First results from the Pristine CaHK survey with CFHT/MegaCam

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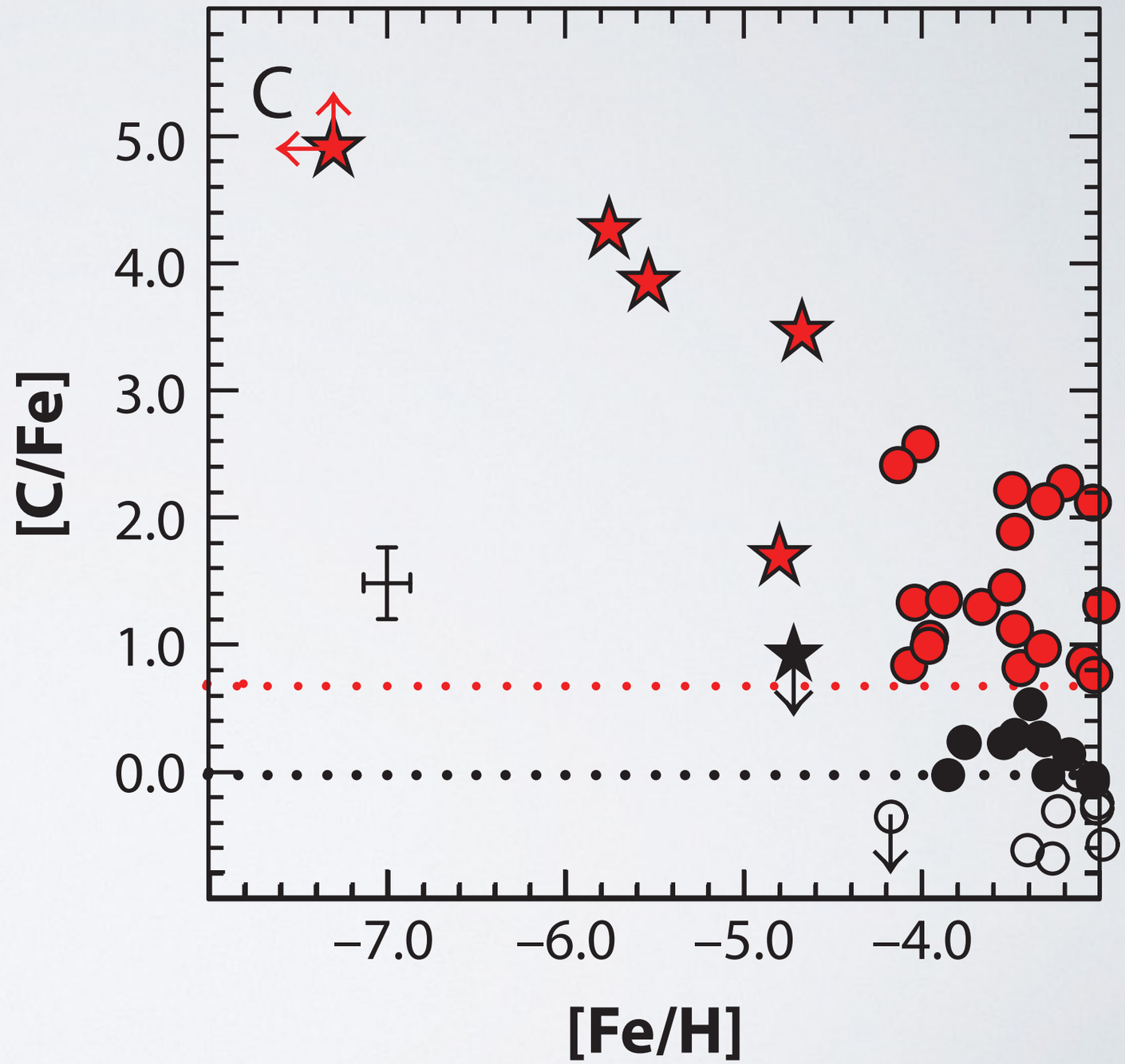
Pristine goals

- ***Oldest/most metal-poor stars*** inform us on
  - early star formation
  - first supernovae
  - early build-up of galaxies

Observations — the most iron-poor

- **[Fe/H] < –4.5**
  - Christlieb et al. (2002)
  - Frebel et al. (2005)
  - Norris et al. (2007)
  - Caffau et al. (2011)
    - Re-defined the metallicity floor via fine-structure
  - Hansen et al. (2014)
  - Keller et al. (2014)
  - Bonifacio et al. (2015)
- Every new star has its own story!



Frebel & Norris (2015)

Need more statistics to…

- Understand and recognize ***chemical subgroups***
  - Model the chemical enrichment in the early universe

- Determine the ***shape of the metal-poor tail***
  - What is the value of the metallicity floor?
  - Is there a true First Star still out there?

- What fraction of the ***most metal-poor are Carbon-rich***?
  - Does this change with environments?

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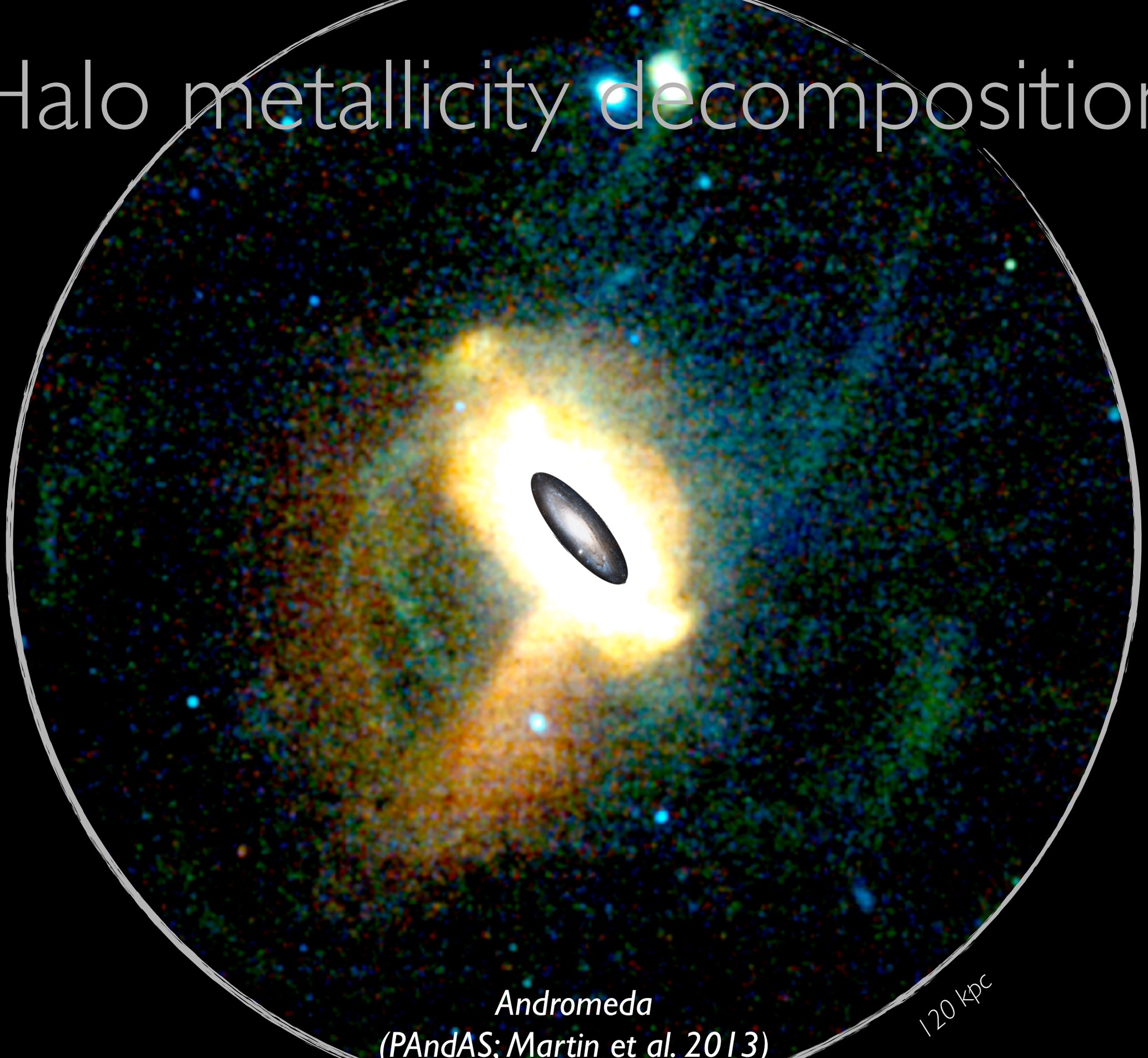
- ***Metallicity decomposition of MW***
  - weeding out foreground contamination
  - structure as f([Fe/H]) → type/history of hierarchical accretion
  - very faint dwarf galaxies
  - added dimension to deconstruct MW, even in Gaia era

Halo metallicity decomposition



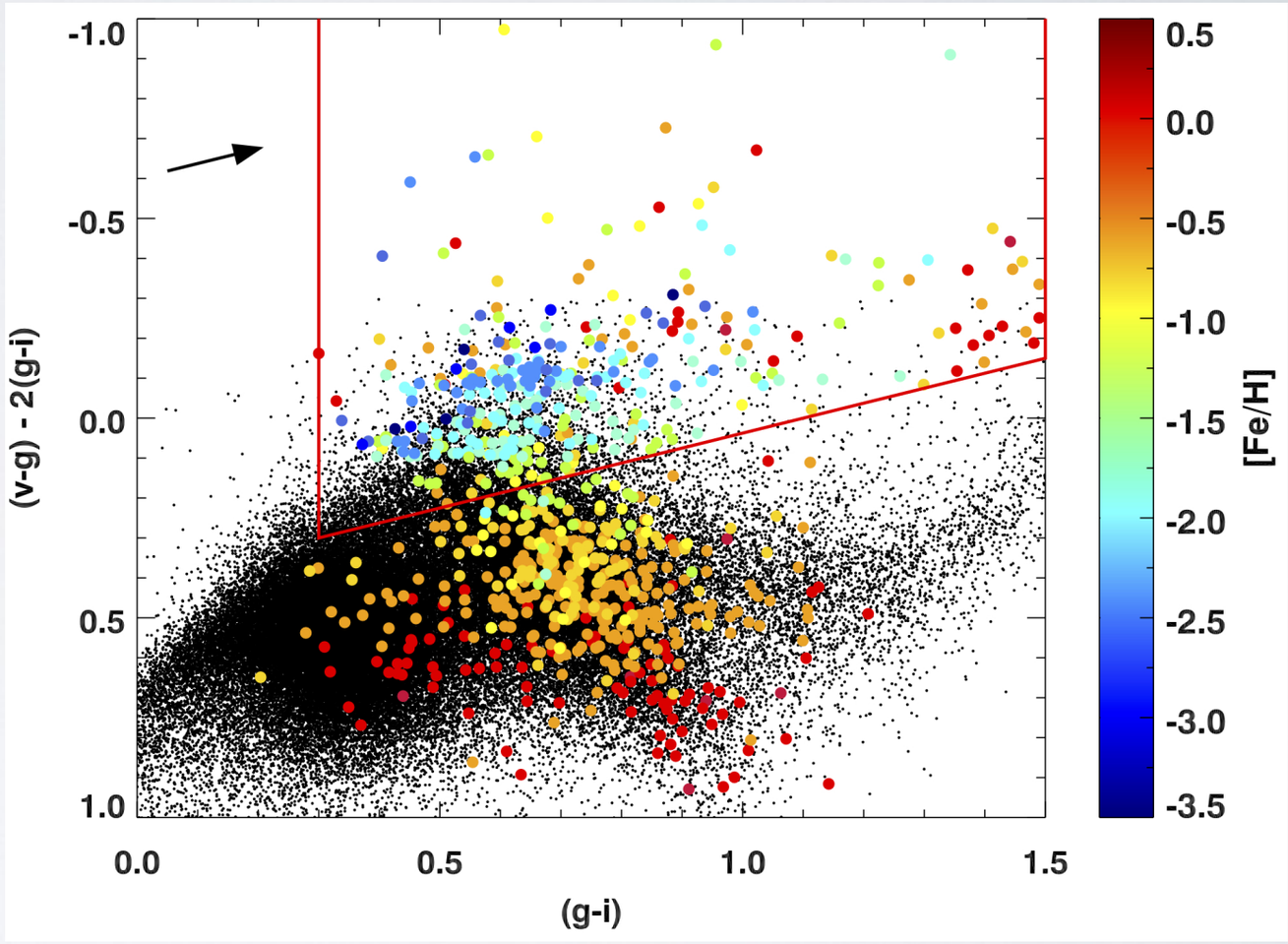
Andromeda
(PAndAS; Martin et al. 2013)

Pristine goals

- ***Oldest/most metal-poor stars*** inform us on
  - star formation
  - supernovae
  - early build-up of galaxies
- ***Metallicity decomposition of MW***
  - weeding out foreground (metal-rich) contamination
  - structure as f([Fe/H]) → type/history of hierarchical accretion
  - very faint dwarf galaxies
  - added dimension to deconstruct MW, even in Gaia era
- ***CaHK photometry → cheap***

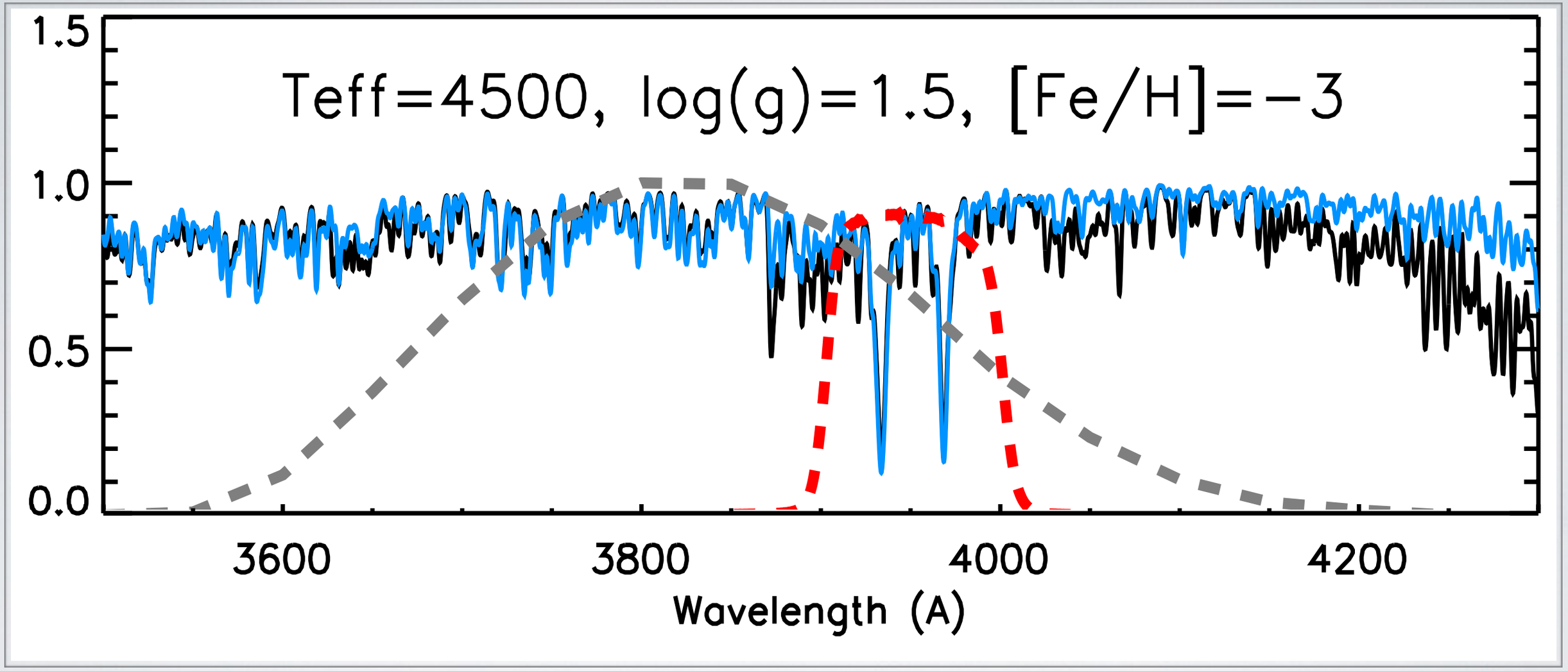
CaHK surveys

- Southern Hemisphere – ***Skymapper***
  - Multi-colour, multi-epoch of all 20,000 deg^2
    - *ugriz* filters + Stromgren-like *v*-filter (Ca H&K)
      - Found [Fe/H] < –7 star!
      - Positioned to reach the bulge
- Northern Hemisphere – ***Pristine***
  - ~1,000 deg^2 (→ 3,000 deg^2)
  - In the Sloan footprint – broad-band colors
    - Object classifications
    - Calibration (SEGUE)



Howes et al. (2016)

The Ca H&K filter



[Fe/H] = –3.0

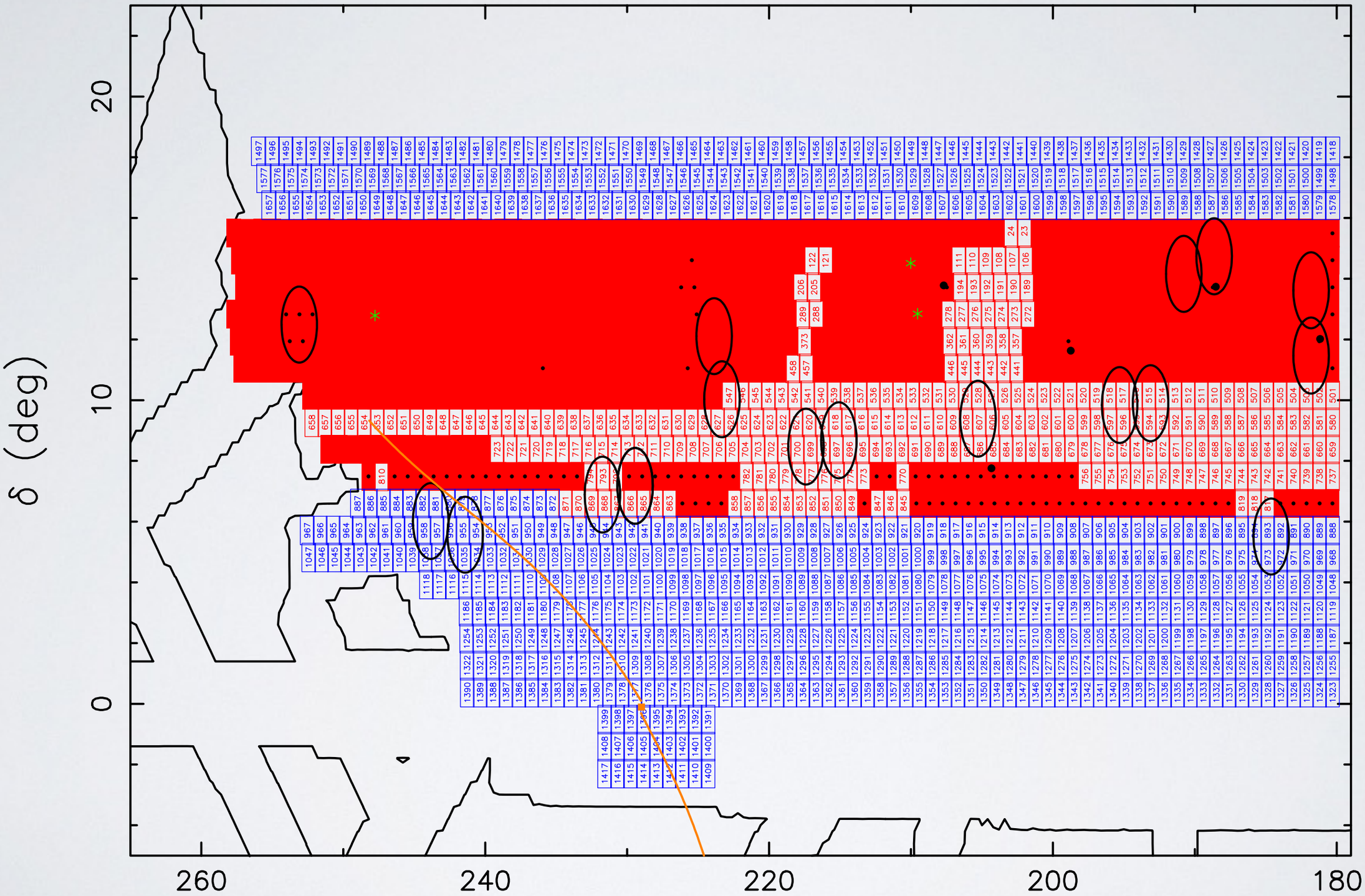
[Fe/H] = –3.0, [C/Fe] = +1

Pristine filter is narrower than Skymapper filter, far less biased by Carbon

Pristine Footprint

Belokurov et al. (2007)

Observations 15A & 16A

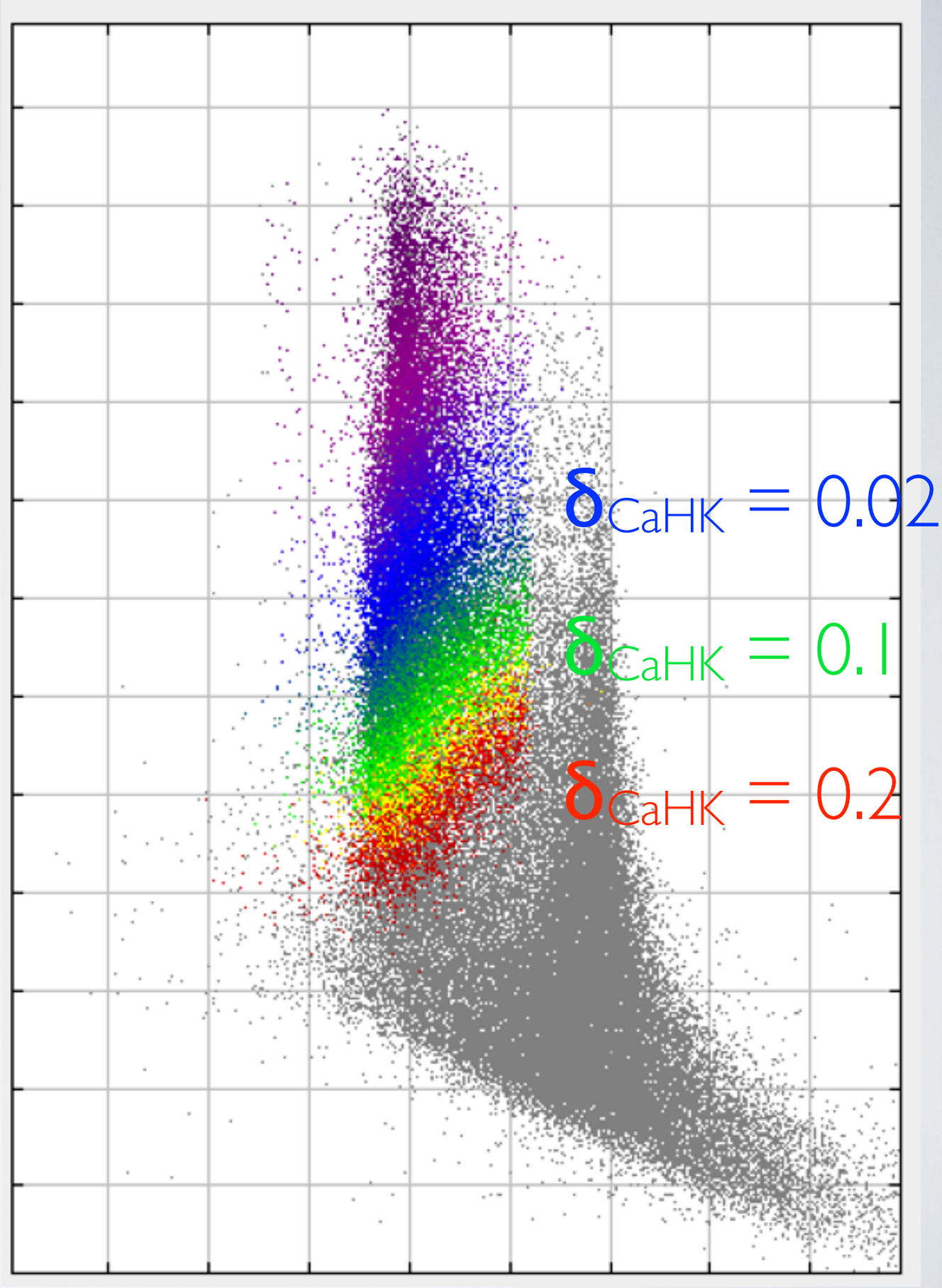


100s per field

Data Quality

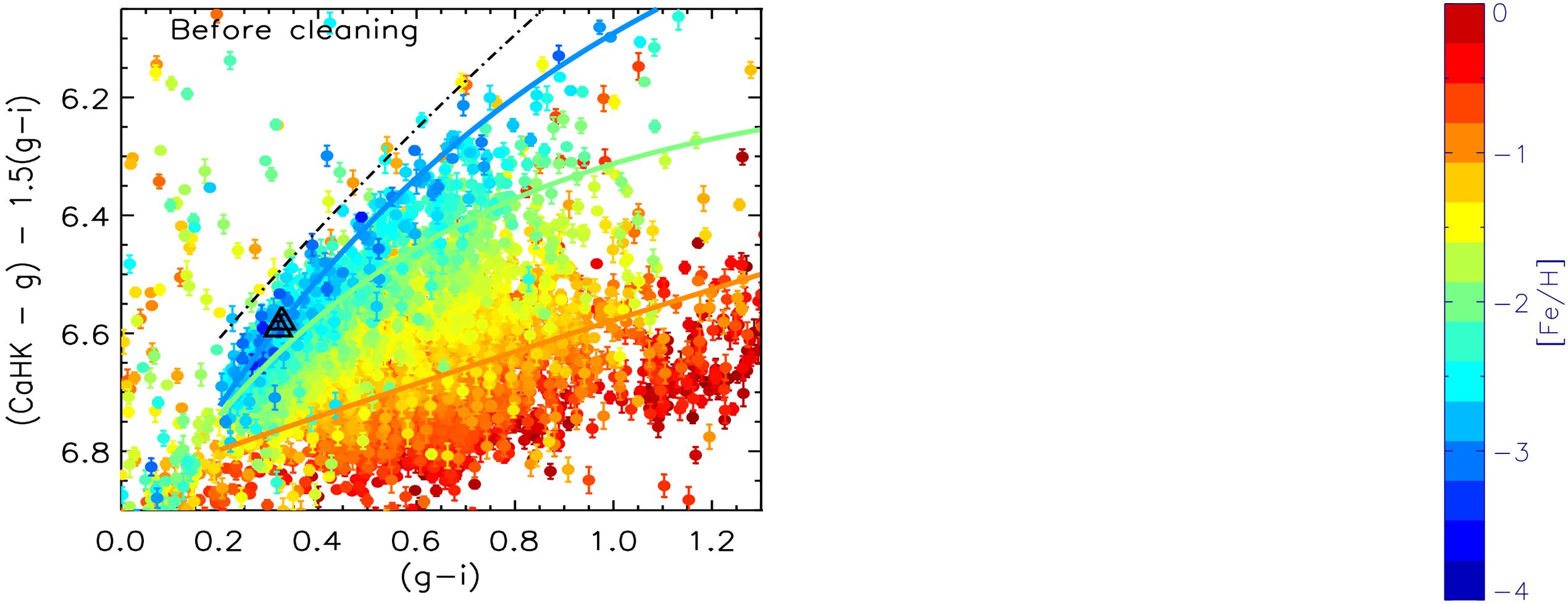
Systematic uncertainties
~0.03 mag in CaHK and
improving

SDSS
+ Pristine



Calibrating Pristine with SEGUE

Starkenburg, Martin et al. (in prep)



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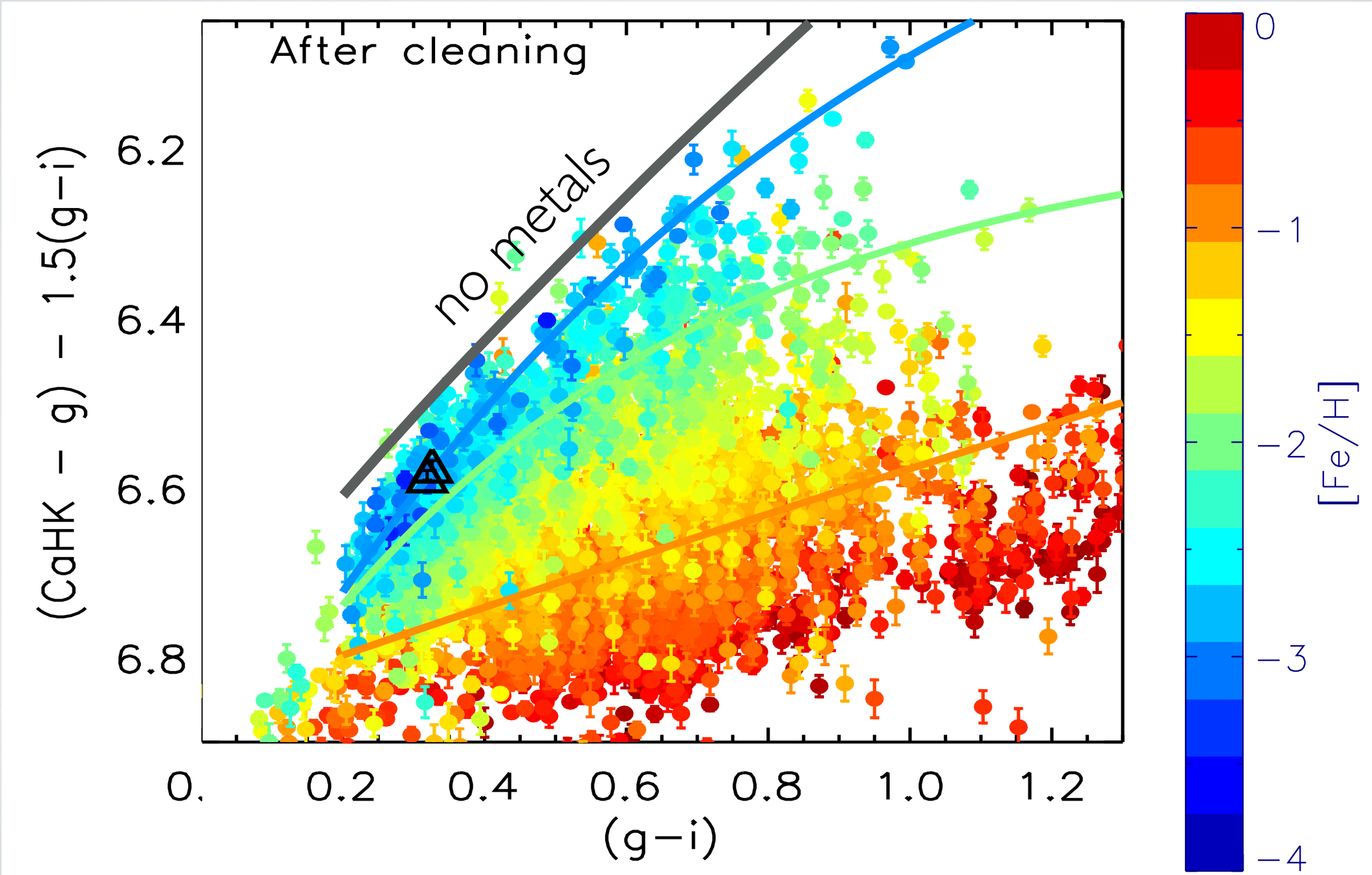
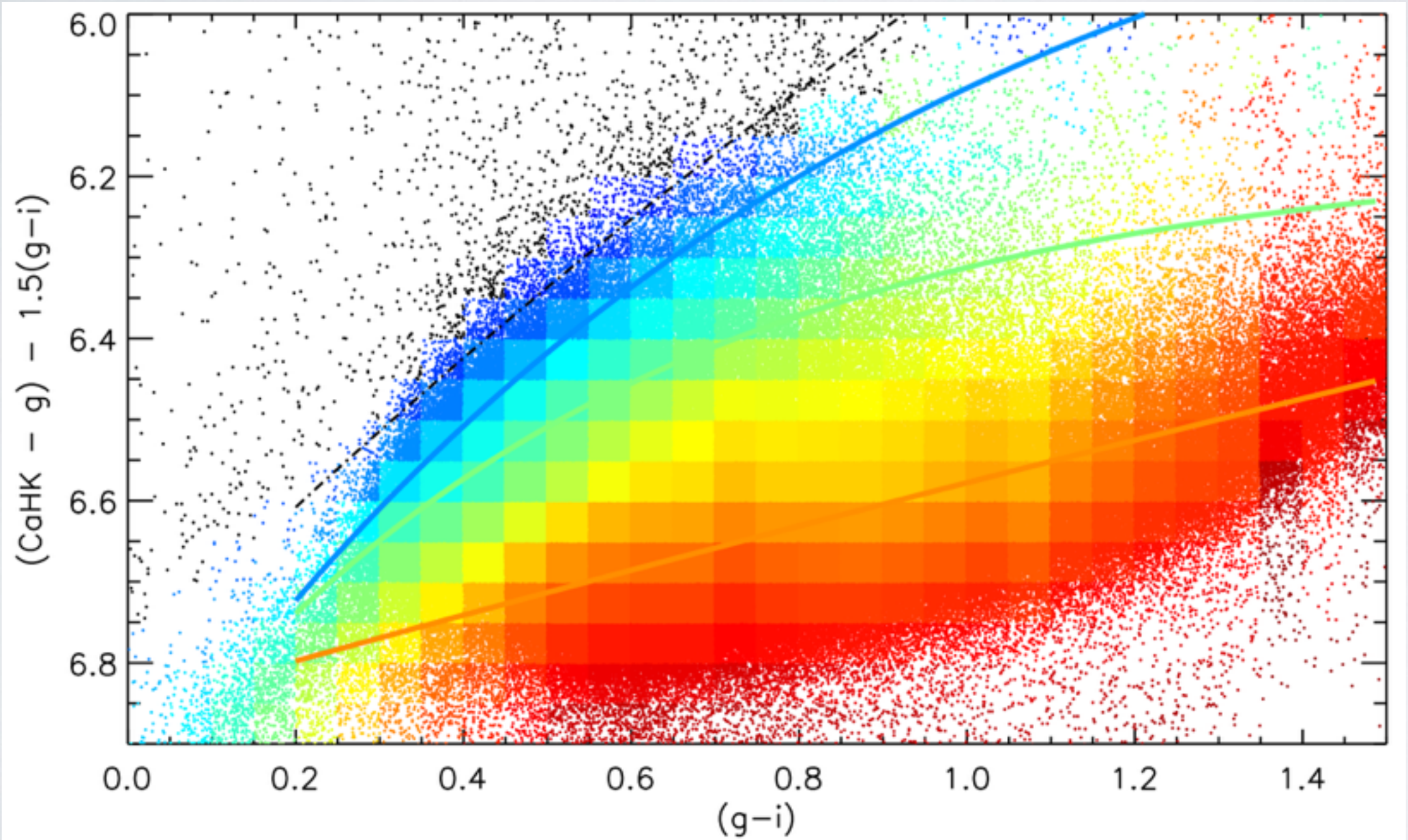


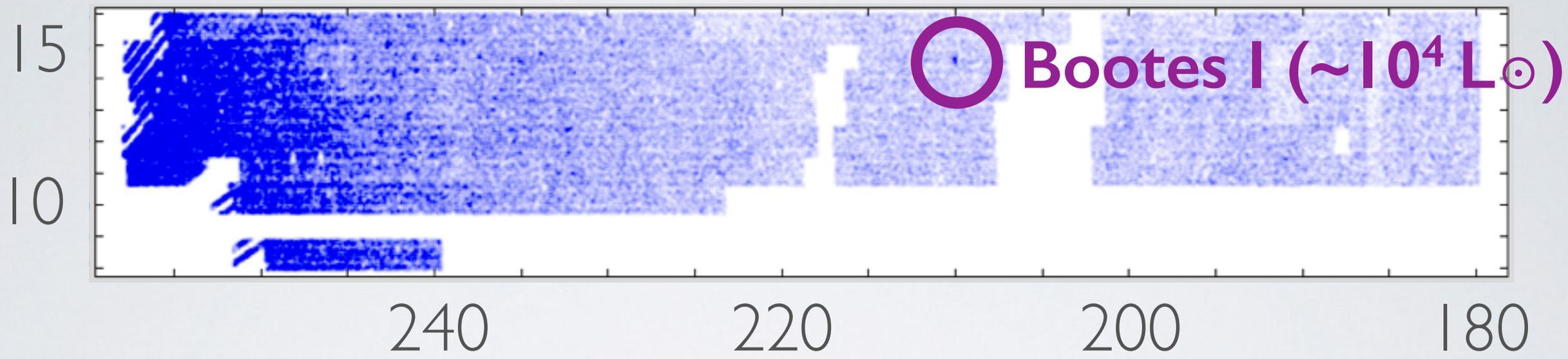
The Pristine [Fe/H] decomposition

Starkenburg, Martin *et al.* (in prep)

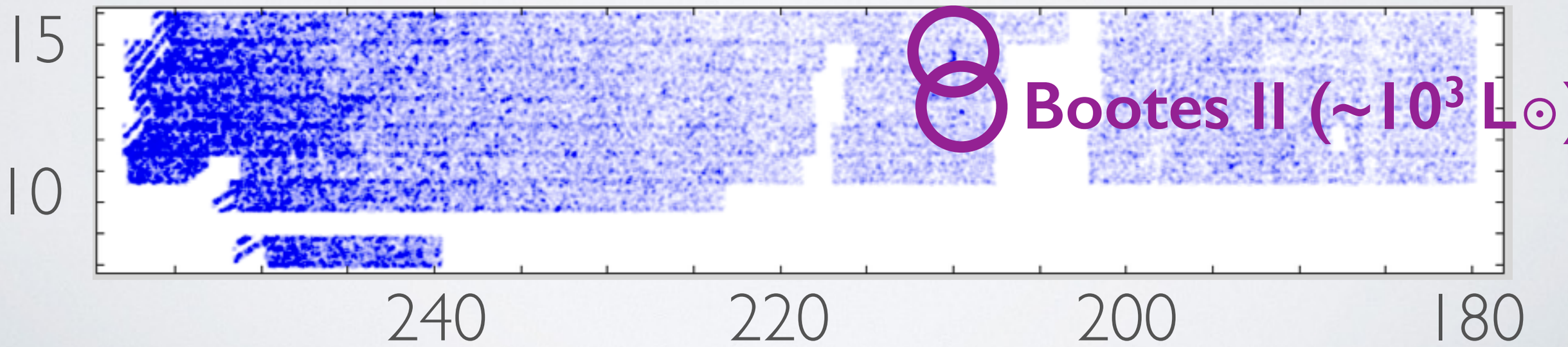


The metal-poor Milky Way

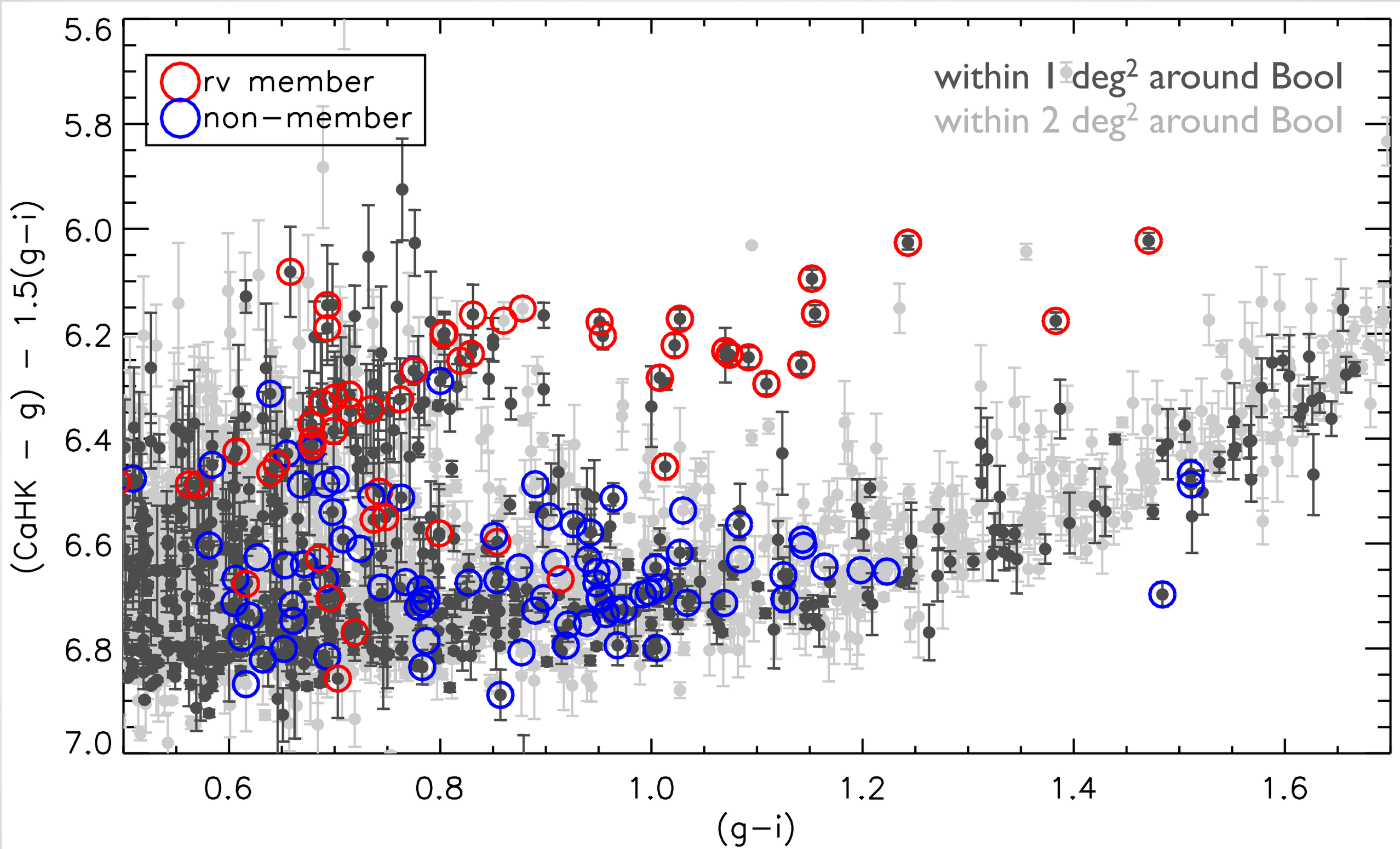
–2.5<[Fe/H]<–1.5



[Fe/H]<–2.5

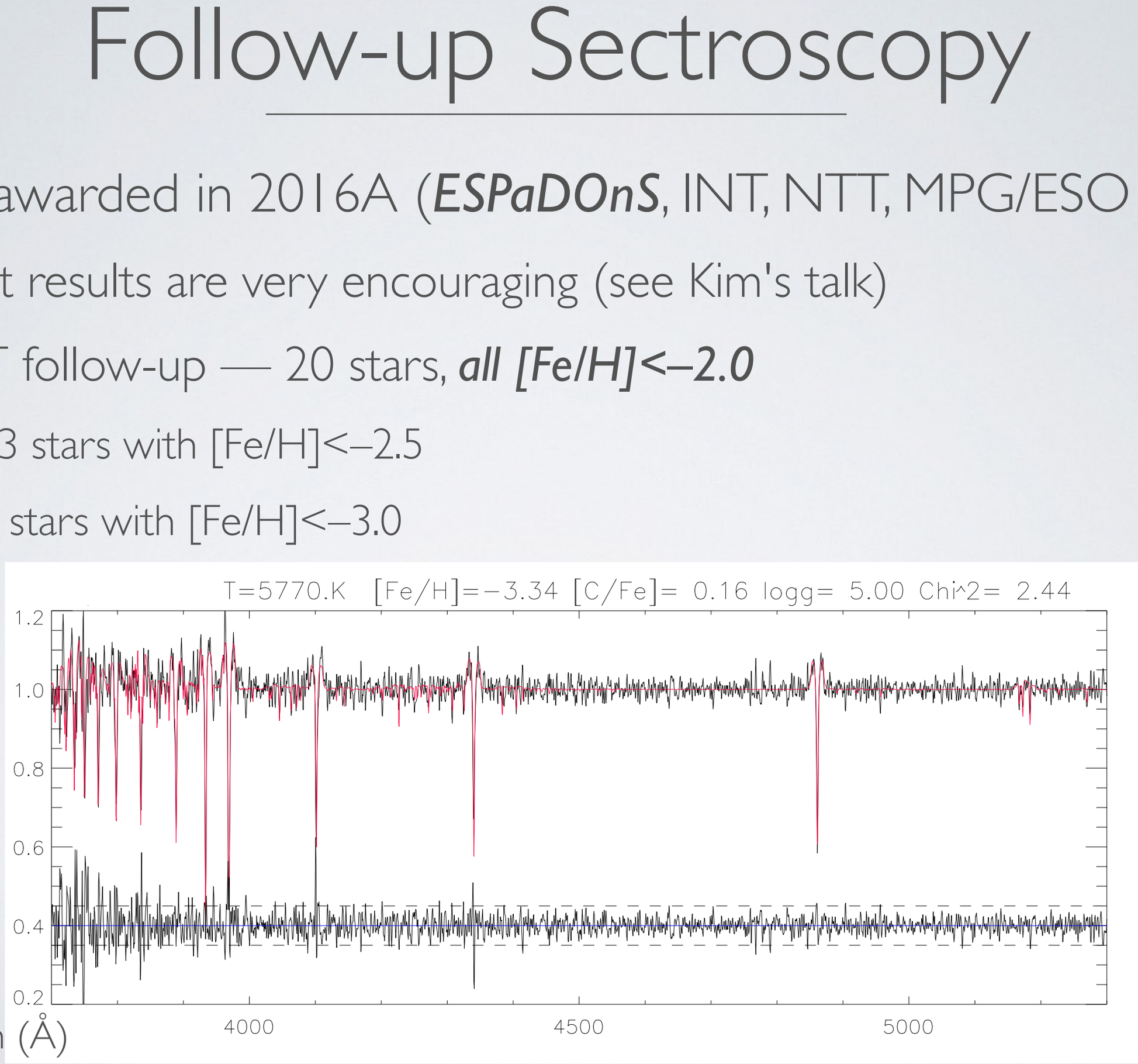


Bootes I seen by Pristine



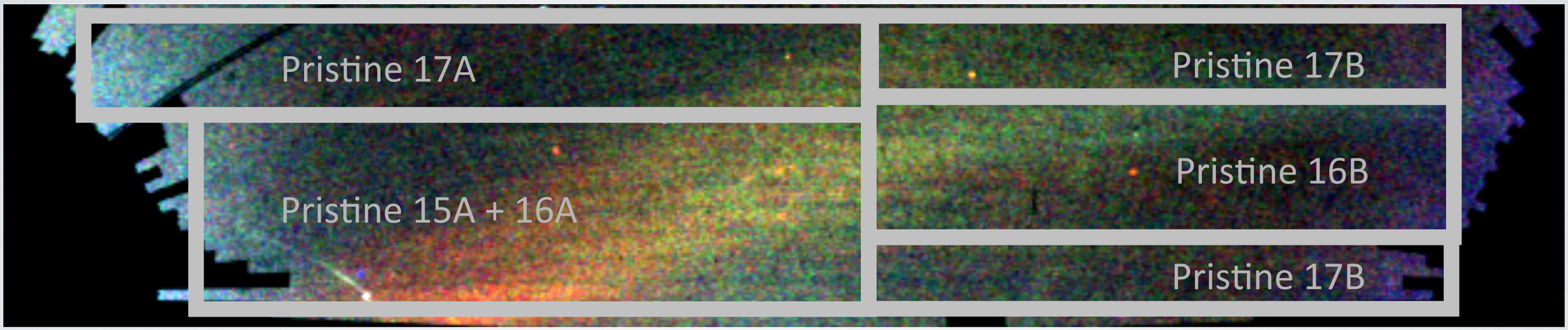
Follow-up Sectroscopy

- 40n awarded in 2016A (***ESPaDOnS***, INT, NTT, MPG/ESO 2p2)
  - First results are very encouraging (see Kim's talk)
  - INT follow-up — 20 stars, ***all [Fe/H]<–2.0***
    - 13 stars with [Fe/H]<–2.5
    - 3 stars with [Fe/H]<–3.0



The Pristine survey

- The Future:



- A dedicated survey on the MW (northern) faint dwarf galaxies
- A systematic spectroscopic follow-up
  - Most intersting targets → 8m telescope high resolution
  - Eventually WEAVE + 4MOST

Pristine