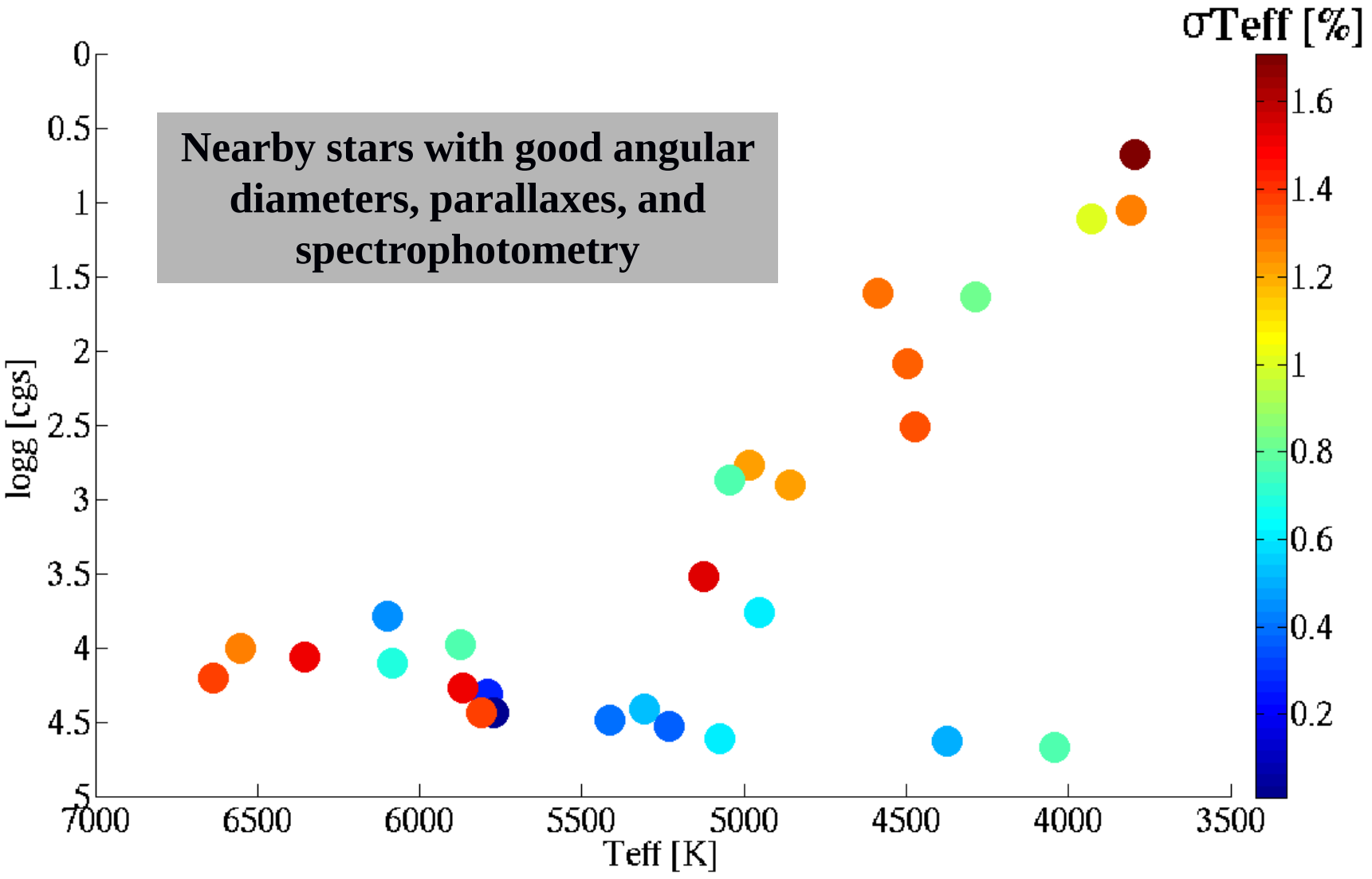
Benchmark stars for PLATO: non-seismic parameters

Parameters to be discussed

- Effective temperature
- Metallicity
- Detailed chemical composition

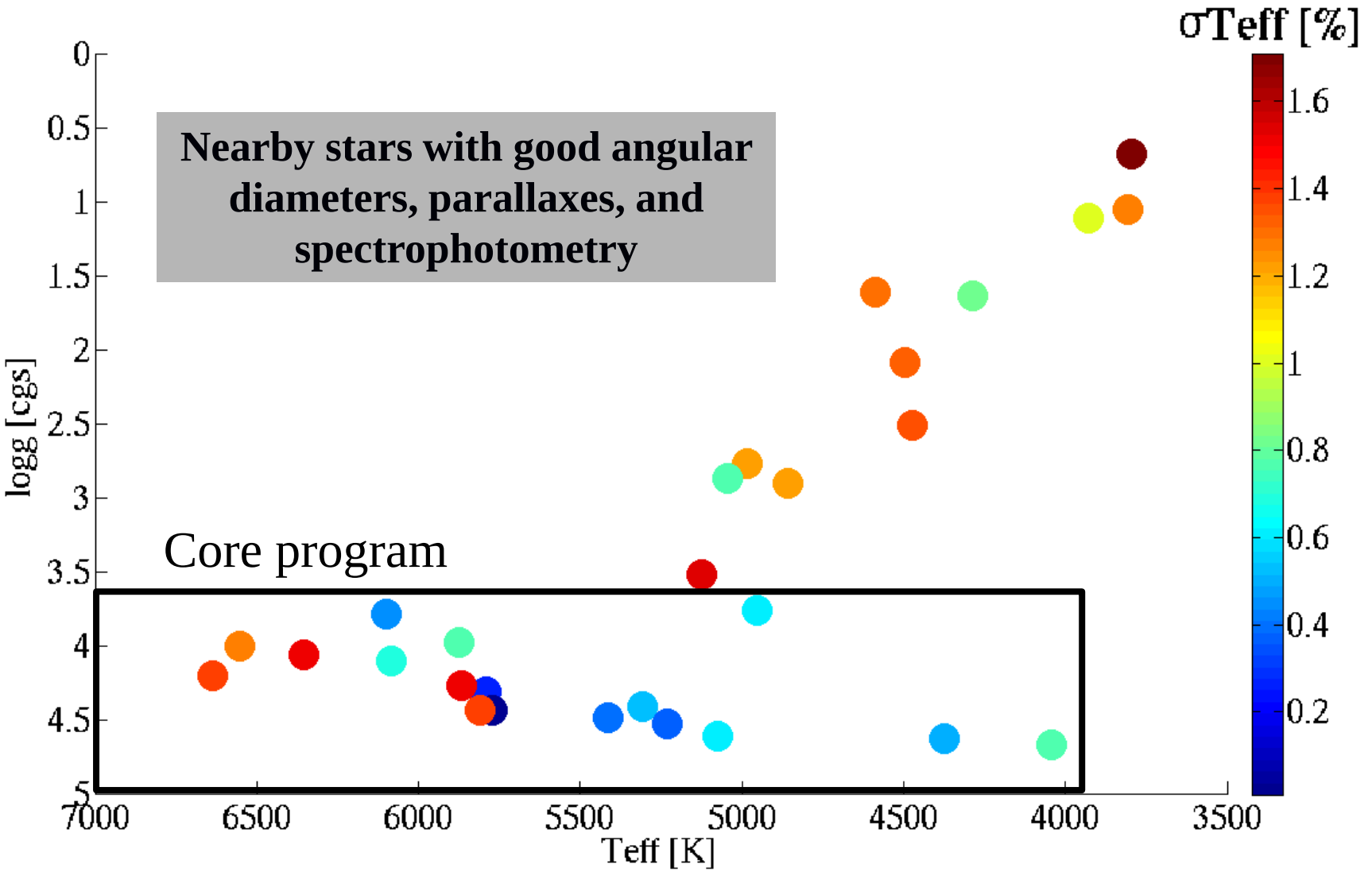
Teff: Gaia benchmarks



Nearby stars with good angular diameters, parallaxes, and spectrophotometry

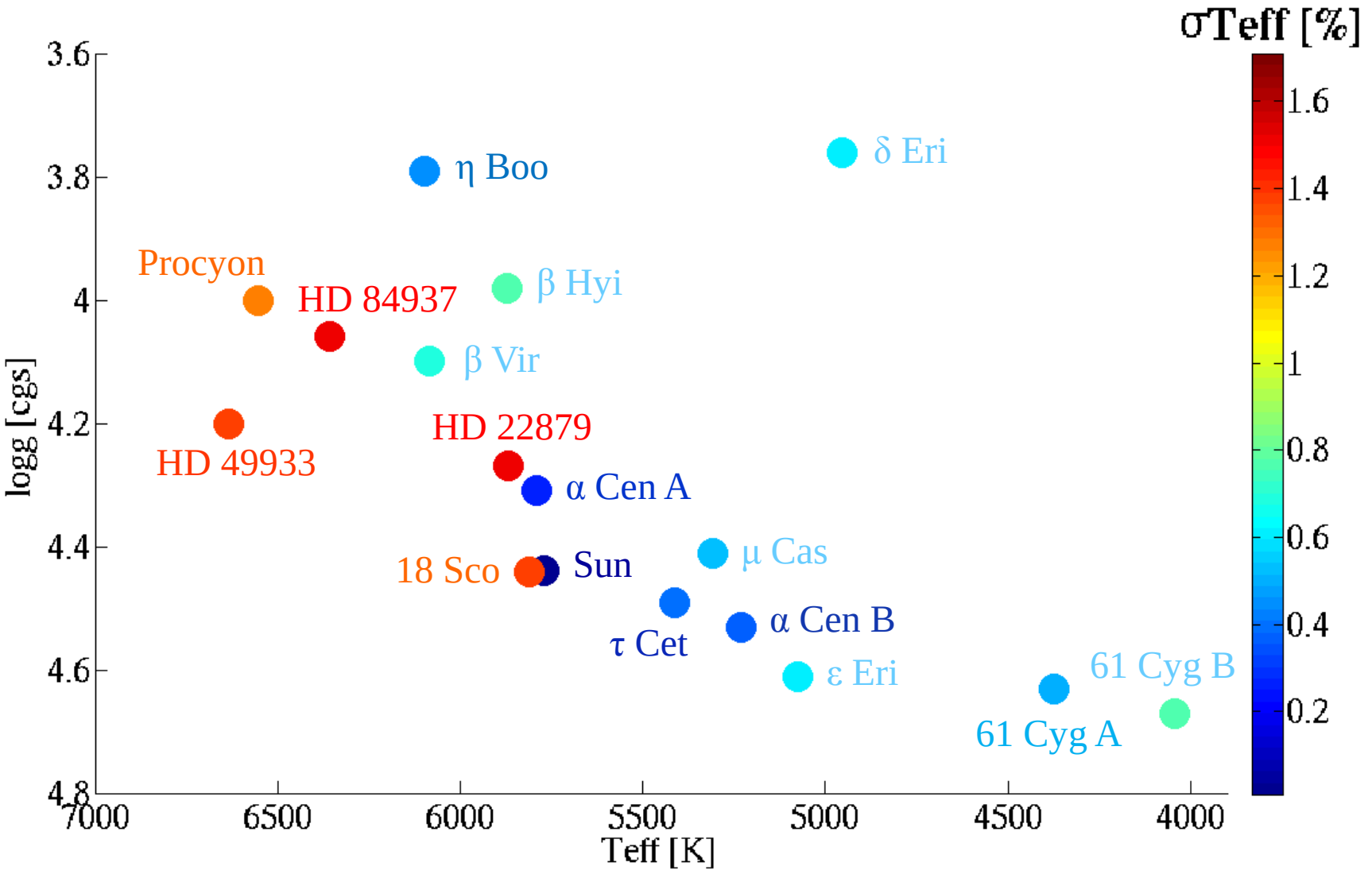
Data from Heiter et al. (2015)

Teff: Gaia benchmarks



Data from Heiter et al. (2015)

Teff: Gaia benchmarks

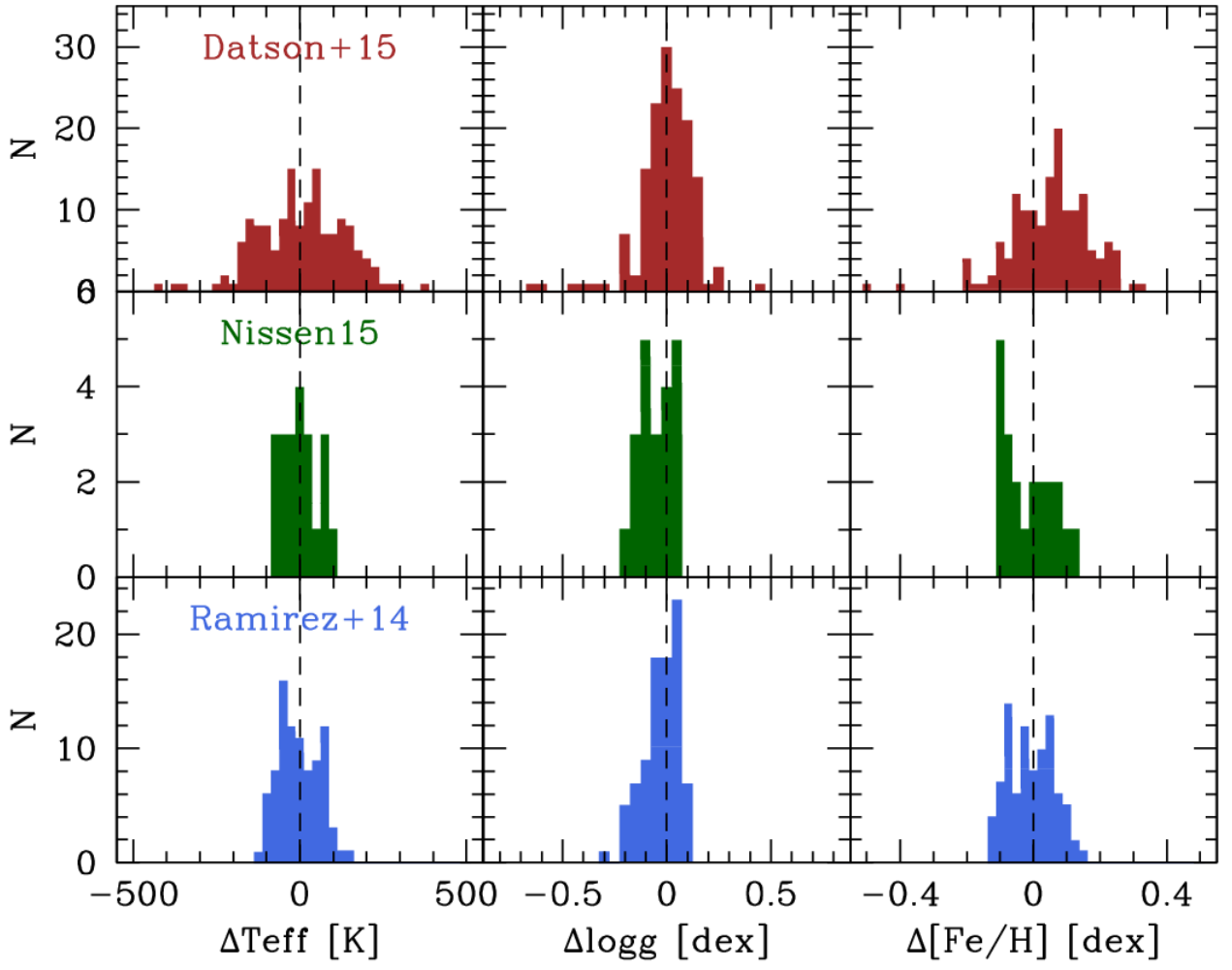


Data from Heiter et al. (2015)

Metallicity: solar twins/analogues

Line-by-line, strictly differential analysis with respect to the Sun

Sample properties: deviations with respect to solar values



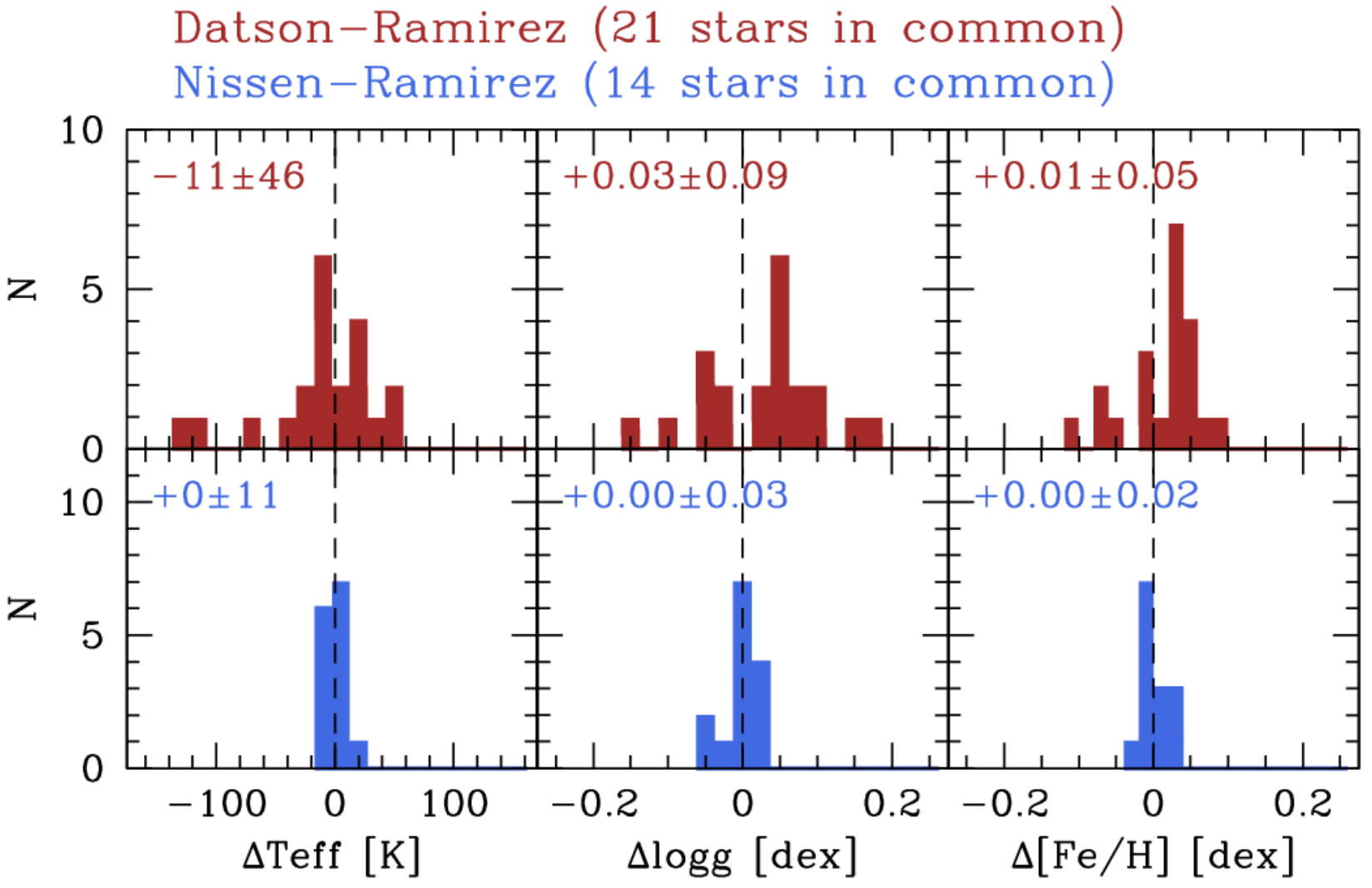
Uncertainties quoted

σTeff~40 K
σlogg~0.07 dex
σ[Fe/H]~0.03 dex

σTeff~6 K
σlogg~0.012 dex
σ[Fe/H]~0.006 dex

σTeff~7 K
σlogg~0.019 dex
σ[Fe/H]~0.006 dex

Metallicity: solar twins/analogues



Metallicity: solar twins/analogues

HD 134664

Reference	Teff [K]	logg [cgs]	[Fe/H]
Datson+15	5884	4.43	+0.13
Nissen15	5853	4.452	+0.093
Ramírez+14	5844	4.49	+0.077
σ	21	0.04	0.03

HD 146233

Reference	Teff [K]	logg [cgs]	[Fe/H]
Datson+15	5819	4.47	+0.08
Nissen15	5809	4.434	+0.046
Ramírez+14	5814	4.45	+0.056
σ	5	0.02	0.02

Metallicity: solar twins/analogues

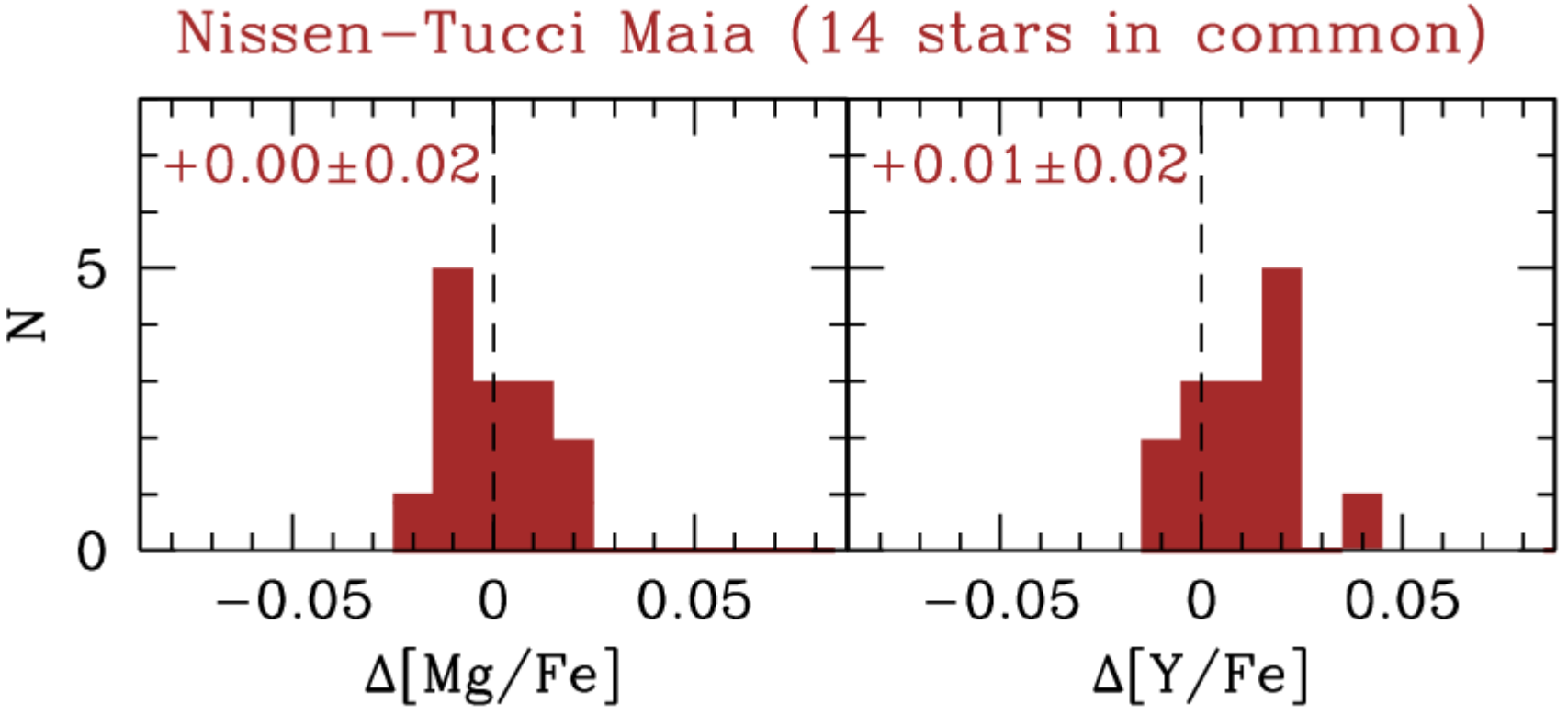
18 Sco
Heiter+15: 5810±80 K

Reference	Teff [K]	ΔTeff [K]
Datson+15	5819±40	+9
Nissen15	5809±6	−1
Ramírez+14	5814±3	+4

τ Cet
Heiter+15: 5414±21 K

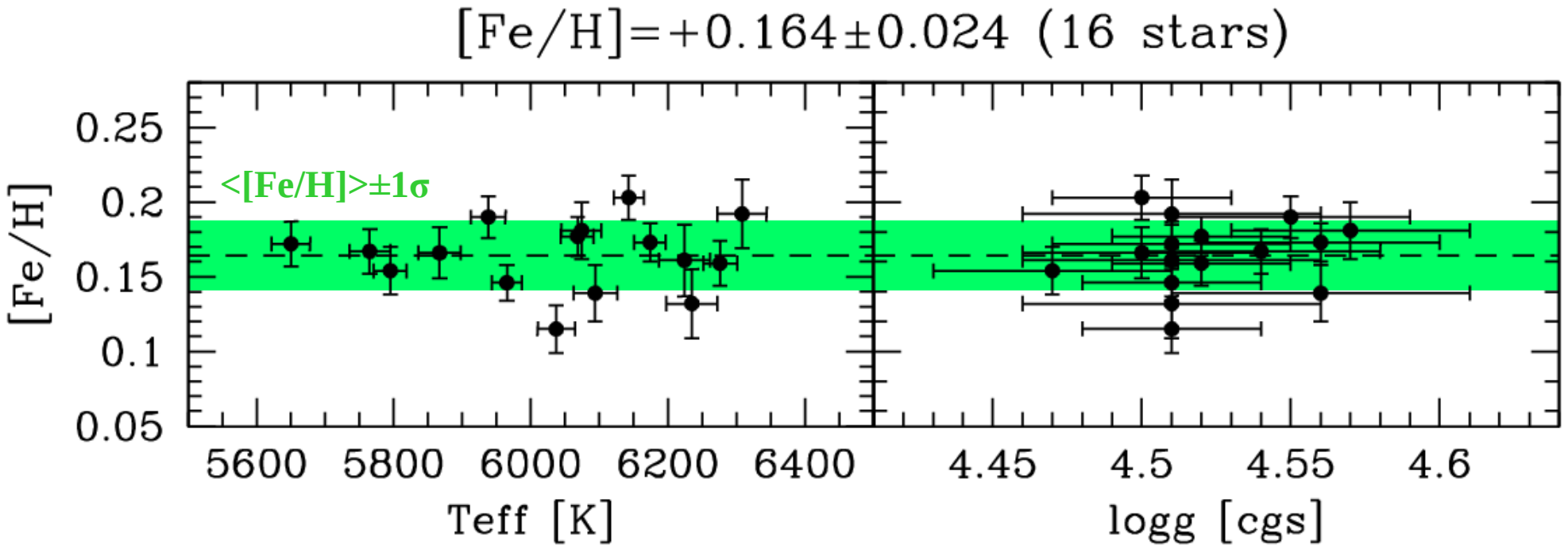
Reference	Teff [K]	ΔTeff [K]
Datson+15	5425±40	+11

Abundance pattern: solar twins/analogues



Metallicity: open clusters

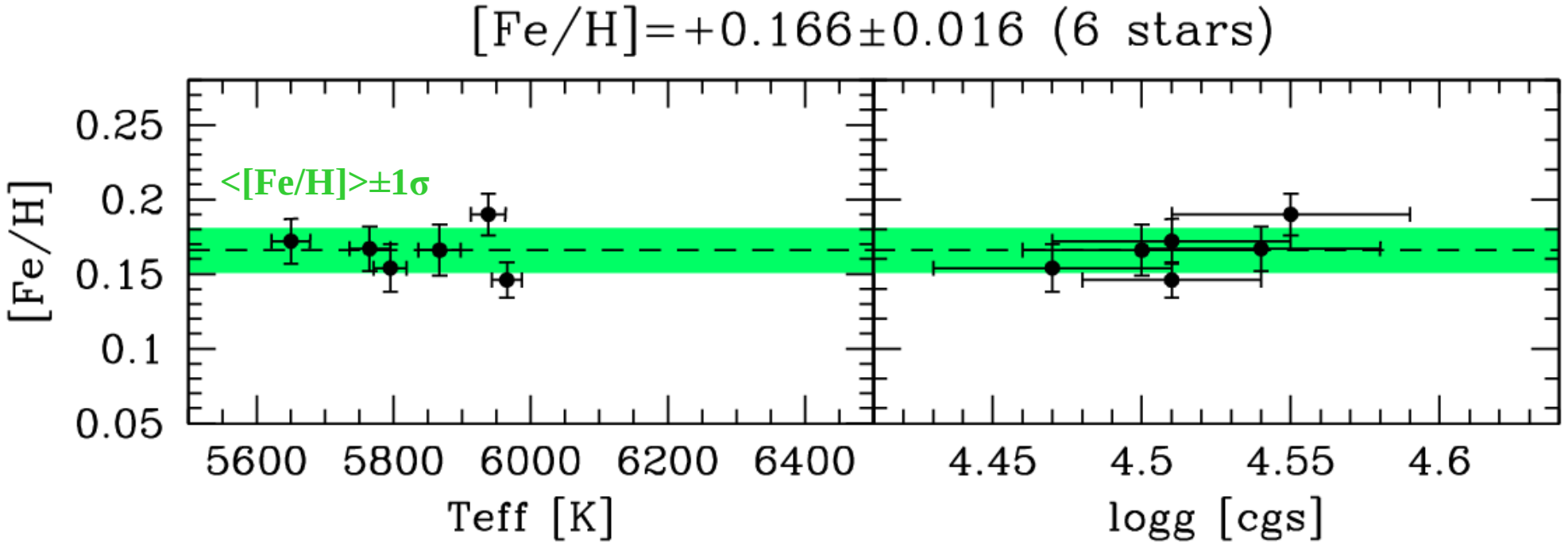
Differential analysis of solar-like stars in Hyades



Data from Liu et al. (2016)

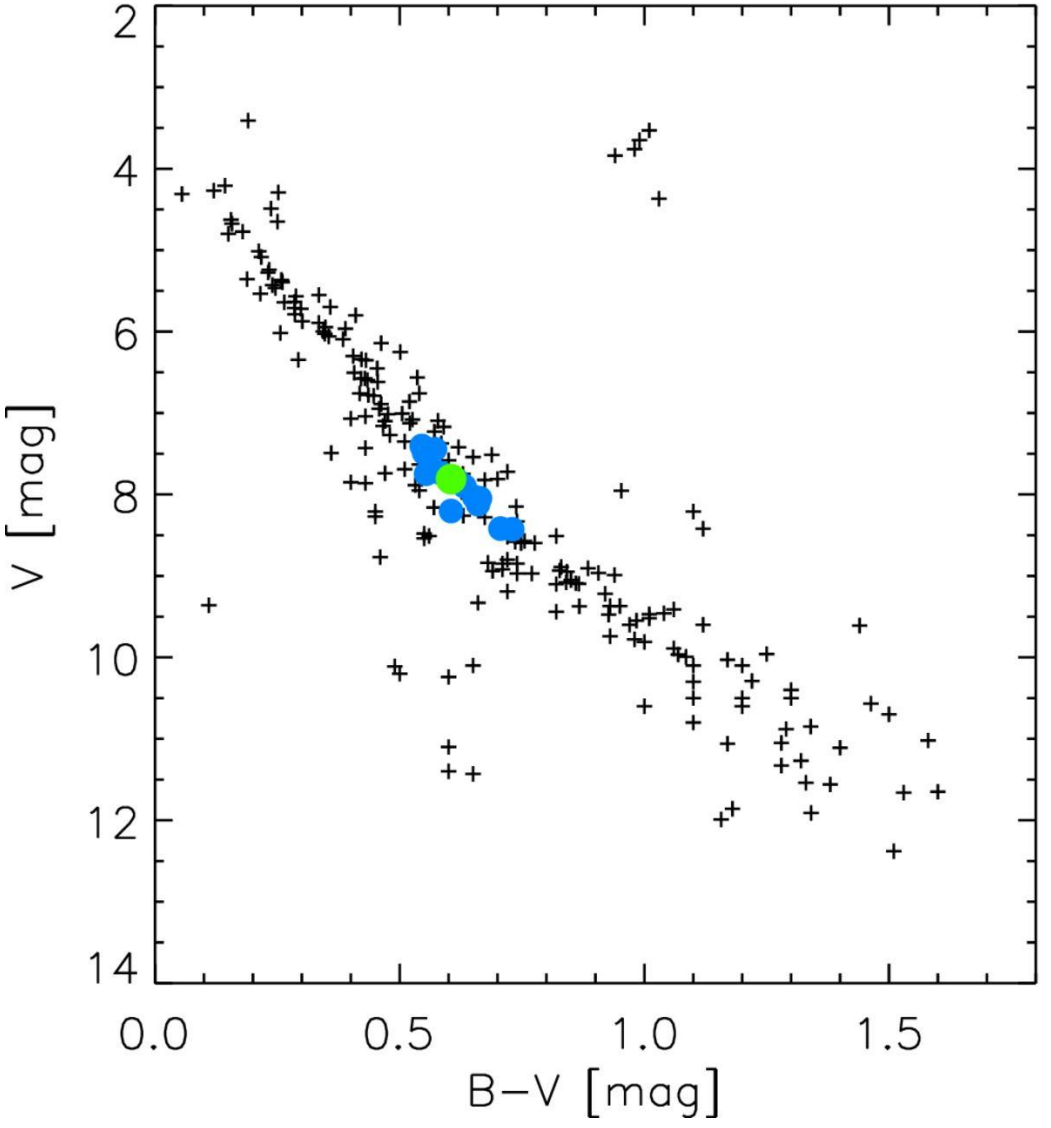
Metallicity: open clusters

Differential analysis of solar analogues in Hyades



Data from Liu et al. (2016)

Metallicity: open clusters



Requirement: retrieving [Fe/H]=+0.17±0.02 for all Hyades members

Liu et al. (2016)

Benchmark categories

Stars with good interferometric and spectrophotometric data

Provide: effective temperature (σTeff < 1%)

Pros: stars sampling the entire HR diagram

Solar analogues/twins with independent, differential studies in literature

Provide: effective temperature (σTeff < 1%) + metallicity and chemical abundances (σ << 0.1 dex). E.g., KIC 3241581 (Beck+16).

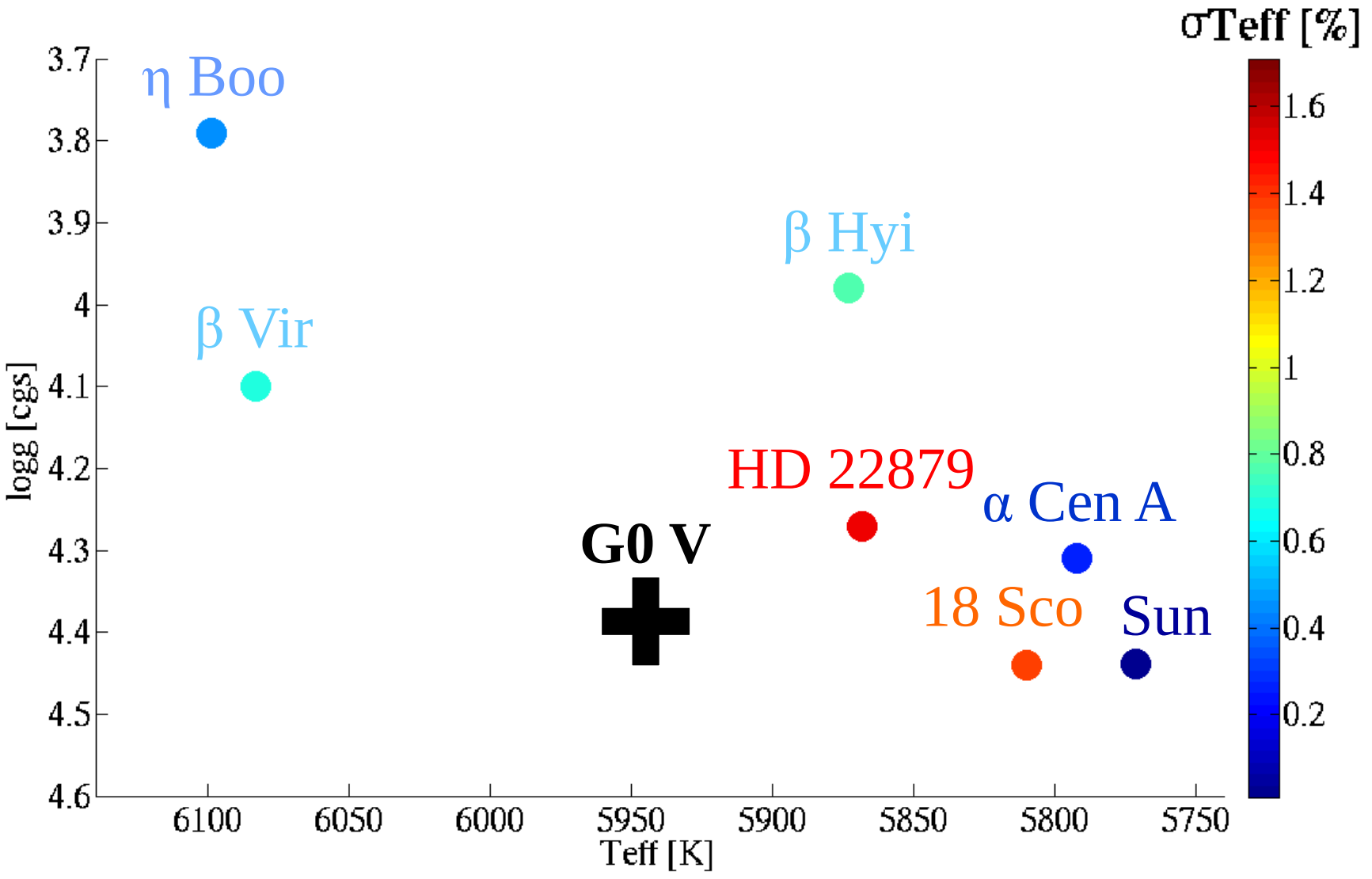
Cons: only restricted parameter space. But if stars are cluster members, can be used to establish metallicity scale of the whole cluster

Consistency checks

Irrespective of their physical parameters (Teff, logg, vsini, …), same abundances of elements not affected by evolutionary effects expected for:

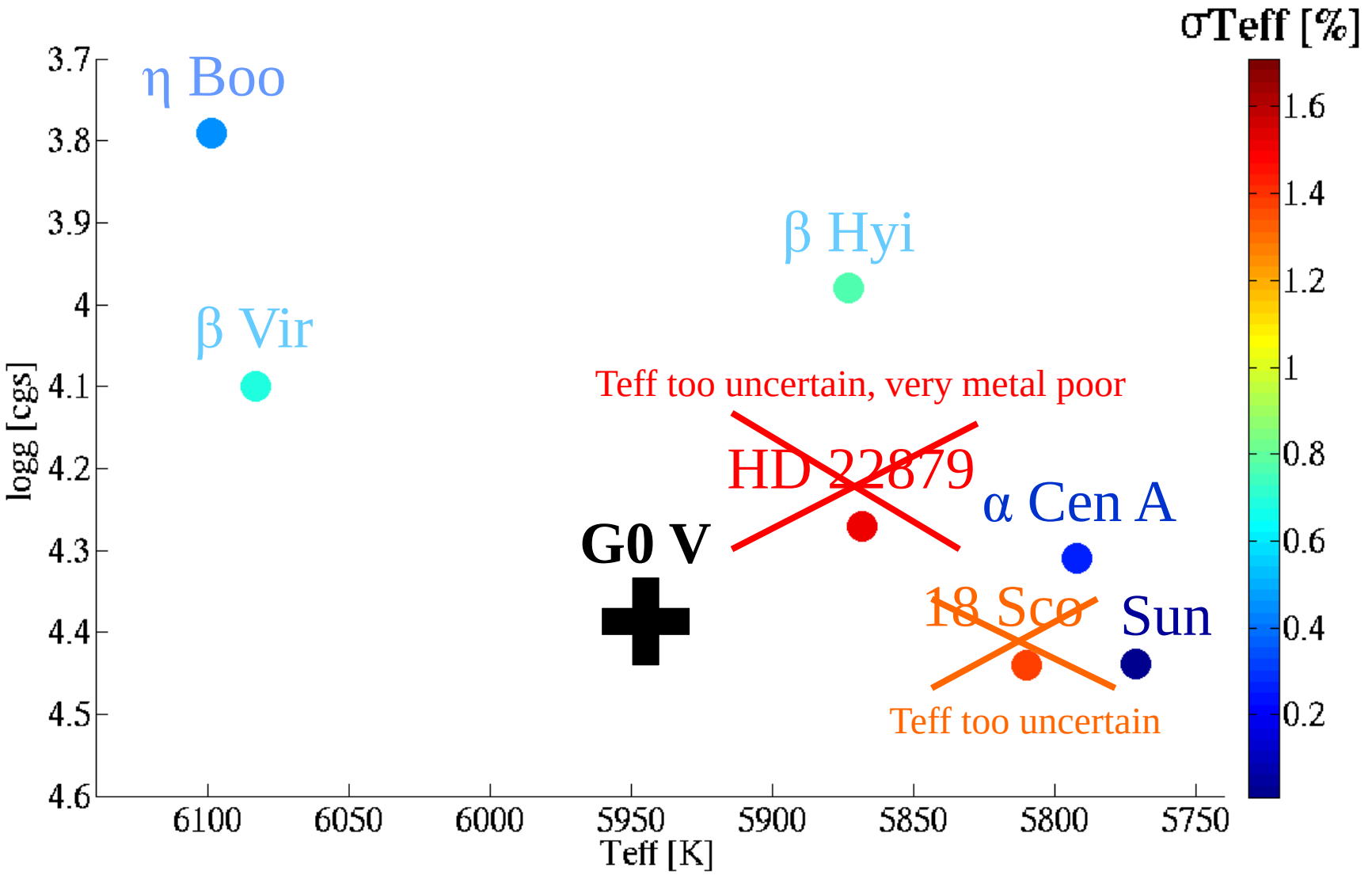
- Open cluster members (e.g., same [Fe/H] within the errors for MS and RG stars).
- Binary components

WP122 H&H campaign



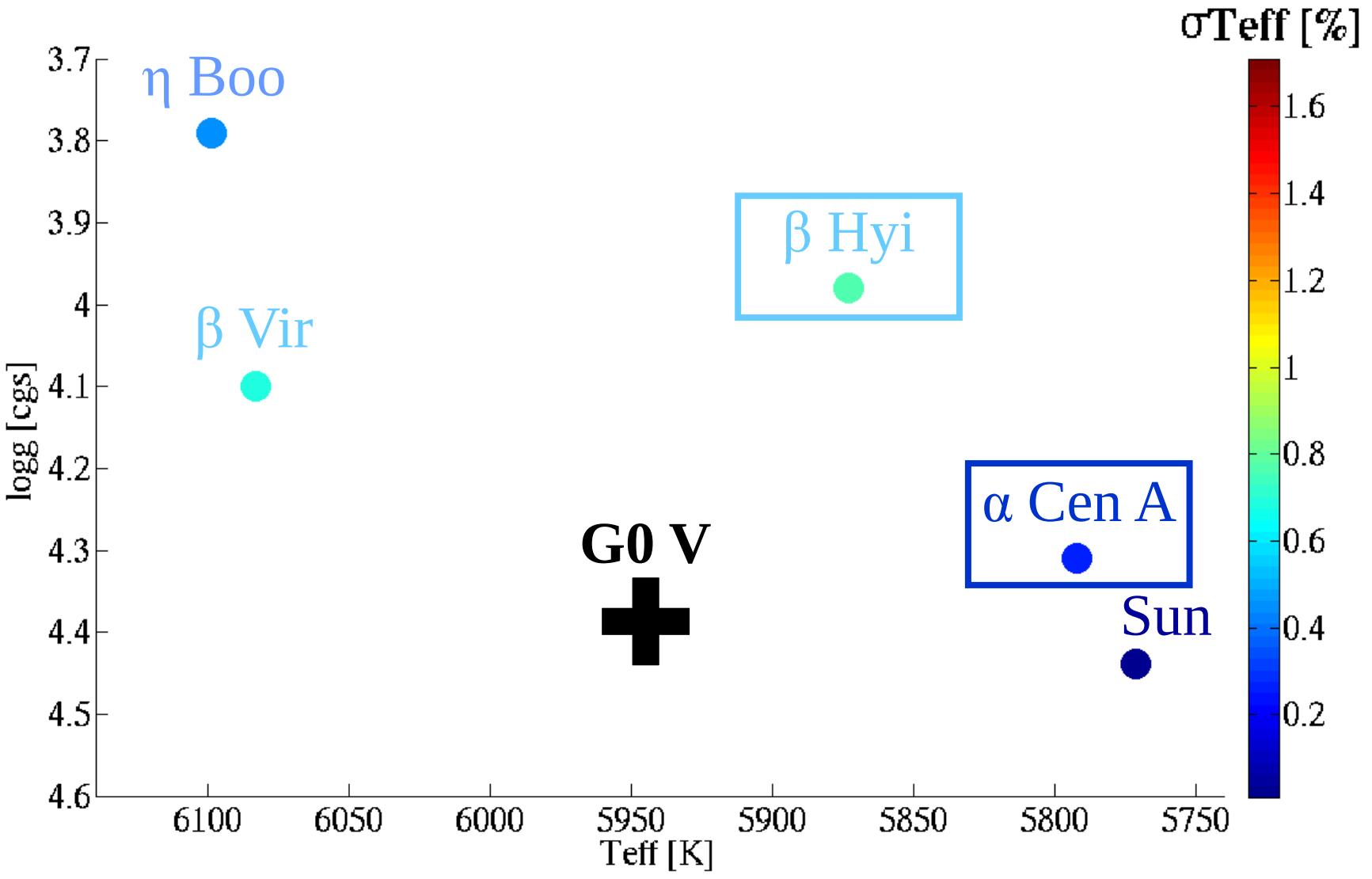
Data from Heiter et al. (2015)

WP122 H&H campaign



Data from Heiter et al. (2015)

WP122 H&H campaign



Data from Heiter et al. (2015)

WP122 H&H campaign

STARS STUDIED

One subgiant (β Hyi) and one dwarf with parameters similar to those of the Sun (α Cen A). Both have accurate interferometric and seismic parameters.

SOURCE OF DATA

A set of non-normalised HARPS spectra degraded in terms of spectral resolution. Taken from Blanco Cuaresma's database of *Gaia* benchmarks: **http://www.blancocuaresma.com/s/benchmarkstars/**

THE H&H CAMPAIGN

Step I: For both stars, analysis of spectra with a resolving power R = 3000, 20000, 65000. In each case, two wavelength intervals are considered (4800-6800 and 6000-6500 Å). Twelve spectra to be analysed in total.
Outputs: Teff, logg, [Fe/H]
Objective: evaluate the effect of spectral resolution and wavelength coverage. Necessary because we do not know what kind of data we will have at our disposal for each PLATO target.

Step II: As above, but adopting the seismic logg as input of the spectroscopic analysis.
Outputs: Teff and [Fe/H]
Objective: evaluate to what extent incorporating the seismic logg of the PLATO target would affect the results.

Step III: Differential, line-by-line analysis of α Cen A with respect to the Sun.
Outputs: Teff, logg, [Fe/H]
Objective: evaluate to what extent a differential analysis improves the results for solar analogues/twins.