Gaia FGK Benchmark Stars: Impact of Spectral Resolution on Stellar Abundances

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1. Motivation and scientific question

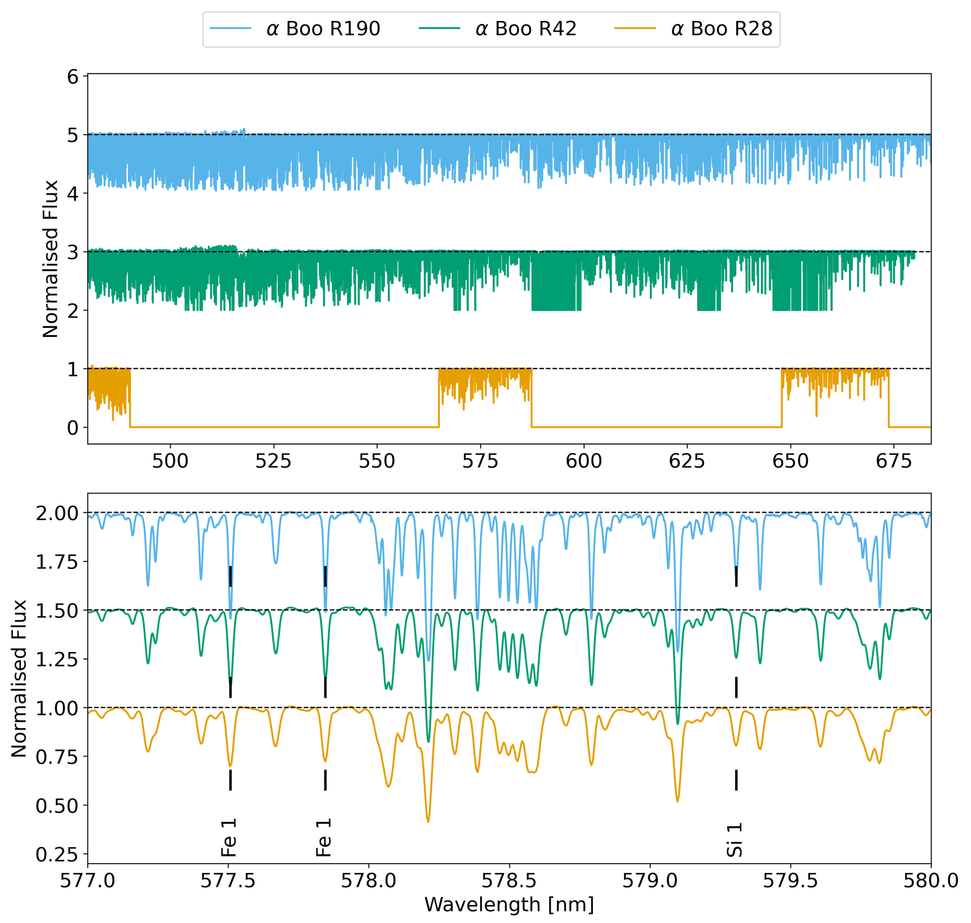
Large spectroscopic surveys require homogeneous stellar parameters and chemical abundances. Gaia Benchmark Stars (GBS) provide fundamental parameters determined independently of spectroscopy and therefore offer an ideal calibration sample [1].

Can different resolution spectra accurately determine stellar parameters and chemical abundances? How critical are wavelength coverage and line selection?

2. Data and experimental design

We analysed **30 southern GBS** using four spectroscopic datasets:

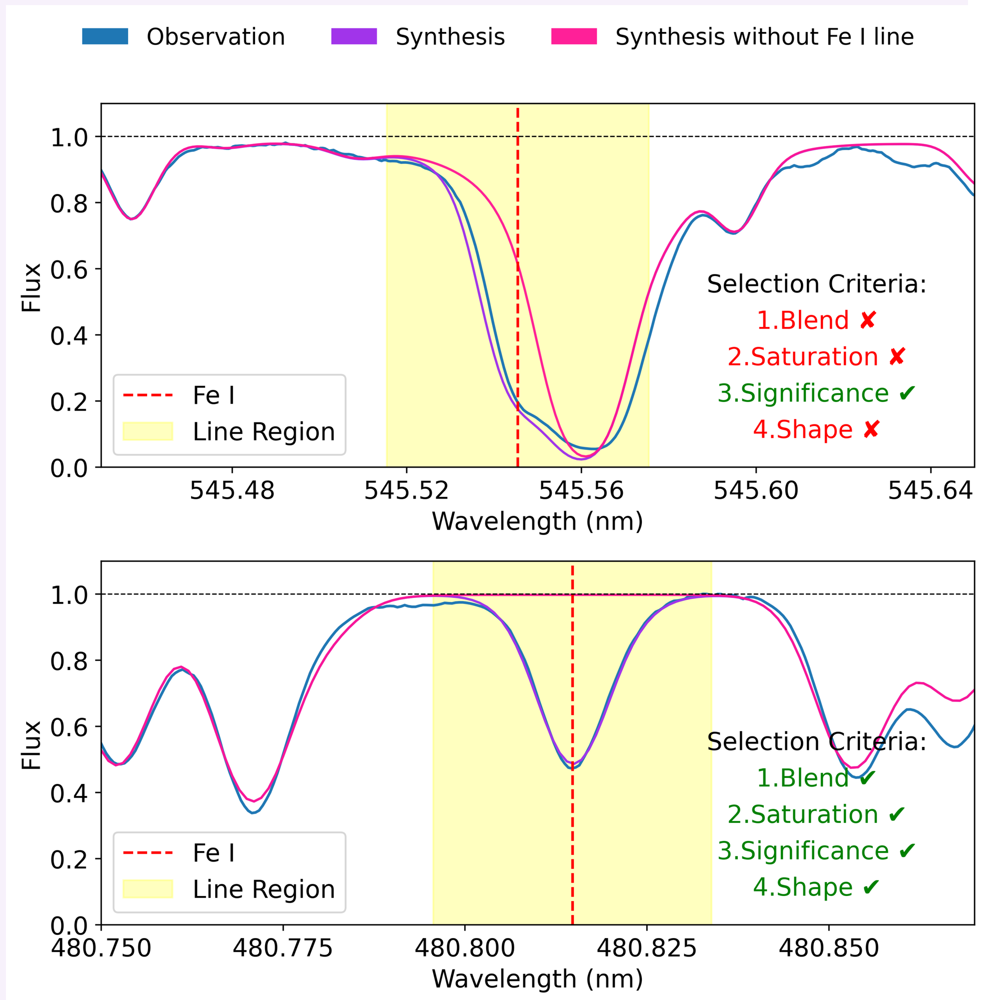
- **R190:** ESPRESSO spectra at $R \sim 190\,000$.
- **R42:** archival spectra at $R \sim 42\,000$.
- **R28:** GALAH spectra at $R \sim 28\,000$.
- **R190-R28:** ESPRESSO spectra degraded to R28.



3. Method: Line Selection

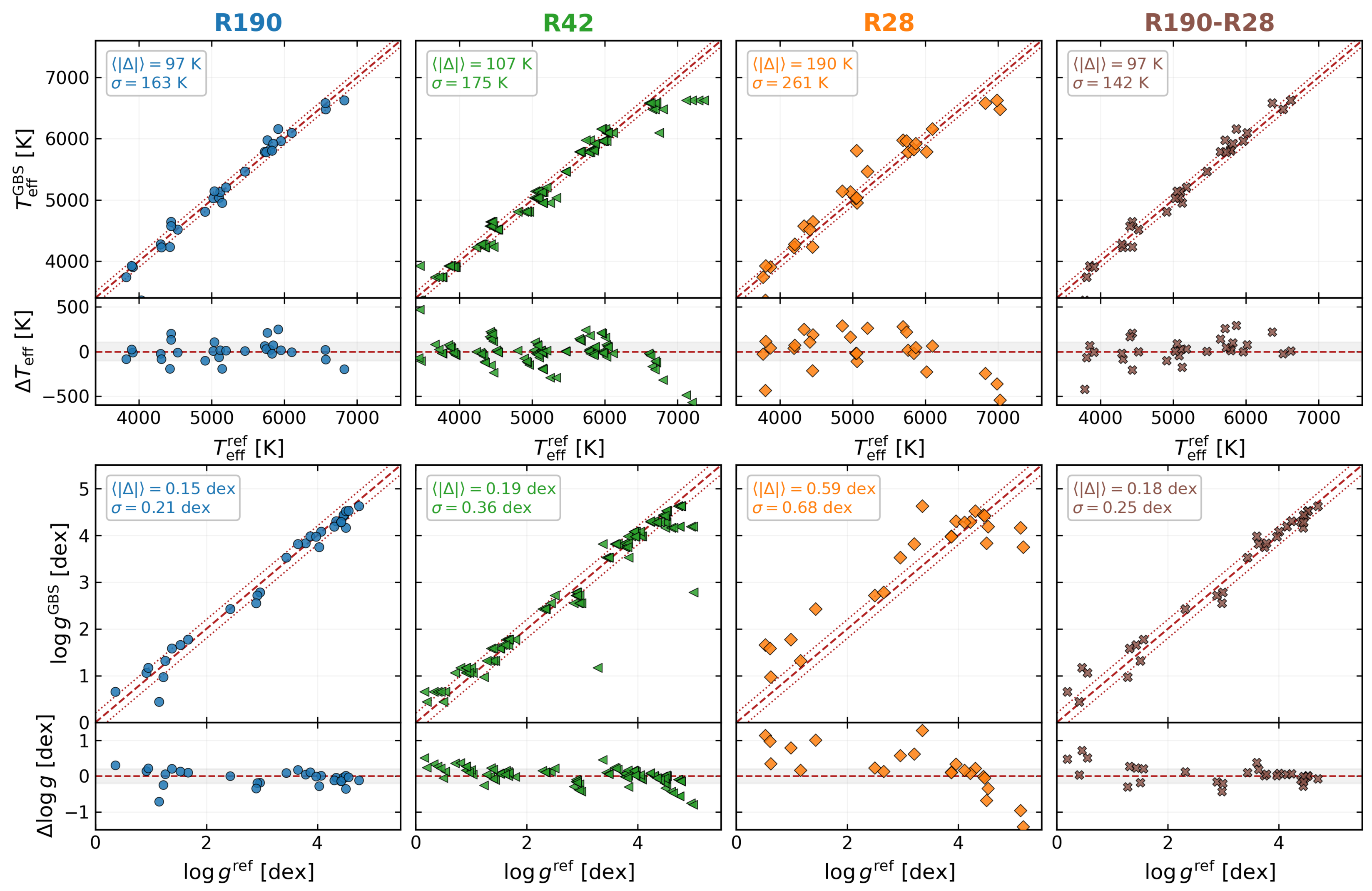
We constructed a new master linelist based on the **GES linelist** [3], refined by direct visual inspection at the R190 resolution.

We retained **clean, unblended lines** for both metal-rich and metal-poor stars, considering line depth, profile, and availability within each spectral coverage.



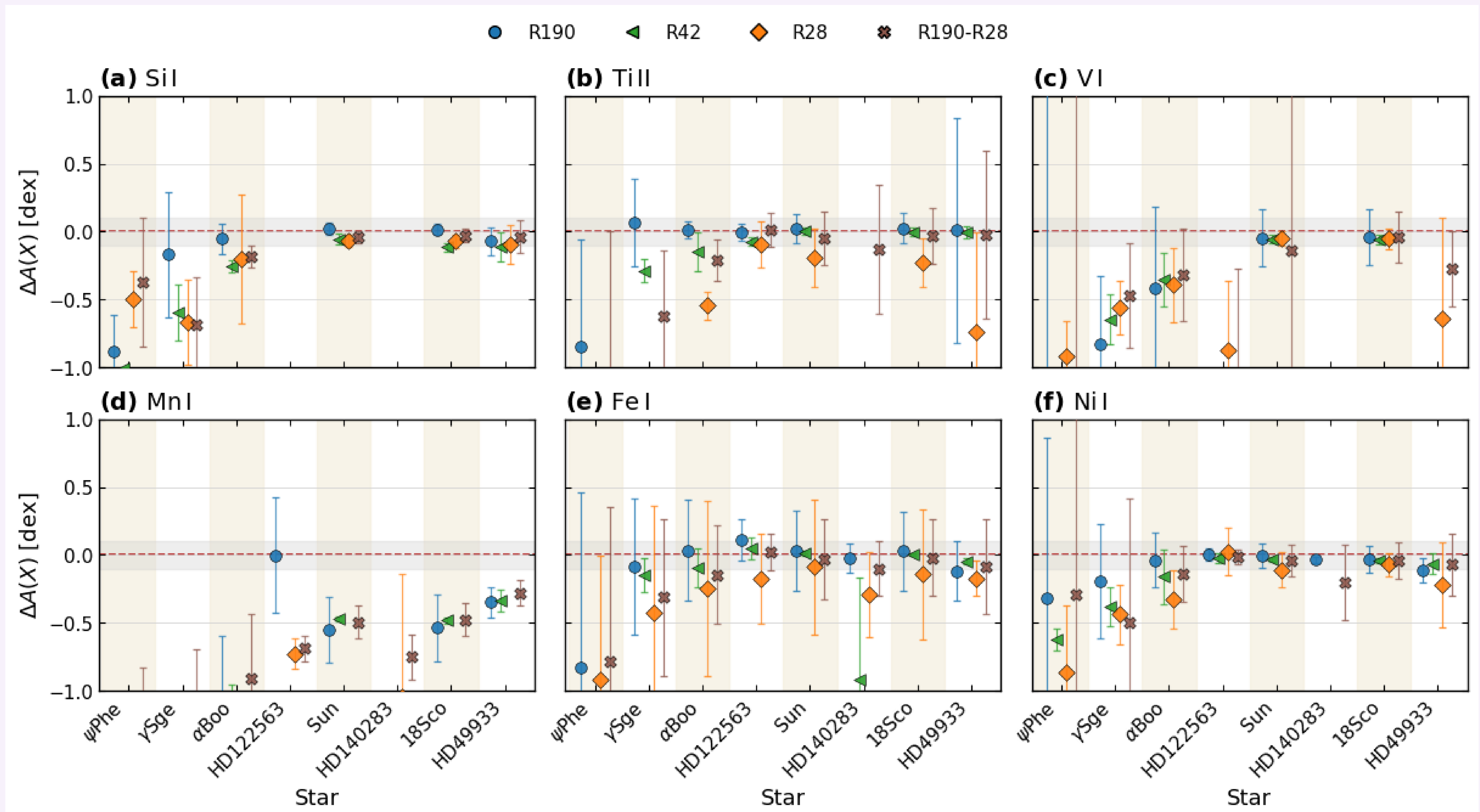
4. Resolution vs Atmospheric Parameters

Using **iSpec spectral synthesis** [4,5], we measured $T_{\rm eff}$ and $\log g$. The set of free parameters optimized at R190 also produces consistent results at R42 for most FGK stars. The R28 $\log g$ offset reflects both **reduced availability of lines and spectral resolution.** Reference atmospheric parameters were adopted from GBSv3 [1,2].



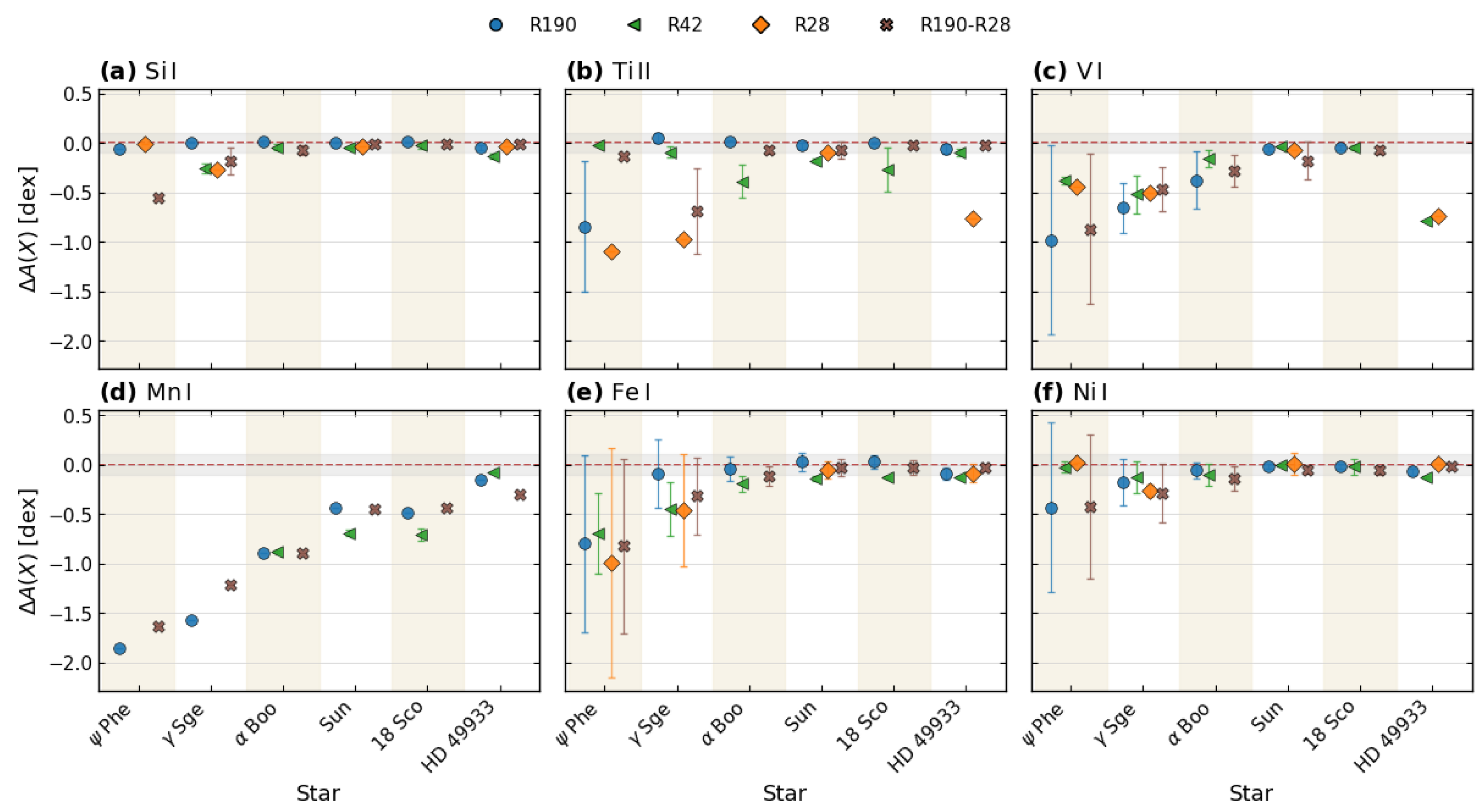
5. Spectral synthesis versus equivalent widths

At R190, both methods agree well for most atomic species in solar-type stars, but **discrepancies increase toward cooler stars, and when the resolution decreases.** Spectral synthesis provides more robust results for species affected by hyperfine structure (HFS), where the Equivalent widths (EW) method can exhibit systematic offsets of up to 0.62 dex for V I.



6. Line-by-line abundance comparison

The line-by-line analysis improves the agreement between spectral synthesis and EW abundances for several species. Nevertheless, the dispersion increases toward R28, and systematic trends toward cooler stars remain. HFS-sensitive species, such as V I, Mn I, and Co I, also retain systematic offsets.



Take-home Messages

- **R42 and R190 give consistent results for many FGK stars.** Cool and metal-poor stars remain challenging.
- **Resolution and wavelength coverage both matter.** Both contribute to the $\log g$ discrepancies at R28.
- **Spectral synthesis is more robust for complex lines.** Matching lines improves method agreement, but HFS-sensitive species retain systematic offsets.

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References

[1] Soubiran et al. (2024), A&A, 682, A145.
[2] Casamiquela et al. (2026), A&A, 705, A167.
[3] Heiter et al. (2021), A&A, 645, A106.
[4] Blanco-Cuaresma et al. (2014), A&A, 569, A111.
[5] Blanco-Cuaresma (2019), MNRAS, 486, 2075.