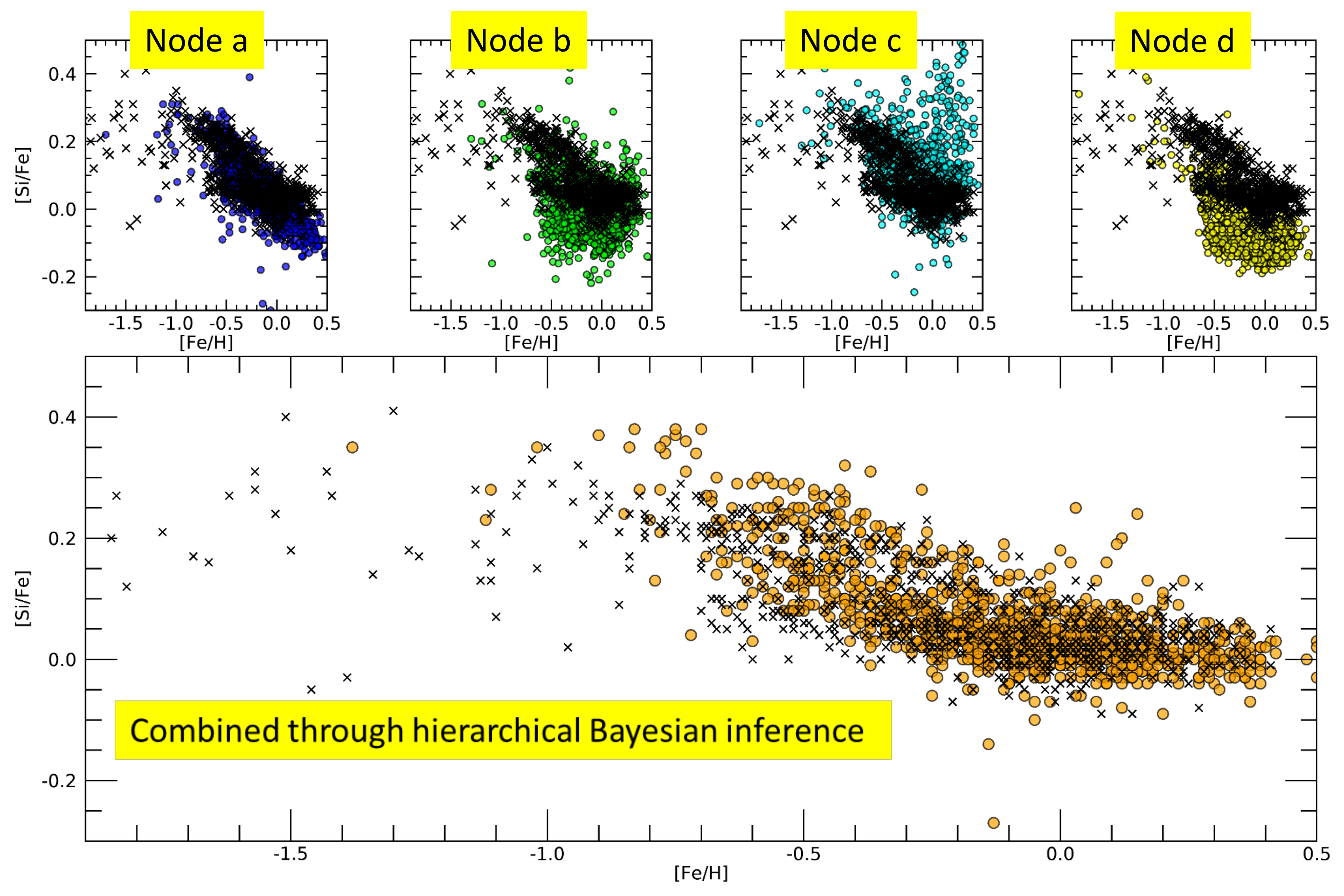
Local field star metallicity – wide range



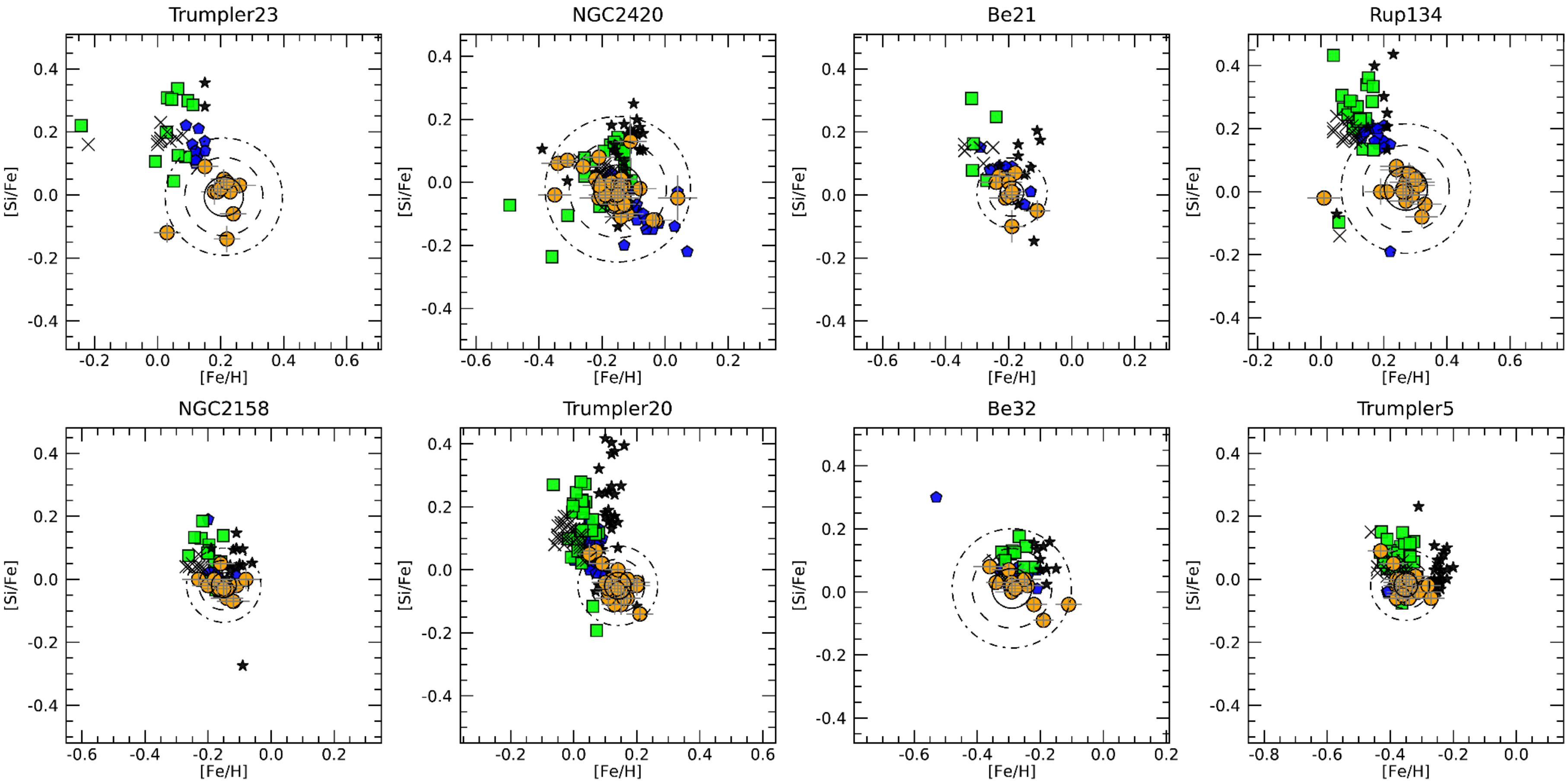
Li was a GES focus. Magrini etal Mess. inpress



Si in field stars – an example of Gaia-ESO multi-node homogenisation

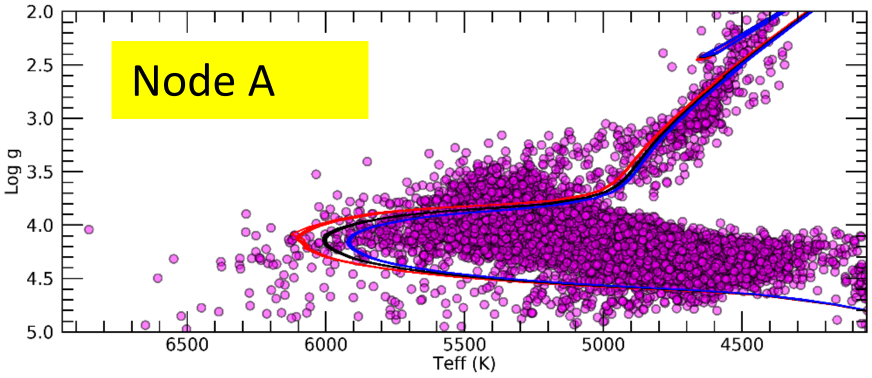


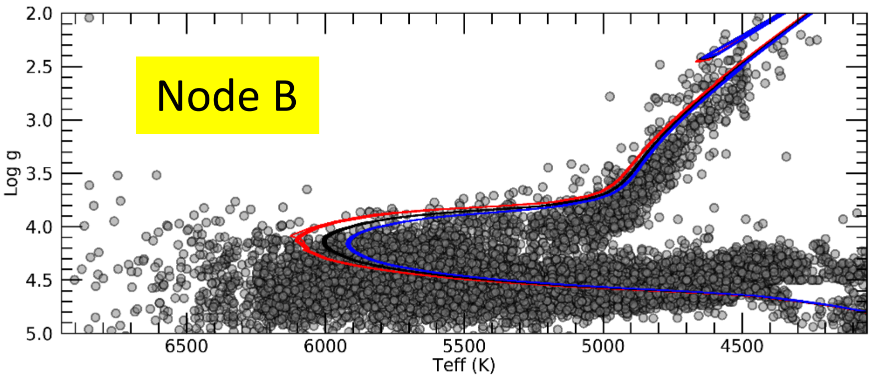
Homogenisation outcomes: Si in OCs

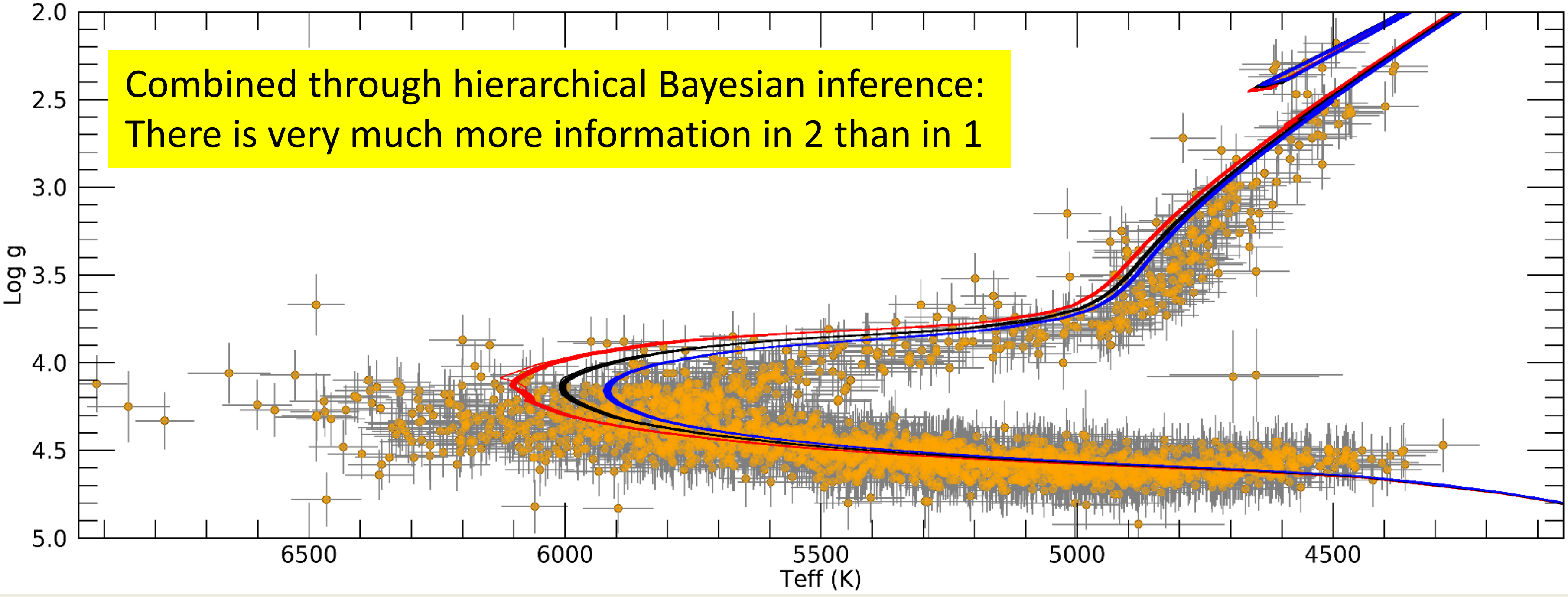


Orange points = final results, other symbols = node results

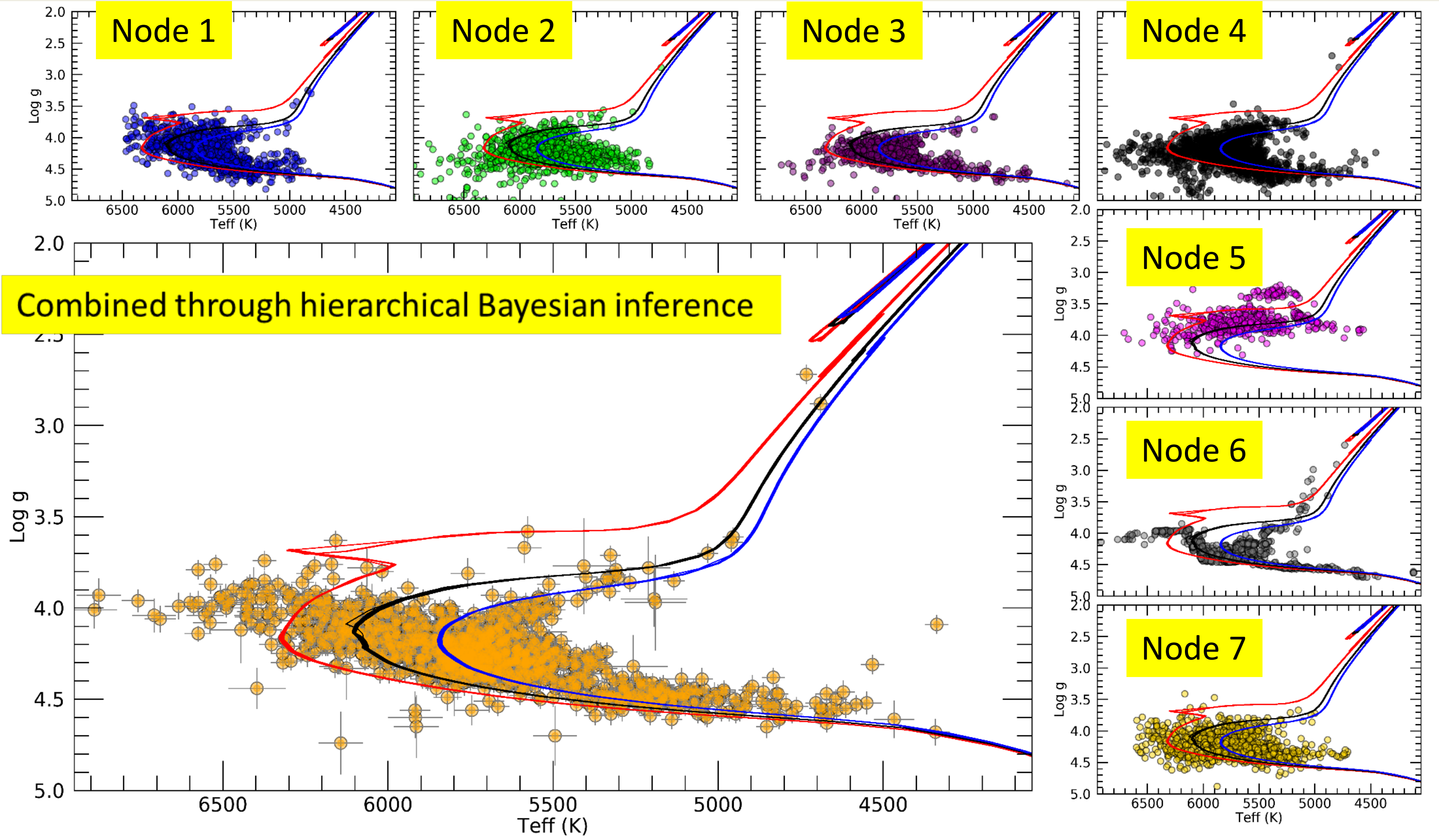
WG10- GIRAFFE spectra







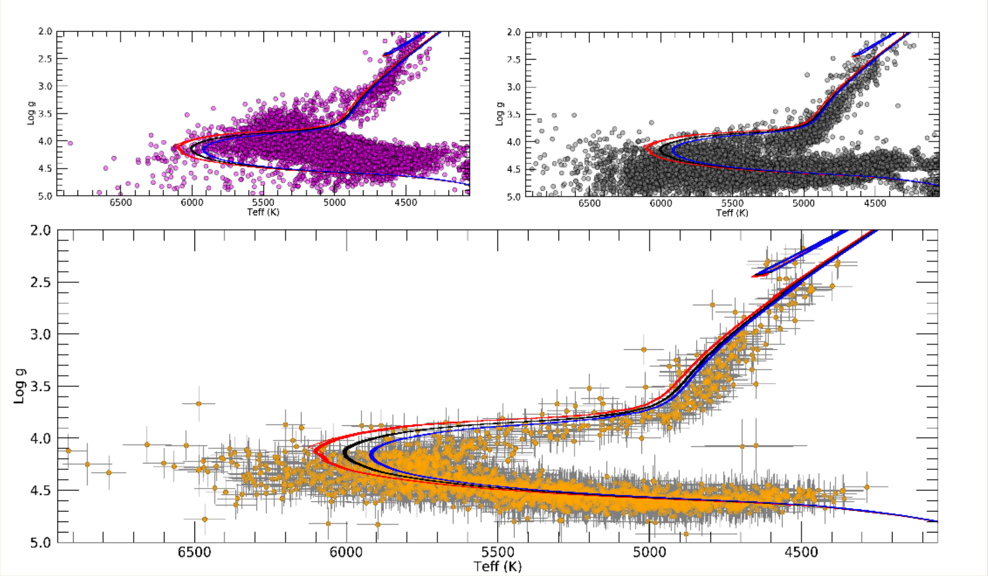
WG11 UVES spectra



WG11 (Rodolfo Smiljanic) & WG10 (Clare Worley) merged the final node results, following earlier work by Andy Casey.

WG15 produced a single homogenized dataset.

The plots show how well this worked: but is it the best possible?
Might more investment in software/statistical methods save hardware costs?



WG10 node merge ➔ clear improvements

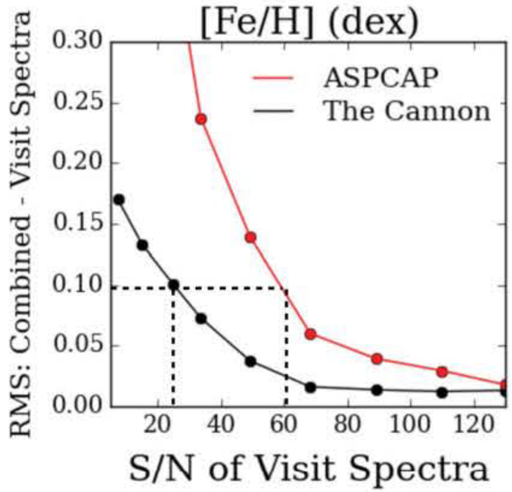


Figure 4. The precision in the [Fe/H] label of *The Cannon* as a function of SNR, compared to the traditional approach to determining stellar parameters and abundances (i.e. ASPCAP, which is representative of the best current performance obtained by the multitude of surveys). These stars comprise a set for which multiple observations (or visits) have been taken, so the rms difference can be determined based on *The Cannon*'s and ASPCAP's results for the combined versus the individual visit spectra.

Melissa Ness: The Cannon

Without calibration on to understood astrophysical properties, the data are uninterpretable.
Are labels science-ready? More work needed here!

Implications for MOS surveys

- The Galactic community is learning how to collaborate on big projects
- New science demands high spectral resolution, good signal-noise, wide wavelength coverage. How do we ***quantify*** these requirements?
- Optimal analysis of stellar spectra is not a "pipeline"
- many methods are essential ➔ much effort
- Calibrating internal results onto a sensible scale is a very, very big challenge
- Gaia Calibration is sensible – global master system
  - Benchmark stars: Definition of accepted parameters & abundances
  - Fundamental parameters by astero-seismology
- The origin of the method differences is still an open question
- Multi-node calibration works well.
- Could it work even better – save resolution and SNR requirements?

- How much hardware cost can be saved by optimal statistical methods?