NOT WORKSHOP

# FIES AND THE *GAIA* FGK BENCHMARK STARS (GBS)

NÚCLEO DE ASTRONOMÍA udp

NÚCLEO MILENIO ERIS

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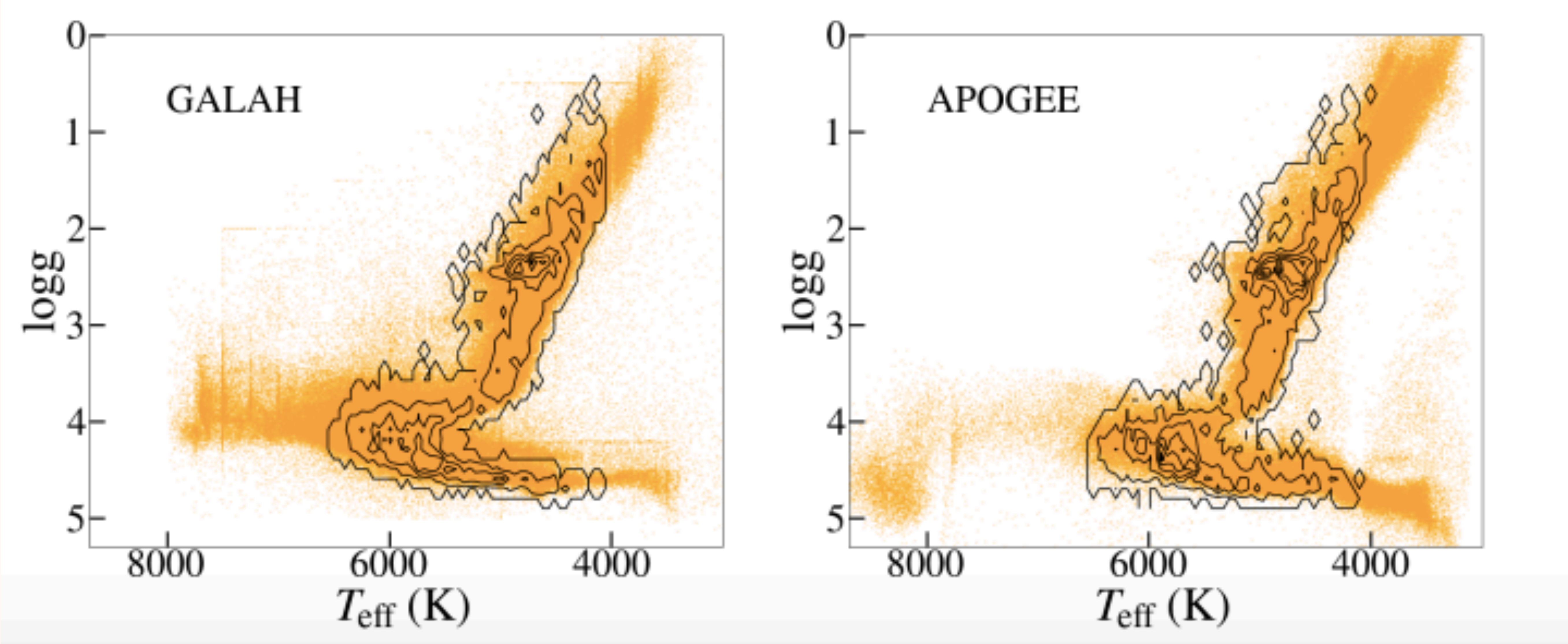
LA PALMA

## 1. Context

Atmospheric parameters and abundances derived from different spectroscopic dataset (Gaia-ESO, RAVE, LAMOST, GALAH, APOGEE) show some differences

→ Different spectroscopic data and analysis processes



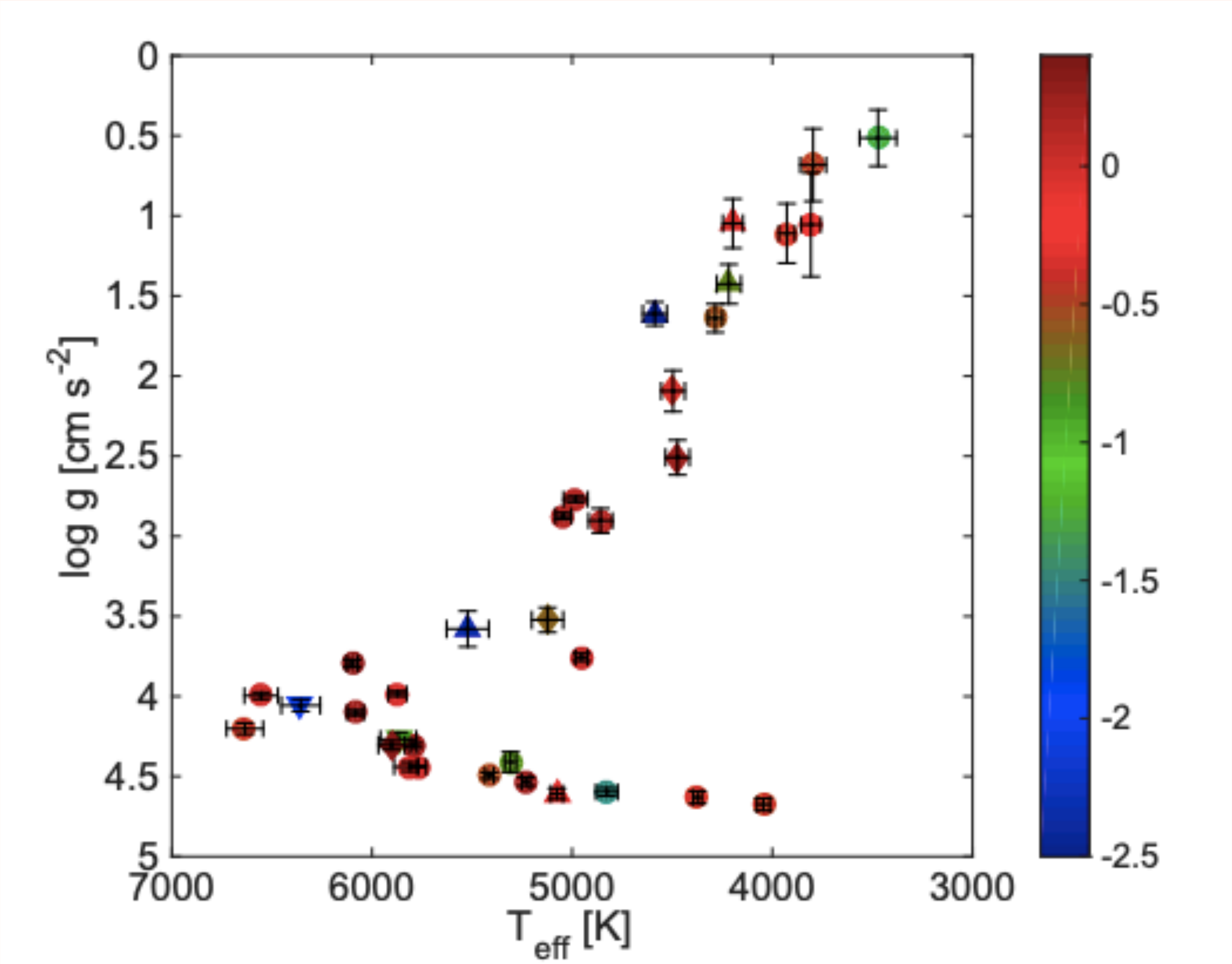

Nandakumar+2022

**Calibration sample:** set of reference objects to calibrate Milky Way spectroscopic surveys

- **Gaia FGK benchmark stars (GBS)**

## 2. GBS v.1

Teff, log g -> independent from spectroscopy
-> from fundamental physic relations




Heiter+2015, GBS-v1.1

Set of 35 stars (Jofré+2014, Heiter+2015):

- Angular diameter $\theta_{LD}$ from literature
- Good parallaxes from Hipparcos
- Bolometric fluxes from literature

$$T_{eff} = \frac{F_{bol}}{\sigma}^{0.25} (0.5\theta_{LD})^{-0.5}$$

Stefan Boltzmann law -> L

Evolutionary tracks (L-Teff plane) -> M

$$g = GM/R^2$$

High accuracy on [Fe/H] and other abundances

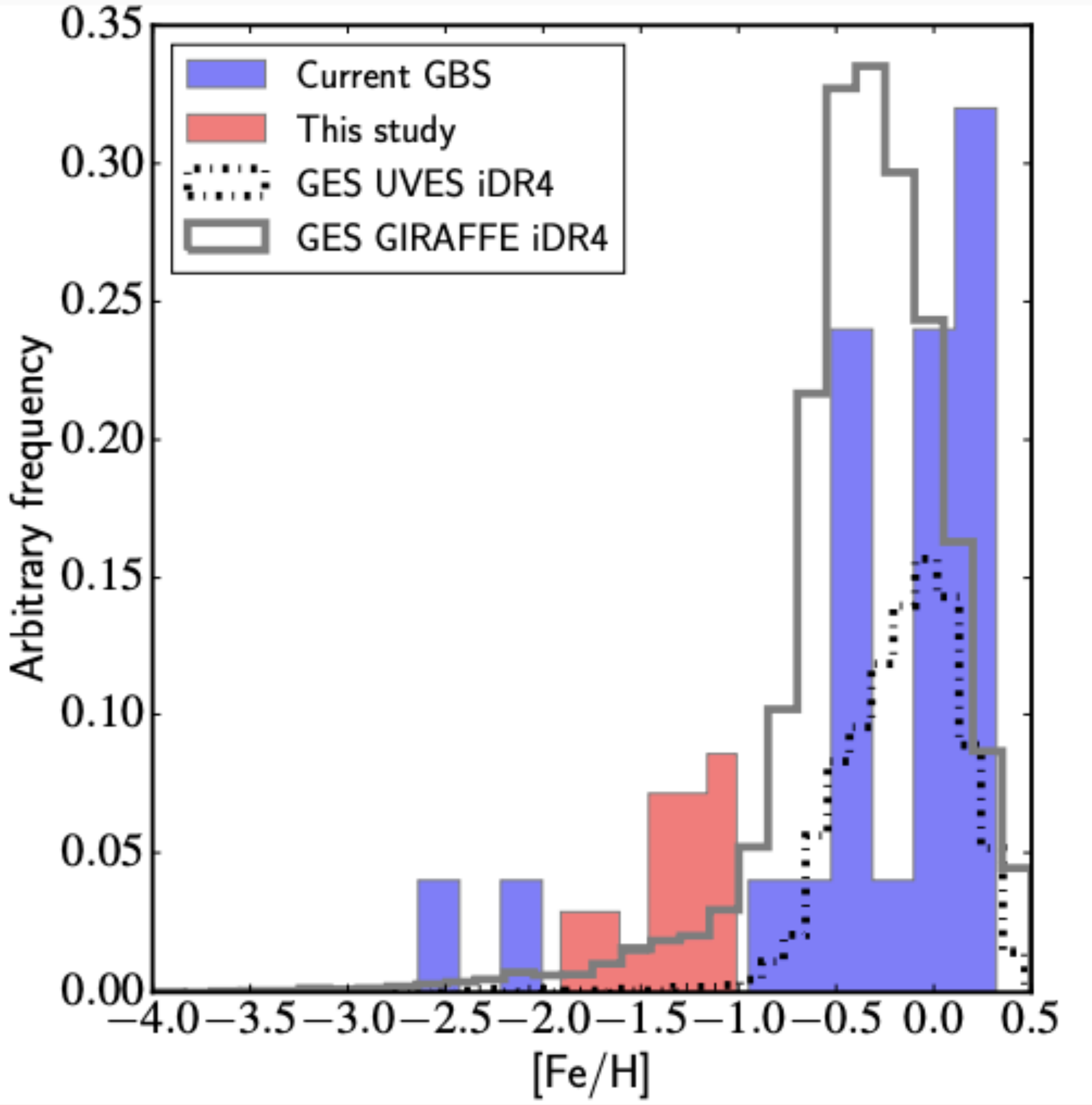
# 3. GBS v.2

Missing metal-poor stars (-2.0 < [Fe/H] < -1.0) and dwarfs → Filling **metal-poor gap** → Towards a **new compilation**

**Table B.1.** Basic information for stars suggested for future extension of the *Gaia* FGK benchmark stars sample.

| HD | Name | RA (J2000) | DEC (J2000) | Spectral type | *V*mag | [Fe/H] | $\sigma$([Fe/H]) |
|---|---|---|---|---|---|---|---|
| 2665 | HD 2665 | 00 30 45.446 | +57 03 53.63 | G5IIIw | 7.7 | -2.00 | 0.09 |
| 2796 | HD 2796 | 00 31 16.915 | -16 47 40.80 | Fw | 8.5 | -2.32 | 0.13 |
| 4306 | HD 4306 | 00 45 27.163 | -09 32 39.79 | KIIvw | 9.0 | -2.70 | 0.19 |
| 4628 | HD 4628 | 00 48 22.977 | +05 16 50.21 | K2.5V | 5.7 | -0.26 | 0.05 |
| 6980 | AI Phe | 01 09 34.195 | -46 15 56.09 | K0IV+F7V | 8.6 | -0.14 | 0.10 |
| 6755 | HD 6755 | 01 09 43.065 | +61 32 50.19 | F8V | 7.7 | -1.55 | 0.05 |
| 6860 | bet And | 01 09 43.924 | +35 37 14.01 | M0III | 2.0 | -0.04 | |
| 6833 | HD 6833 | 01 09 52.265 | +54 44 20.28 | G9III | 6.7 | -0.88 | 0.11 |
| 9826 | ups And | 01 36 47.842 | +41 24 19.64 | F9V | 4.1 | 0.08 | 0.05 |
| 10476 | HD 10476 | 01 42 29.762 | +20 16 06.60 | K1V | 5.2 | -0.04 | 0.04 |
| | BD +44 493 | 02 26 49.738 | +44 57 46.52 | G5IV | 9.1 | -3.68 | 0.11 |
| 16160 | HD 16160 | 02 36 04.895 | +06 53 12.75 | K3V | 5.8 | -0.12 | 0.06 |
| 17051 | iot Hor | 02 42 33.466 | -50 48 01.06 | F8V | 5.4 | 0.13 | 0.10 |
| 20010 | alf For | 03 12 04.527 | -28 59 15.43 | F6V+G7V | 3.9 | -0.28 | 0.06 |
| 19994 | HD 19994 | 03 12 46.437 | -01 11 45.96 | F8V | 5.1 | 0.19 | 0.07 |
| 20301 | TZ For | 03 14 40.093 | -35 33 27.60 | G8III+F7IV | 6.9 | 0.10 | 0.15 |

Heiter+2015




Hawkins+2016

↓

Gaia parallaxes
JMDC: angular diameter

In some cases uncertainties on interferometric radii are high

## 4. The update of the sample: GBS v.3

FGK stars chosen with angular diameter from **JMDC:**
Criteria from Selsi+2020:

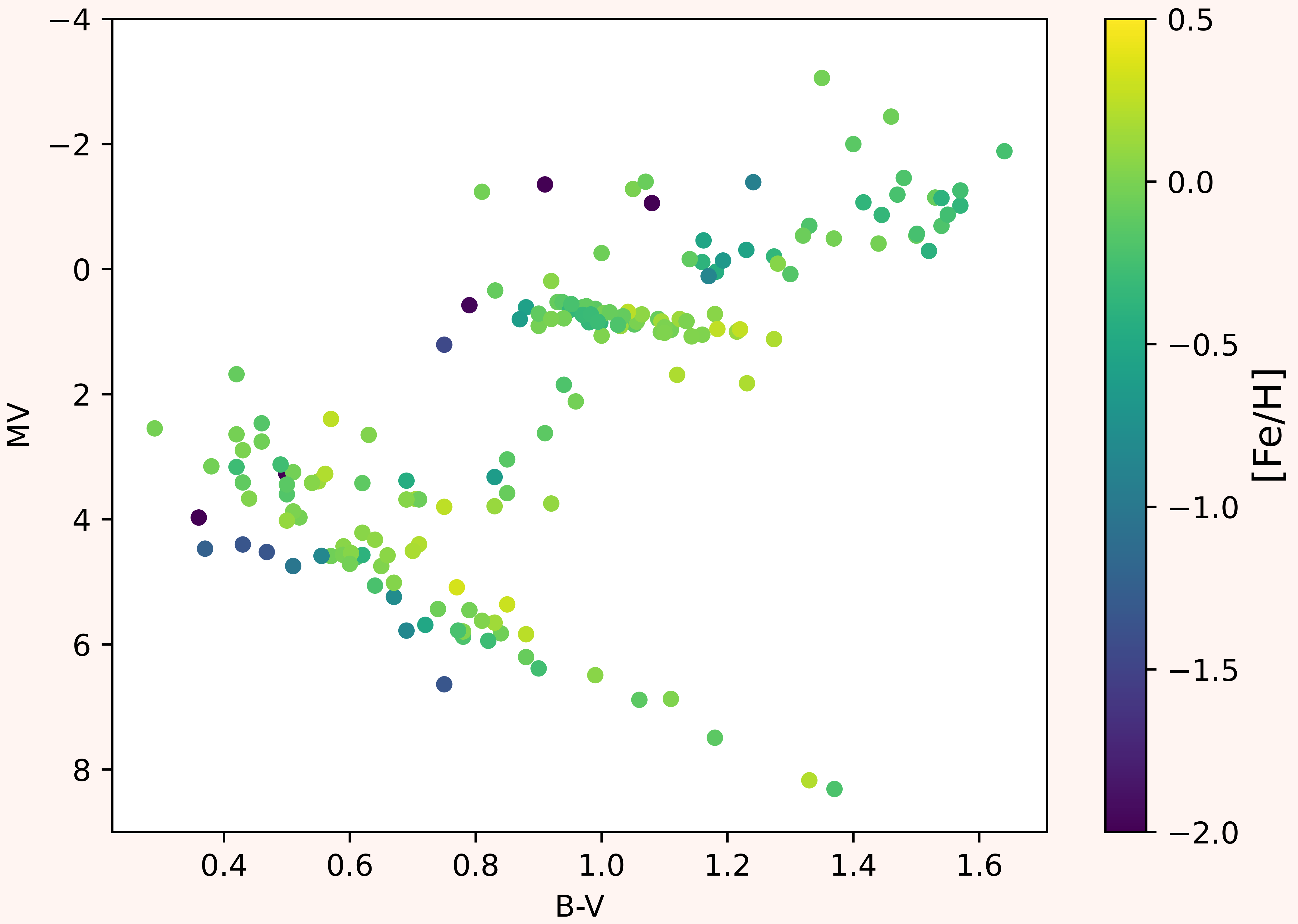
- Remove Miras, Binaries, Variables, Cepheids
- Remove angular diameter with σ > 8%
- Remove bad photometry (high K uncertainties)

Add

Metal-poor stars

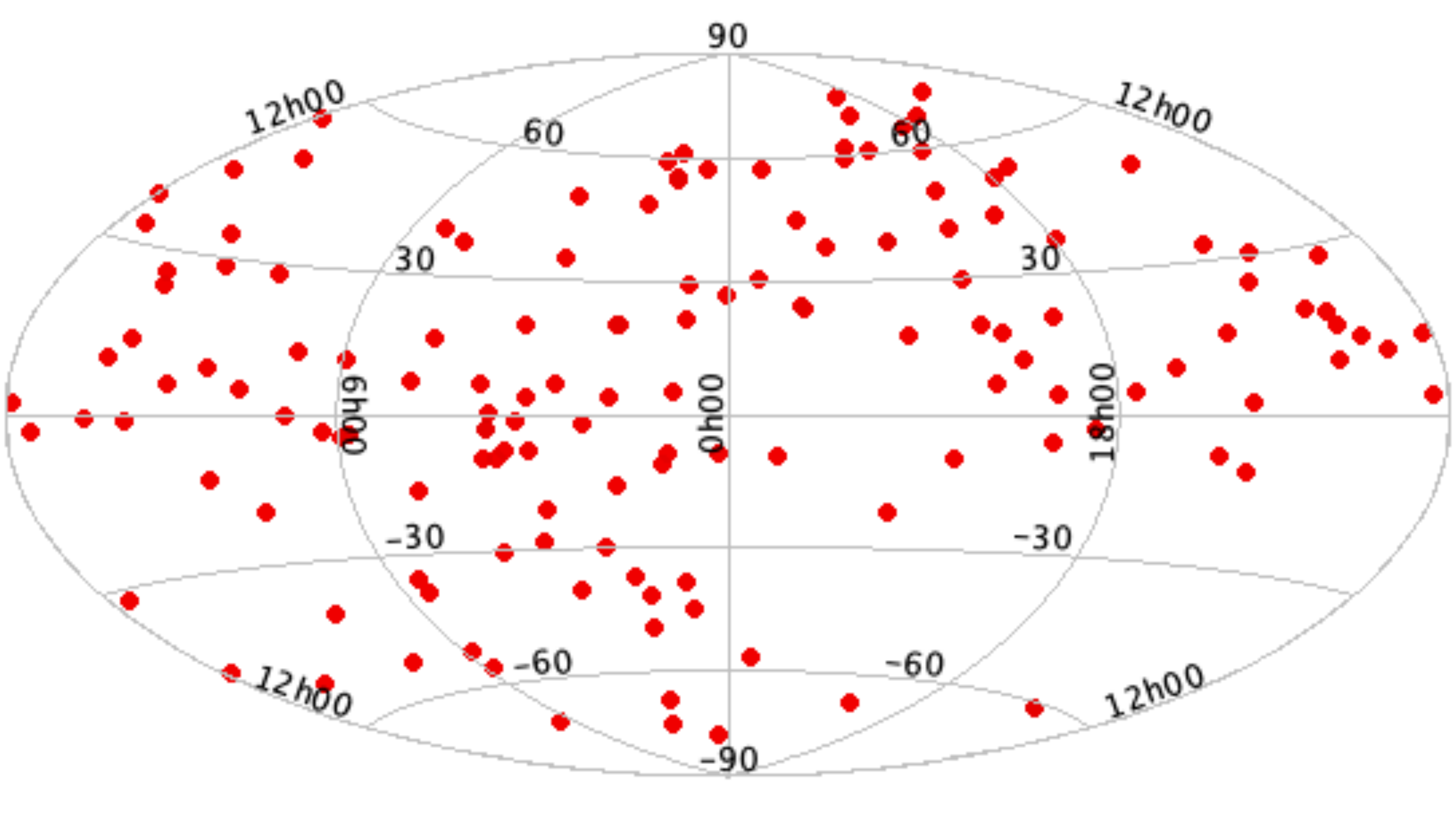
↓

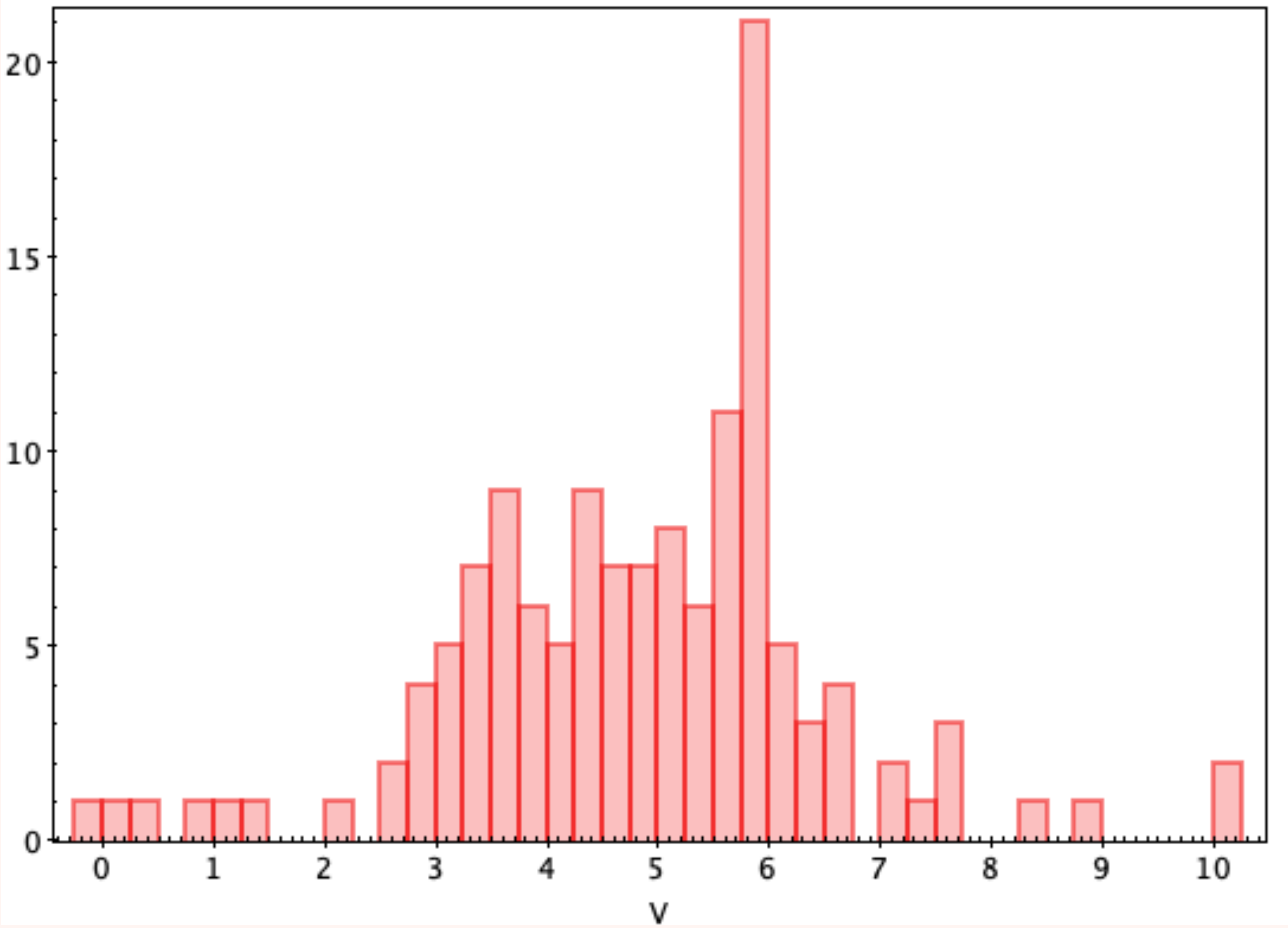
196 candidates
Parameters are covered by **PASTEL** catalogue (Soubiran+2018)
"own" bolometric fluxes -> determination of log g and M



## 4. The update of the sample: GBS v.3

Sky coverage and magnitudes from **Simbad**



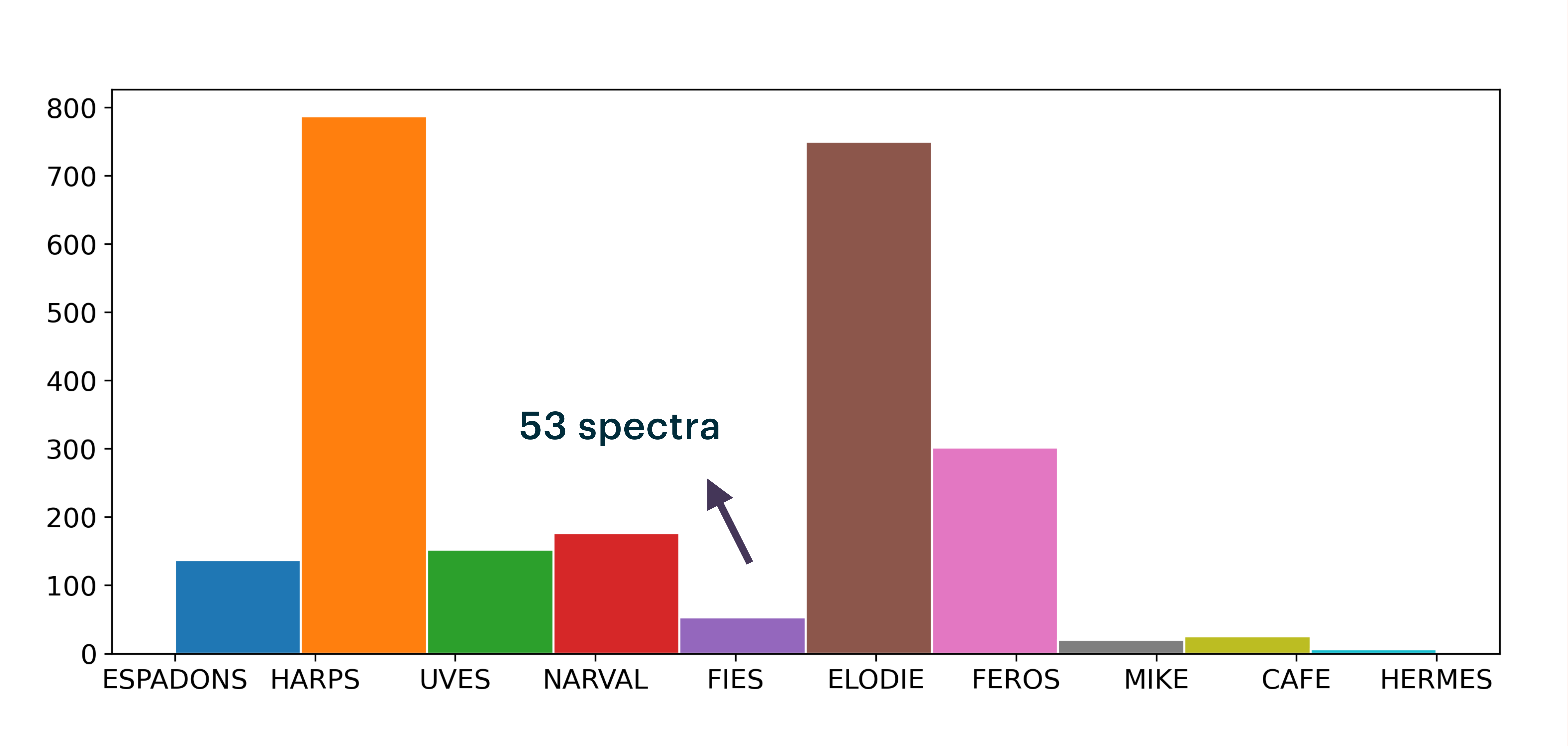




Both hemispheres

## 5. Spectroscopic analysis to derive detailed abundances

Half of the sample has high resolution spectroscopy from public archives (HARPS, FEROS, UVES, ELODIE, NARVAL, ESPADONS)

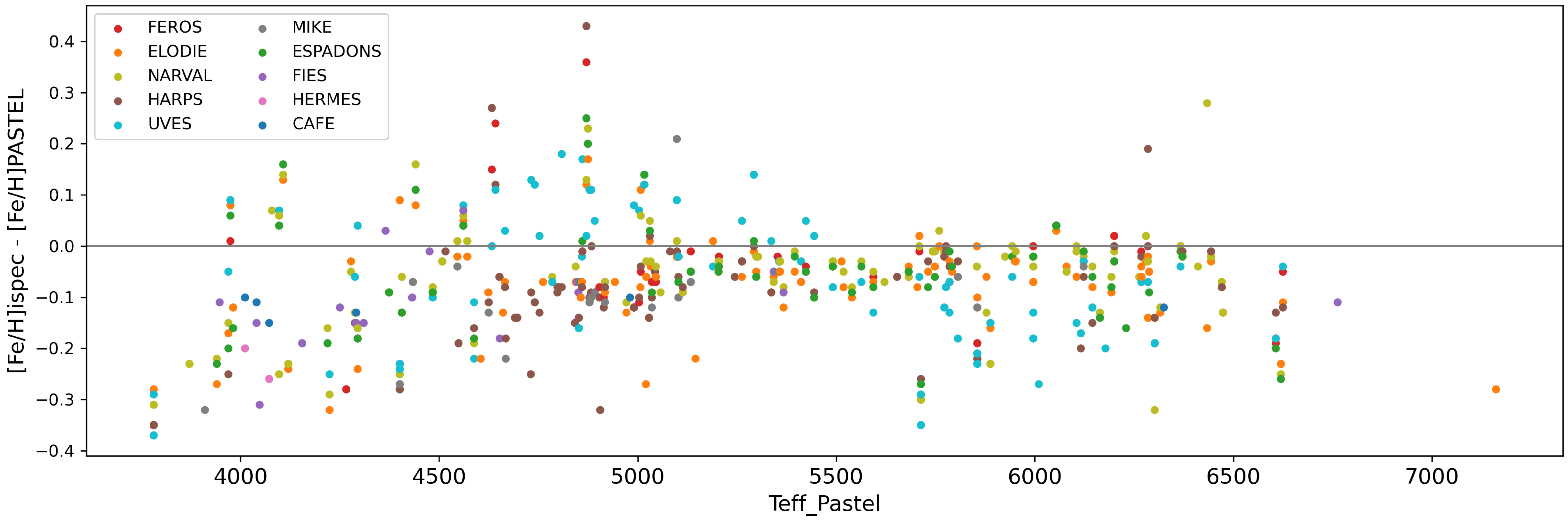
In total: 2408 spectra



# 5. Spectroscopic analysis to derive detailed abundances

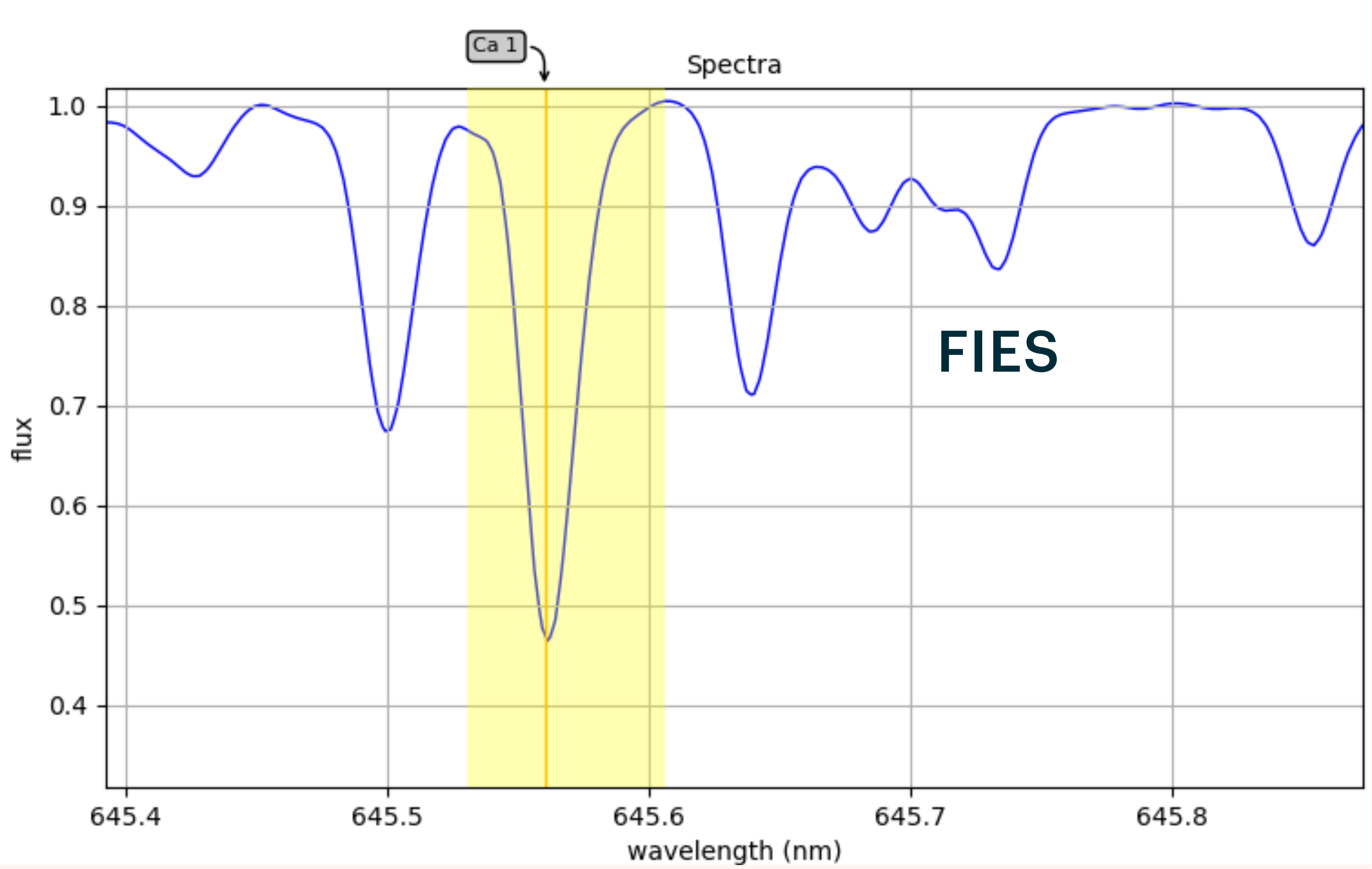
Aim: - build an homogenous spectral library with **iSpec (Blanco-Cuaresma+2014)**
- chemical abundances

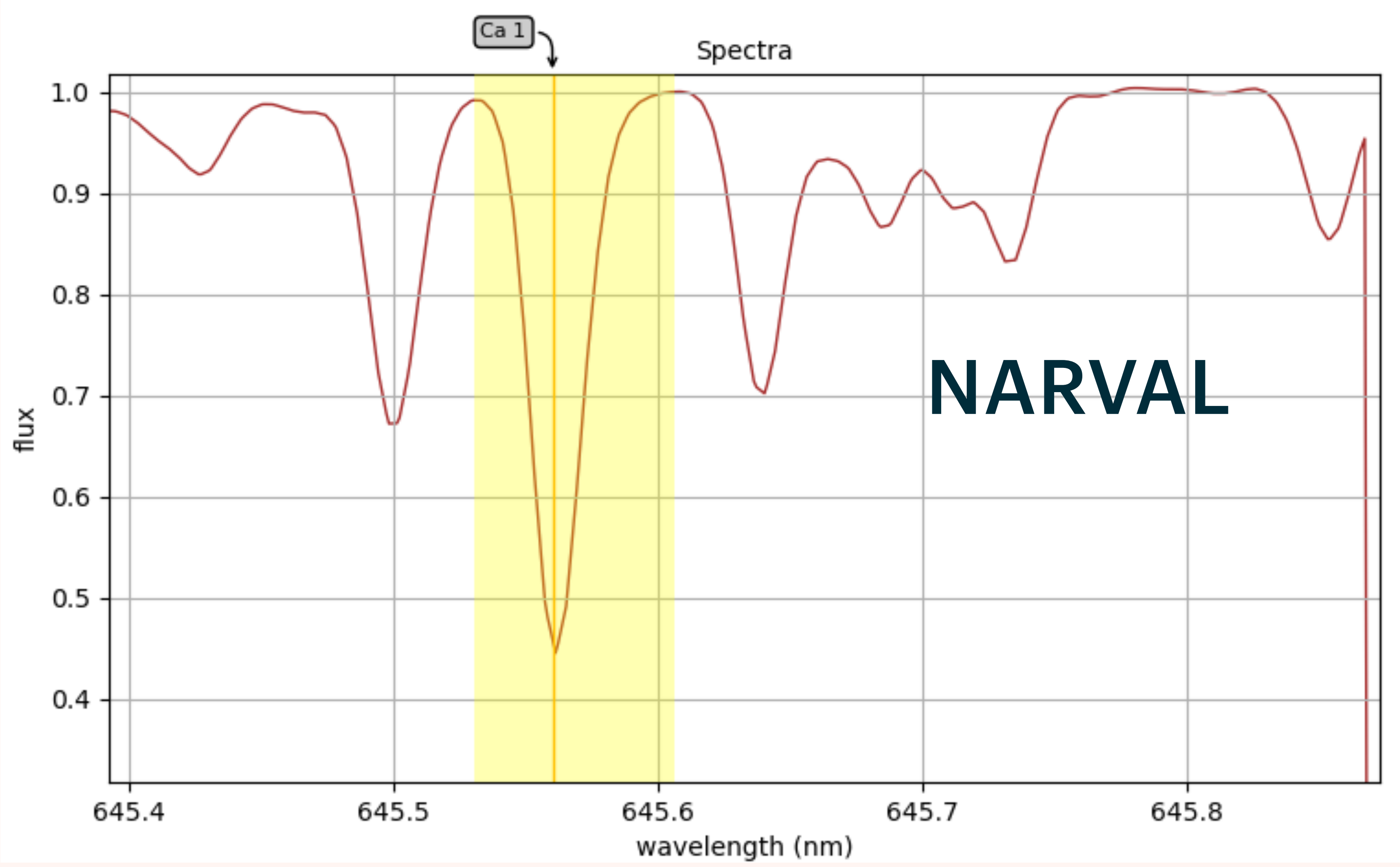
Turbospectrum code



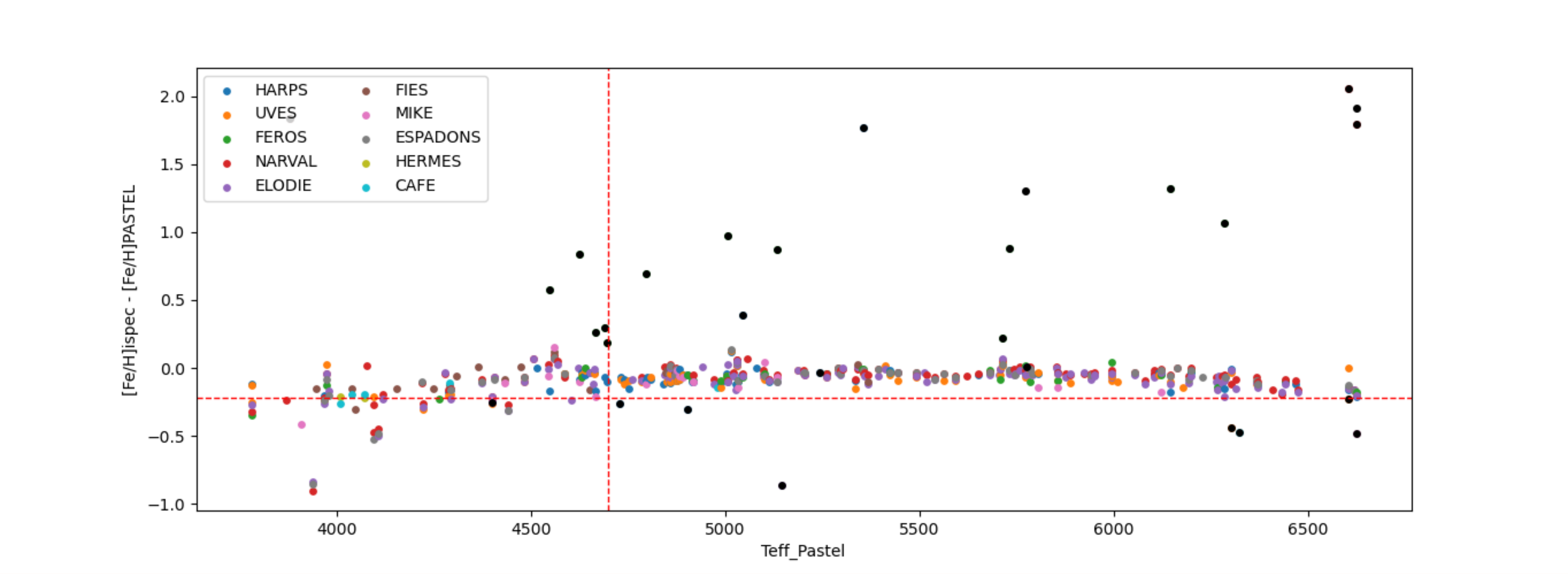
## 5. Spectroscopic analysis to derive detailed abundances: FIES

19 stars observed with FIES
13 stars only with FIES
SNR >100

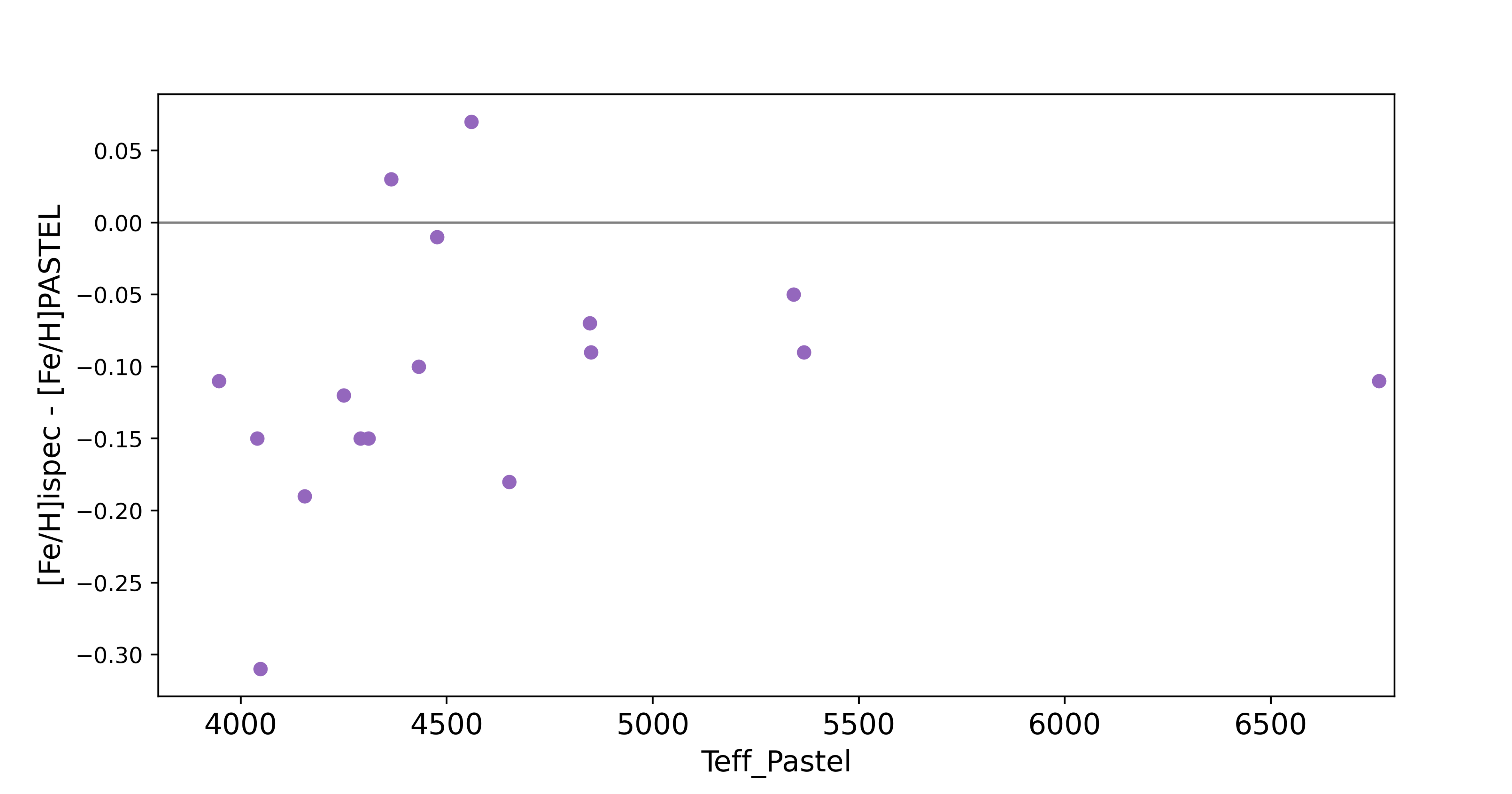


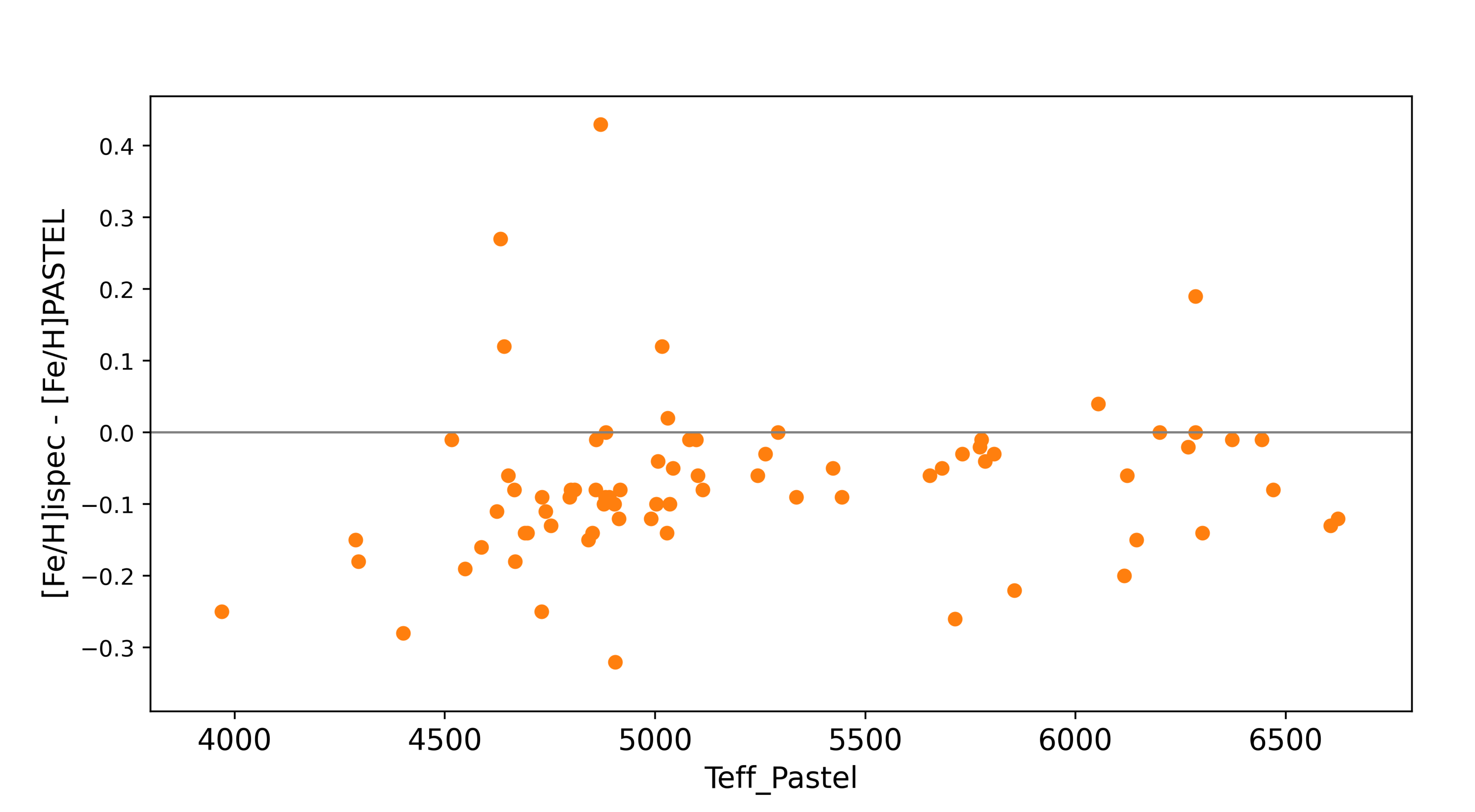




Crucial to observe outliers with no duplicates



## 5. Spectroscopic analysis to derive detailed abundances: FIES

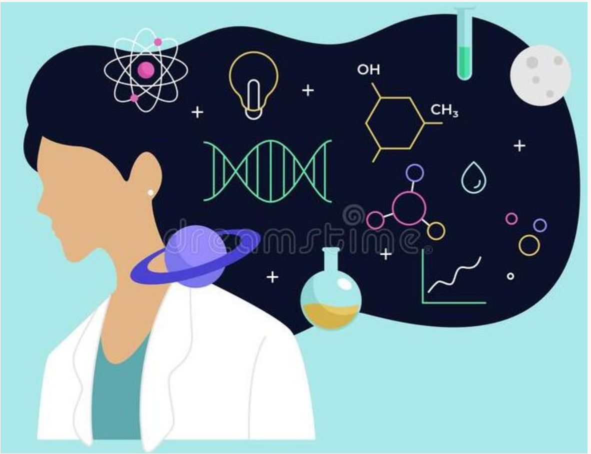


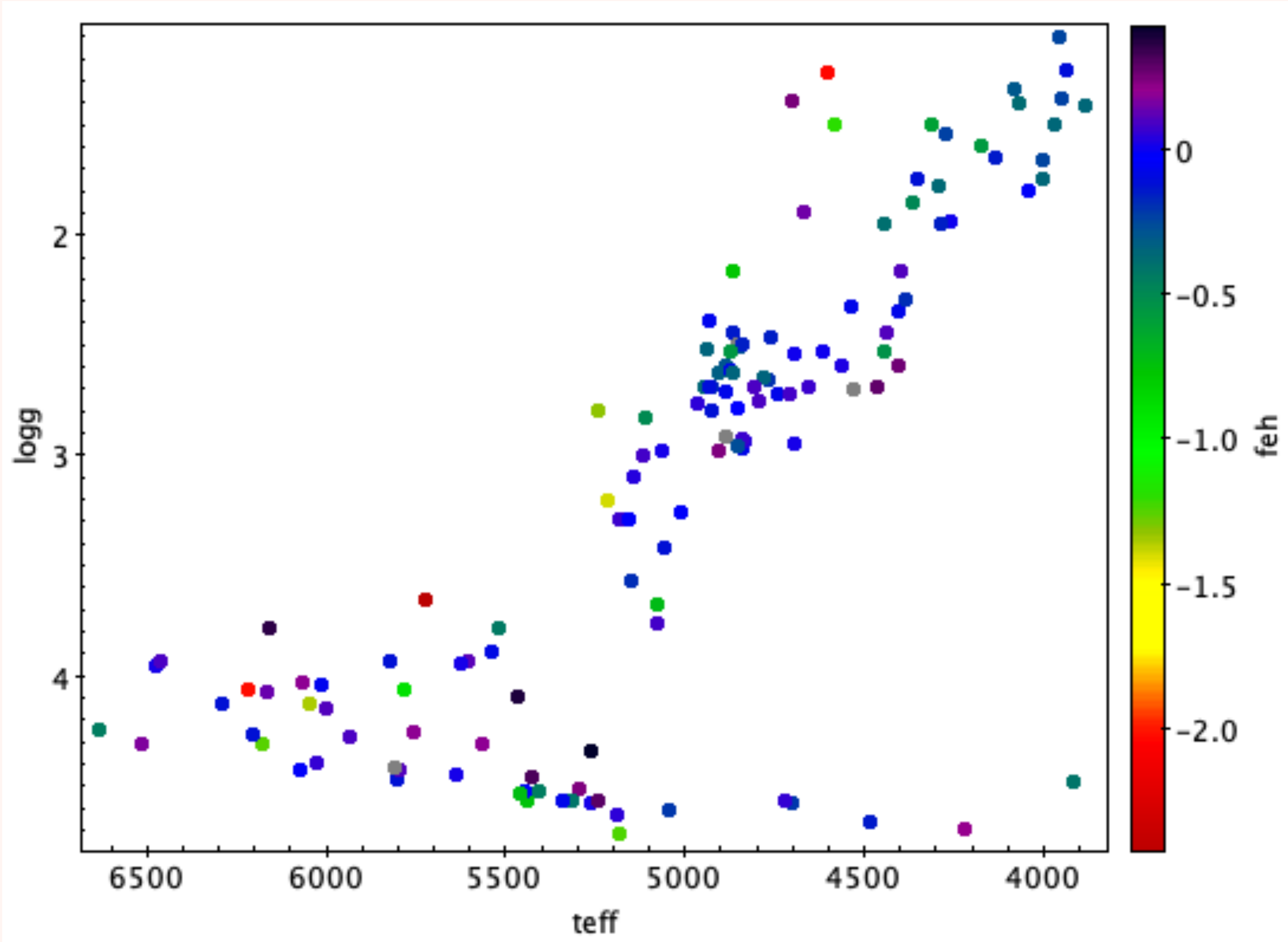

Derivation of stellar parameters:
> good results
-> high-quality data

★ Perfect learning experience: observations + science project

## Building the next reference sample



Still work to do…




GBSv.3 workshop November 2022 hosted ESO

Stellar sample already proposed for:

calibration sample for the ASTRA pipeline (SDSS-V)

Benchmark stars for PLATO

Interest from WEAVE and 4MOST teams

Important to keep observing GBS!