Searching with SkyMapper for Metal-Poor Stars in the Bulge: The EMBLA Survey

Louise Howes (ANU)

SkyMapper: Everything you need to know to use the Terabytes
RSAA, April 7-9th 2014

SkyMapper: a long road...

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Really?

Is that a good idea?

Hahahaha

Sure, of course you are

Oh...

Have you heard about the other SkyMapper students?

Good luck!

Let's see in a couple of years!

The EMBLA Survey

* The first dedicated search for metal-poor stars in the Galactic bulge, part of the collaboration between SkyMapper and Gaia-ESO.

Australian National University

* Louise Howes
* Martin Asplund
* Stefan Keller
* David Yong
* Mike Bessell
* Anna Marino
* David Nataf

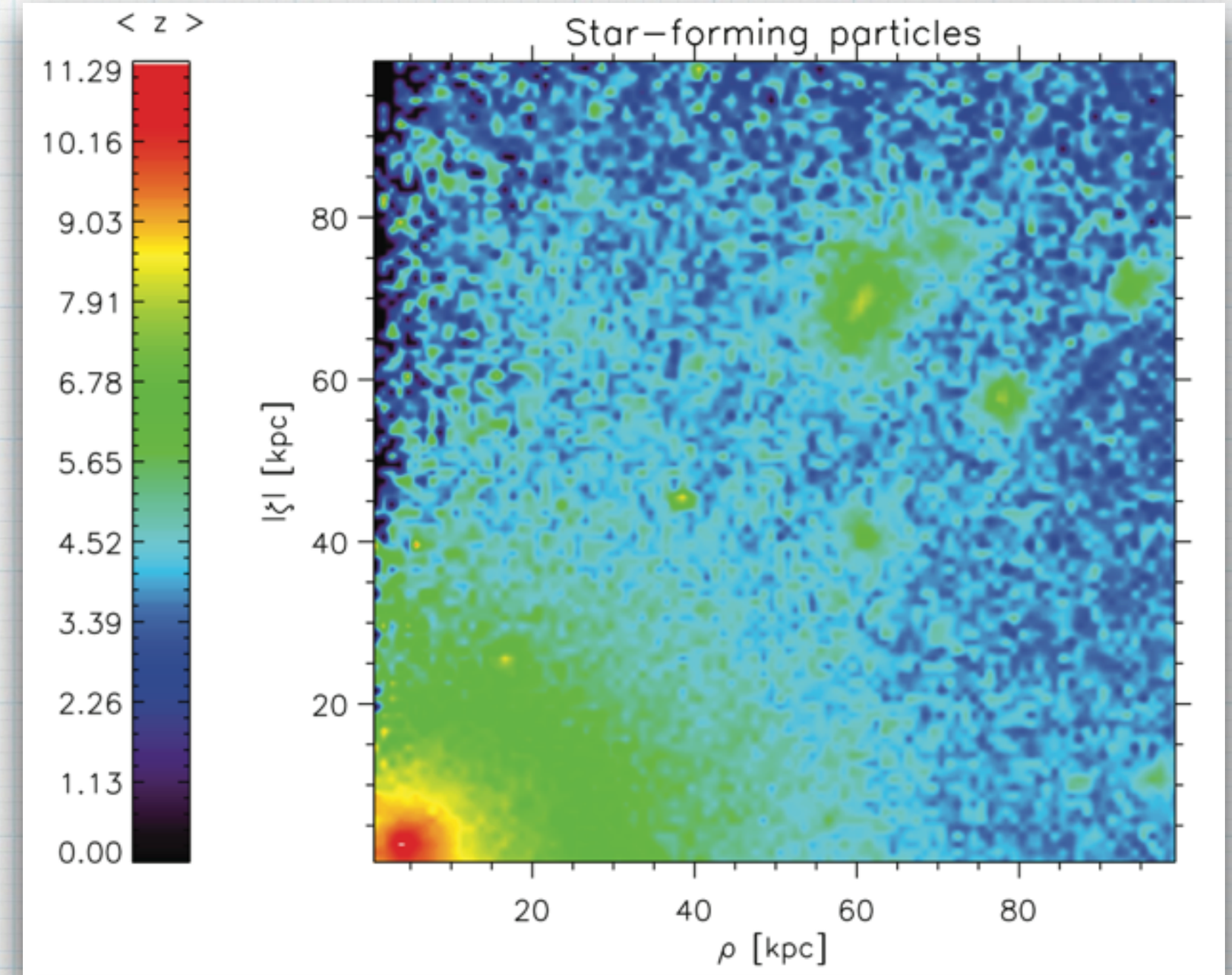
UNIVERSITY OF CAMBRIDGE

* Andy Casey
* Karin Lind
* Clare Worley
* Gerry Gilmore

First Stars in the Bulge

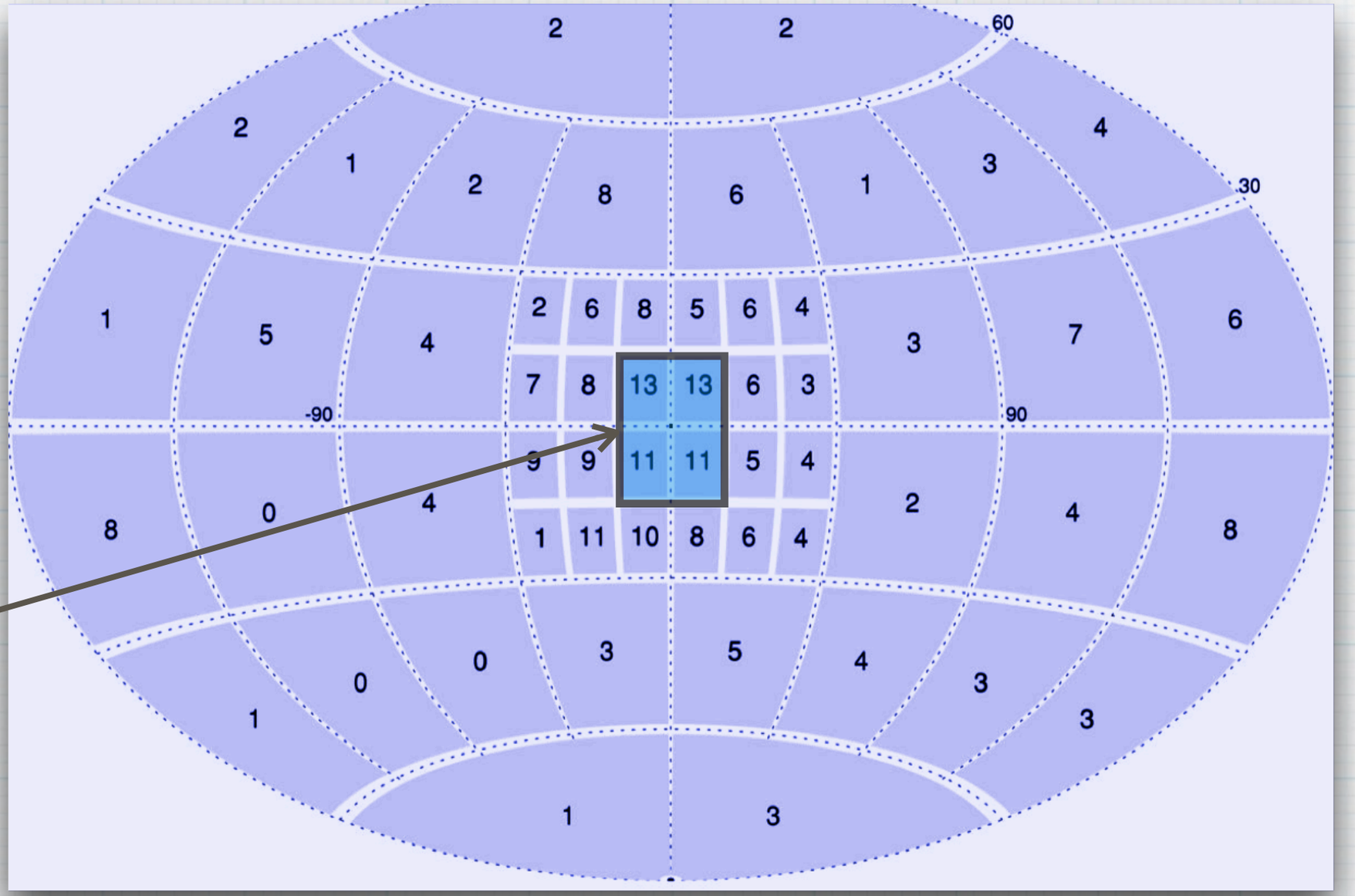
* Diemand et al. (2005):

"If the first stars form at early epochs... then half of their remnants should be found in the bulge."



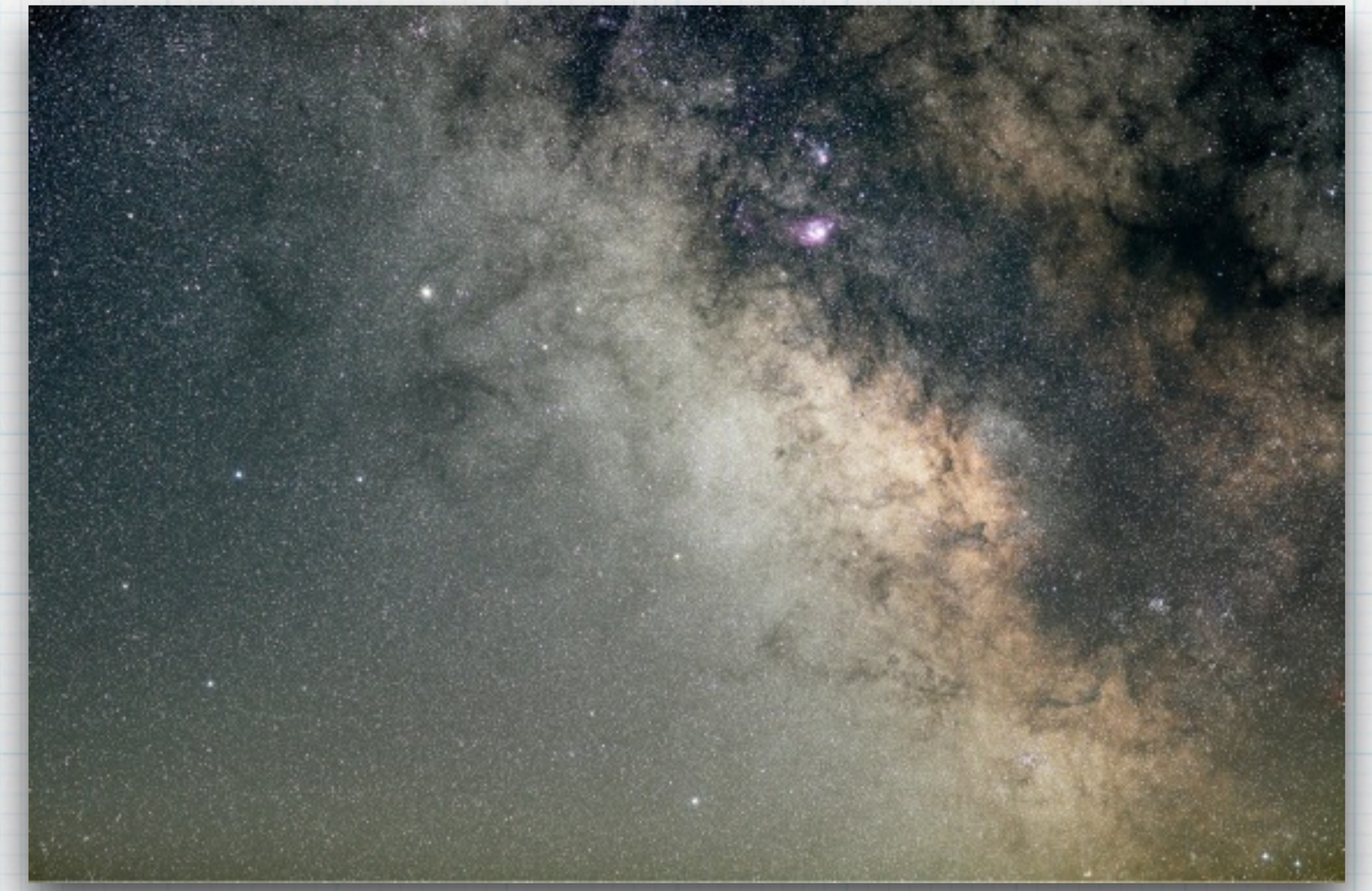
Salvadori et al. (2010)

First Stars in the Bulge



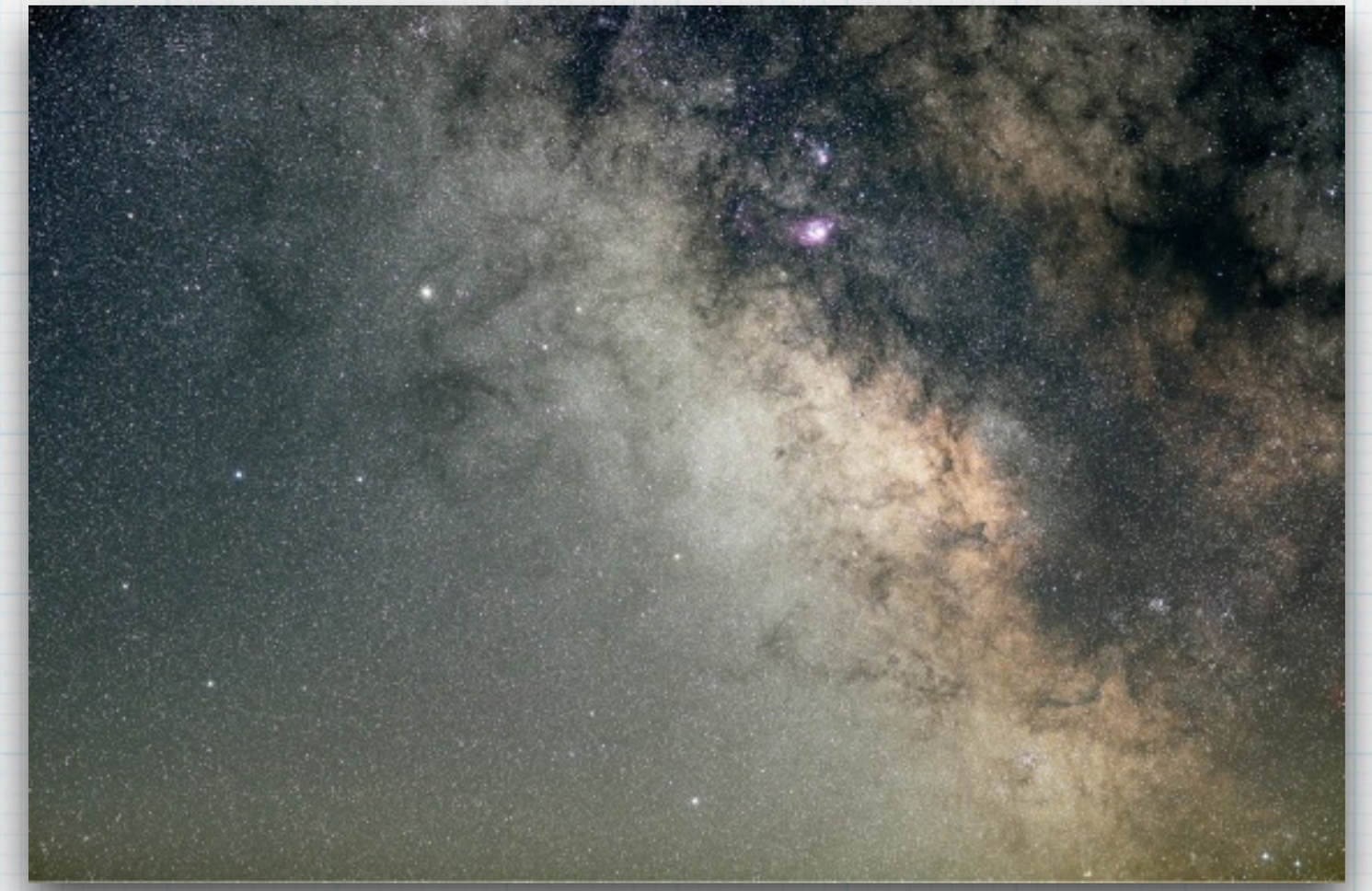
* Tumlinson (2010): Fraction of low-metallicity (EMP) stars from high redshift as a function of position on the sky. In each bin, the percentage of stars with [Fe/H] < −3 that formed prior to z = 15.

Looking in the Bulge



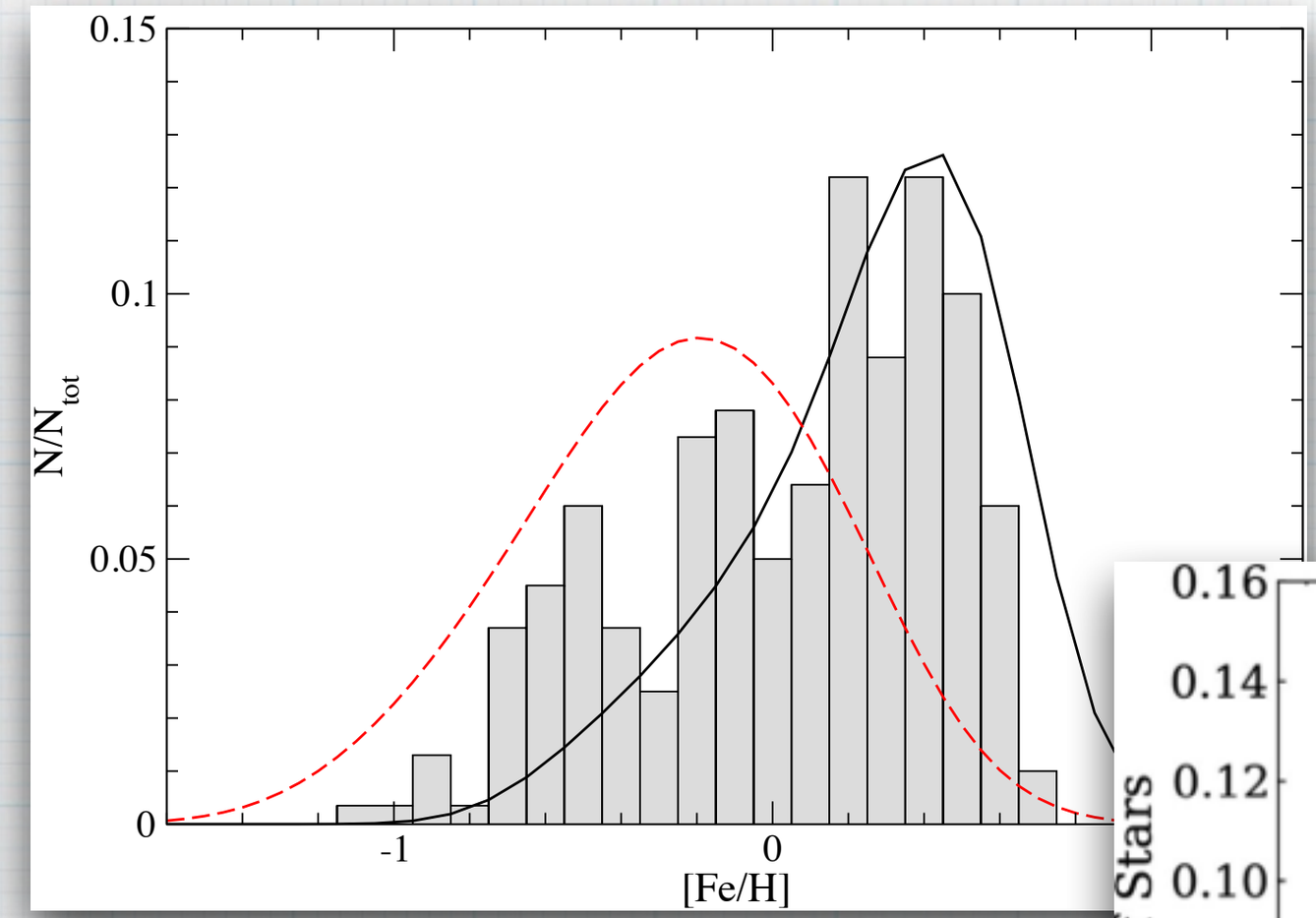
- Previous searches in halo: the HK survey, the Hamburg-ESO survey, SDSS-SEGUE.
- Found more than ~300 stars with [Fe/H] < -3.

Looking in the Bulge



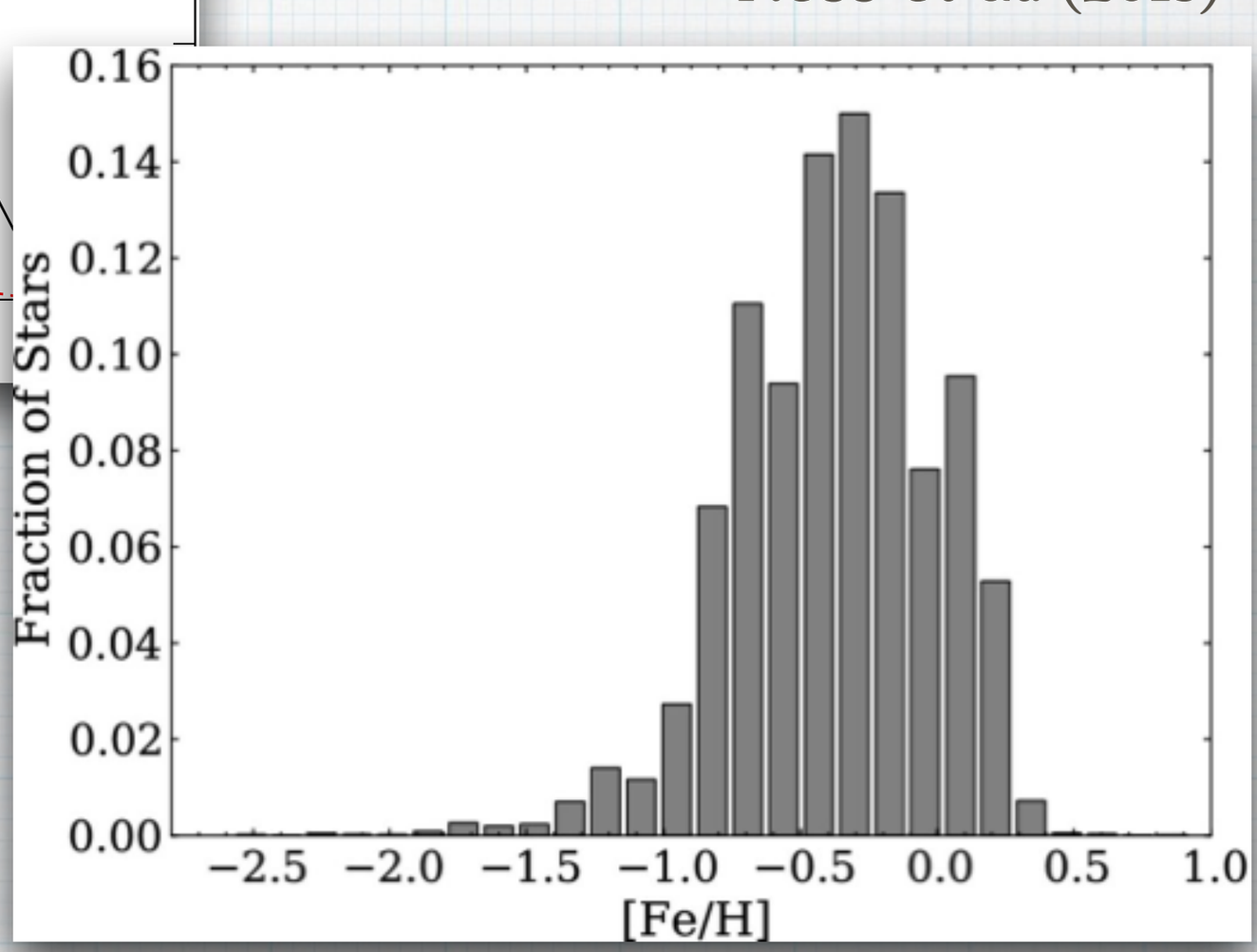
- Practically very difficult to look in the bulge for these - issues of dust extinction and overcrowding.
- Must search through 10,000 bulge stars to find 10 with [Fe/H]<-2 (numbers from Ness et al. (2013)).

The Bulge MDF

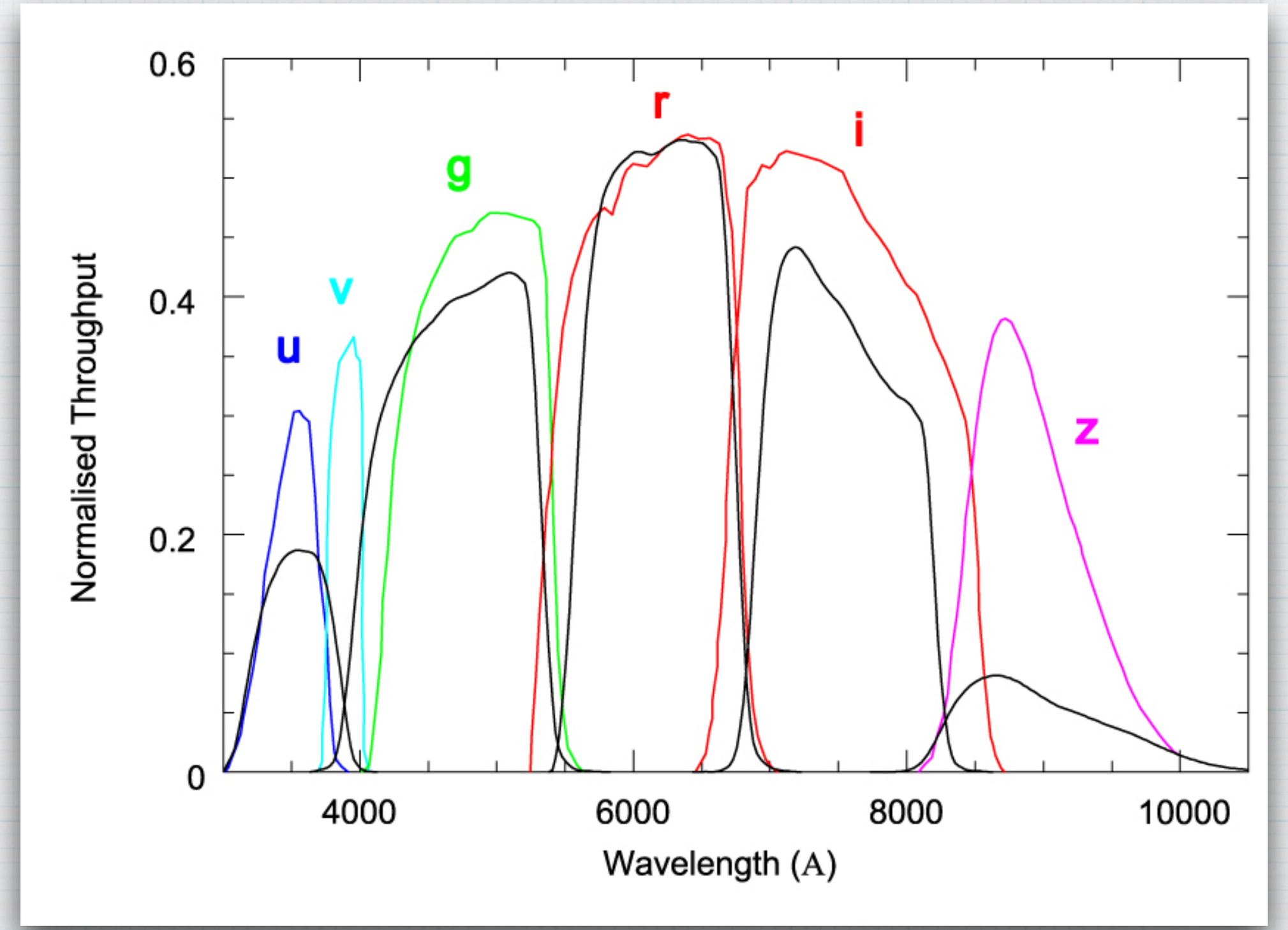


Grieco et al. (2012)

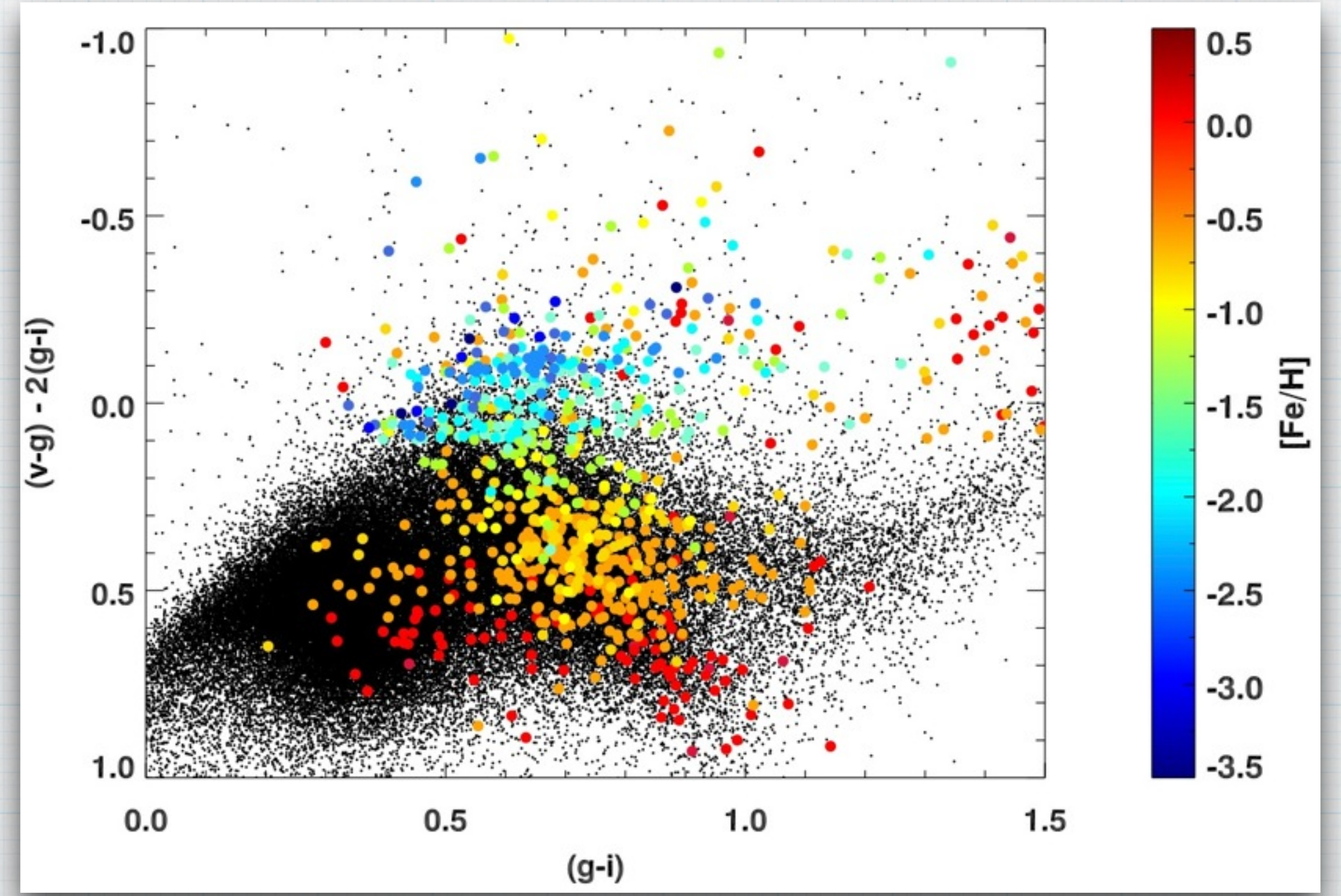
Ness et al. (2013)



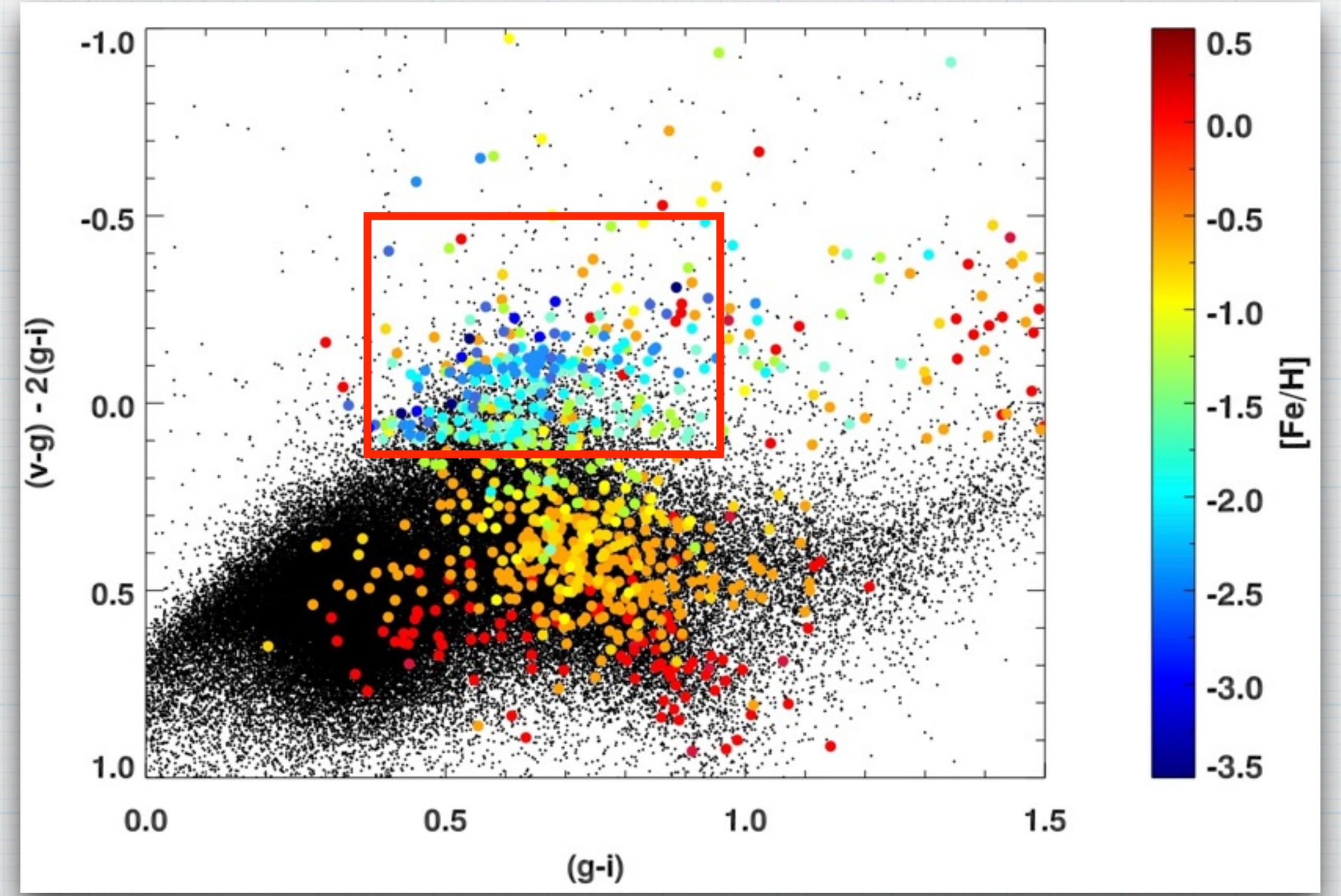
The advantage of SkyMapper



The Selection Process



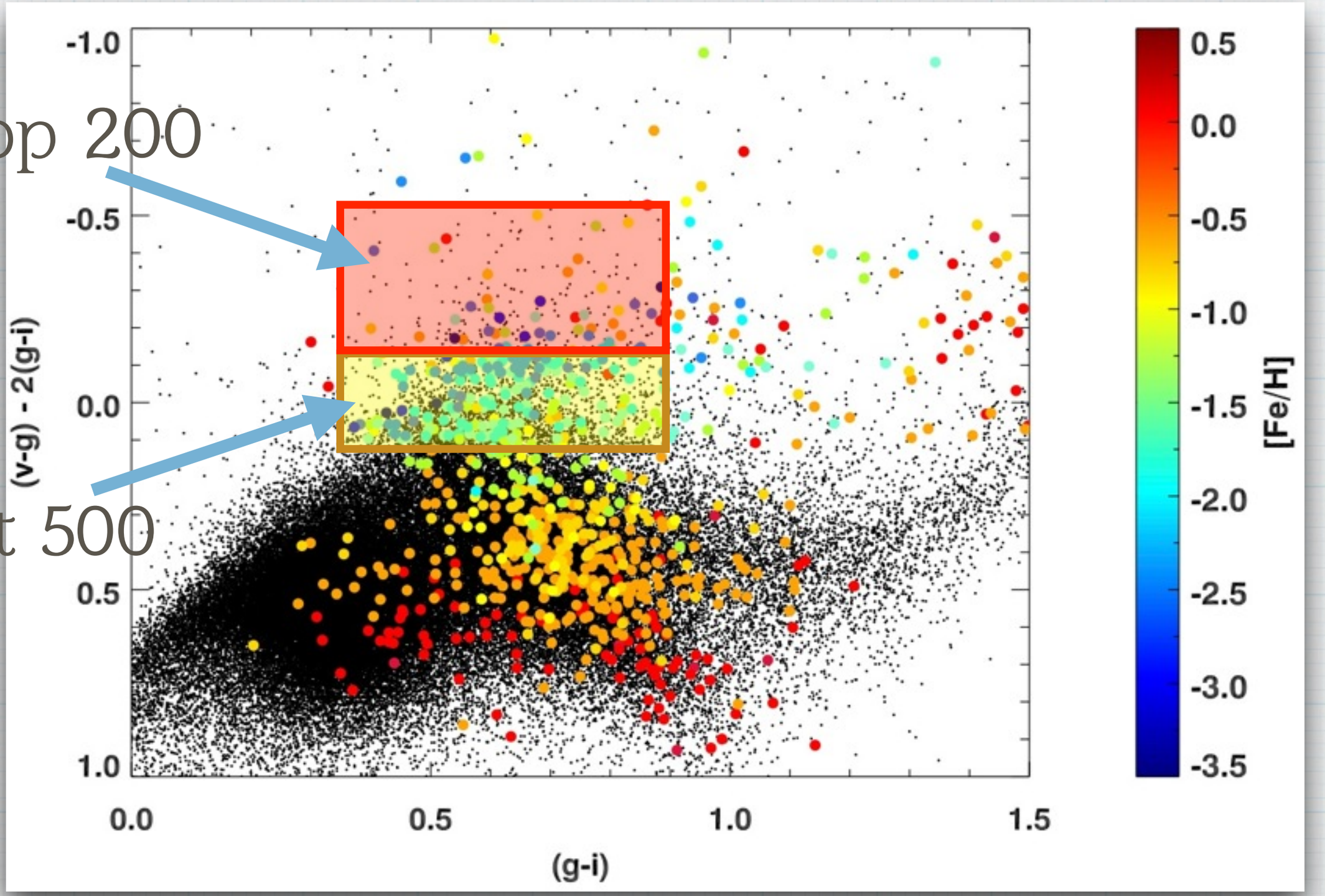
The Selection Process



The Selection Process

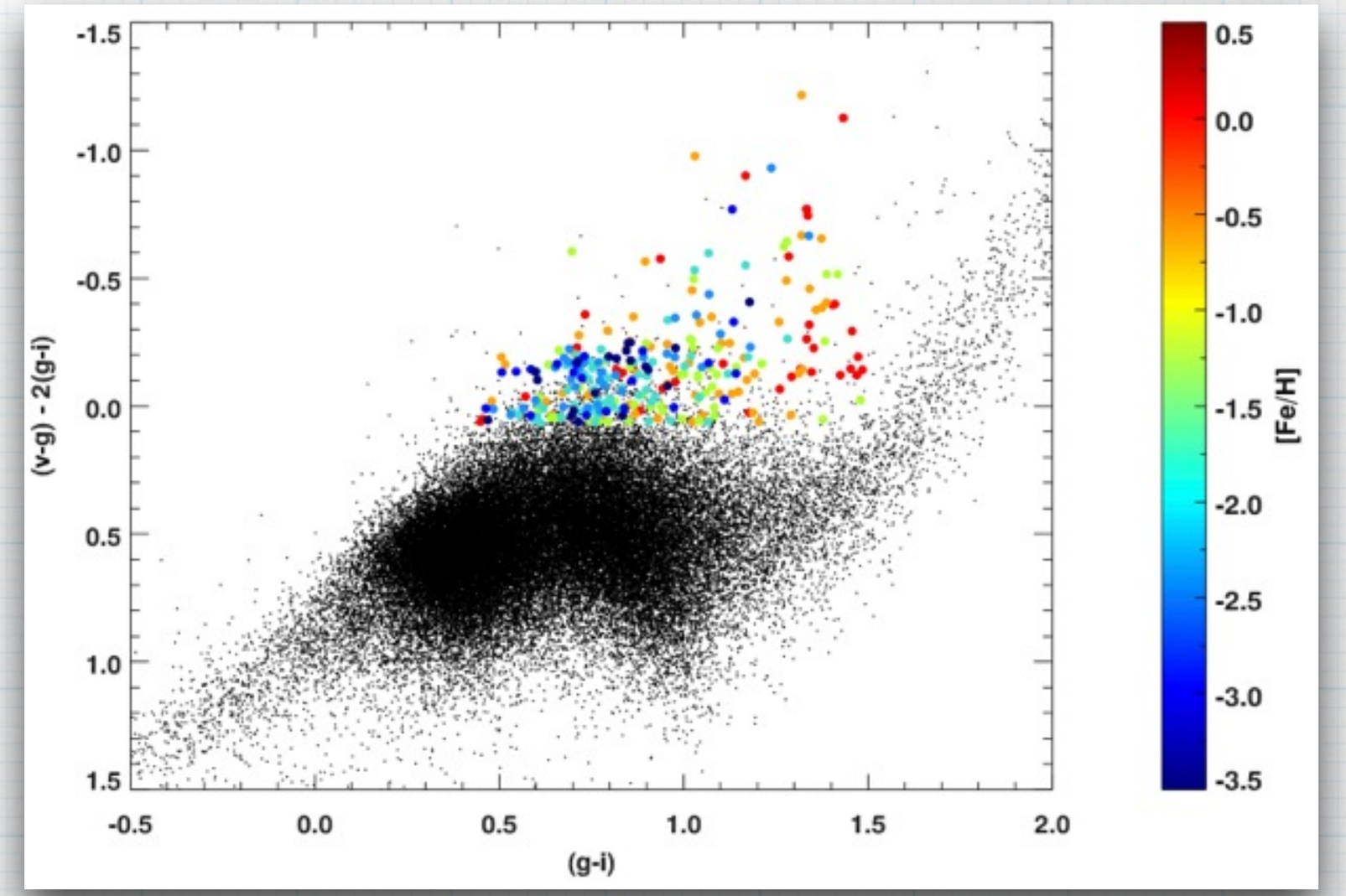
Top 200

Next 500



But what about reddening?

* Difference between fields at b=-2 and b=-8 is huge.
* Attempts to use reddening maps to de-redden have not worked.
* The problem is individual line of sight reddening.



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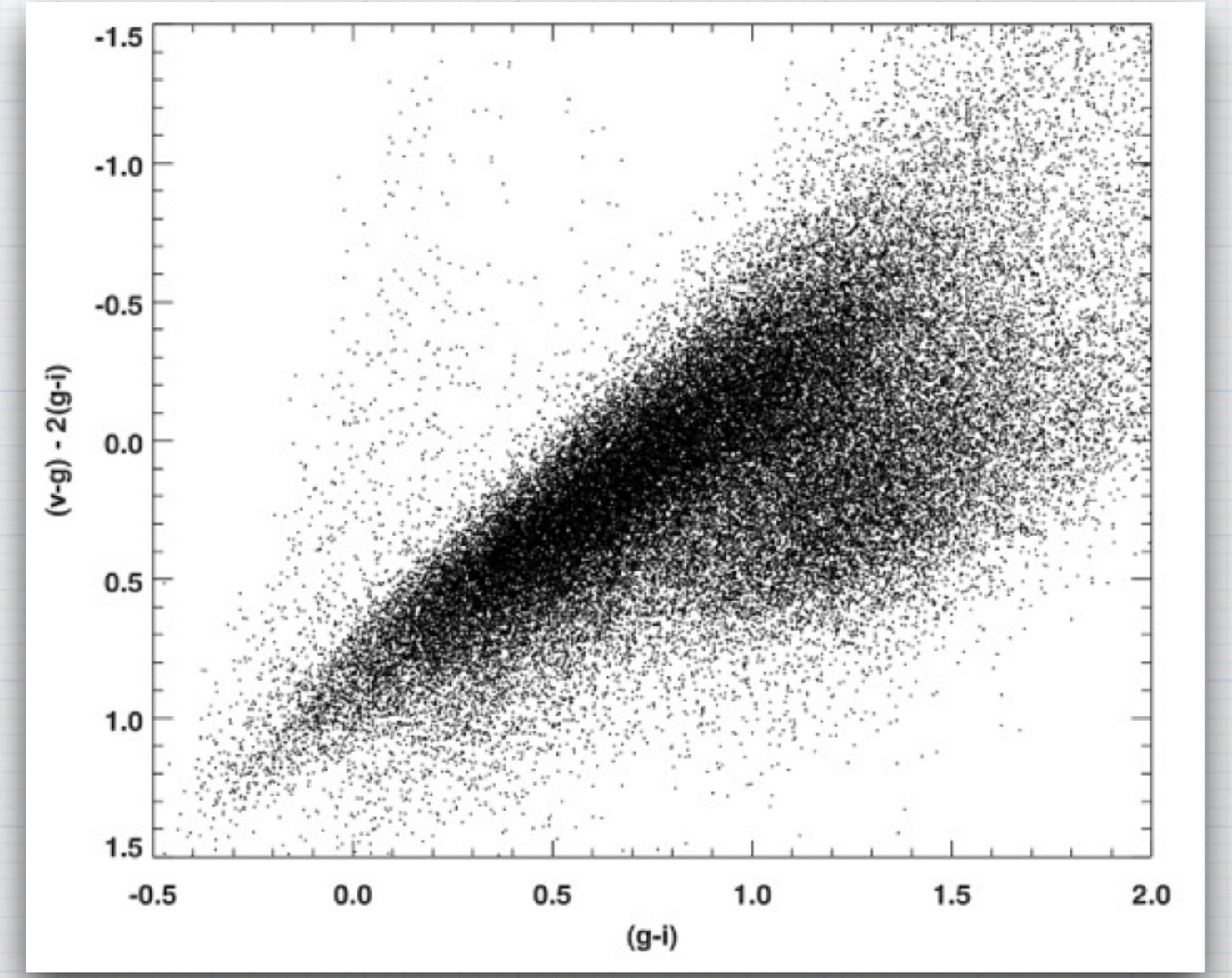
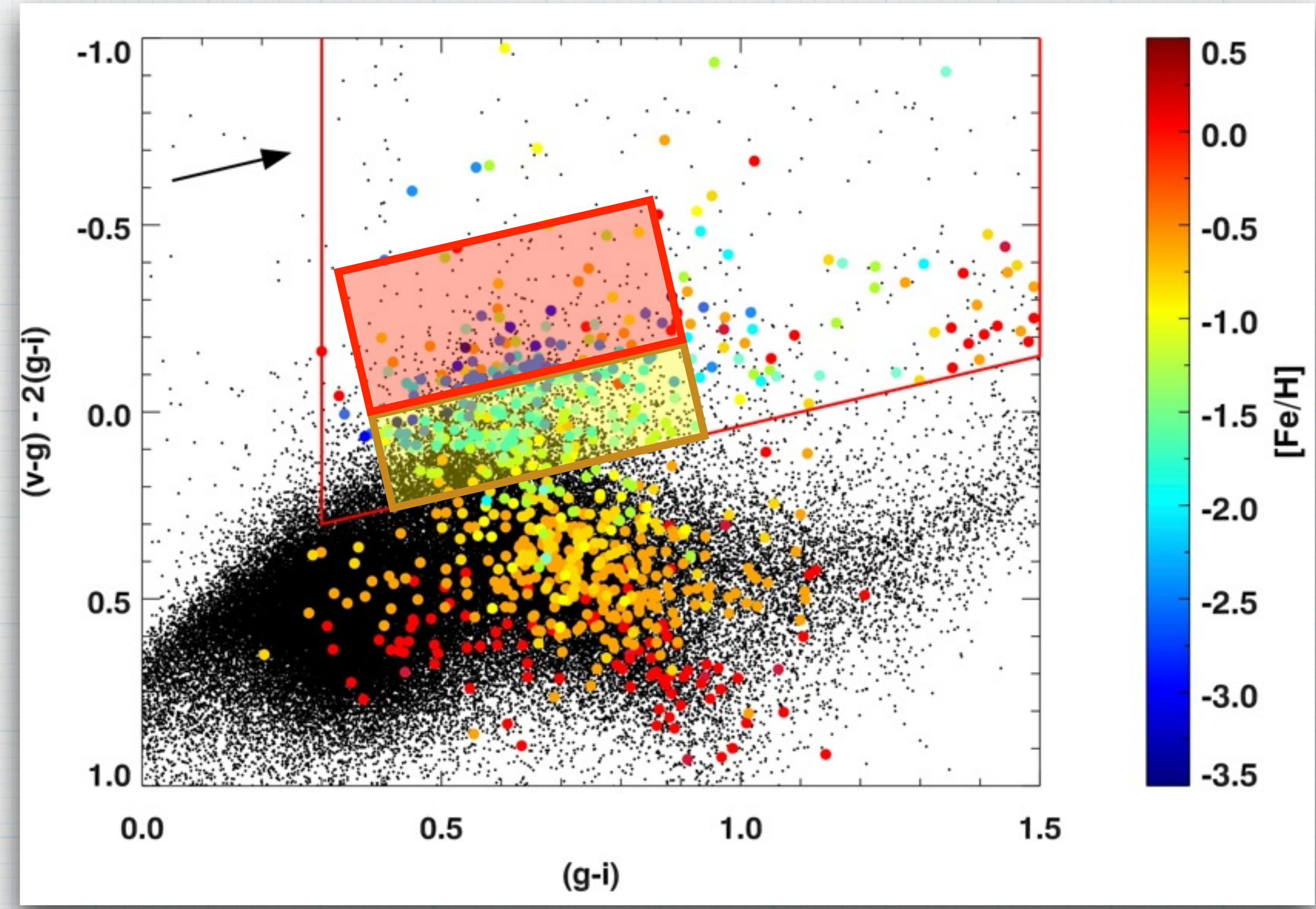
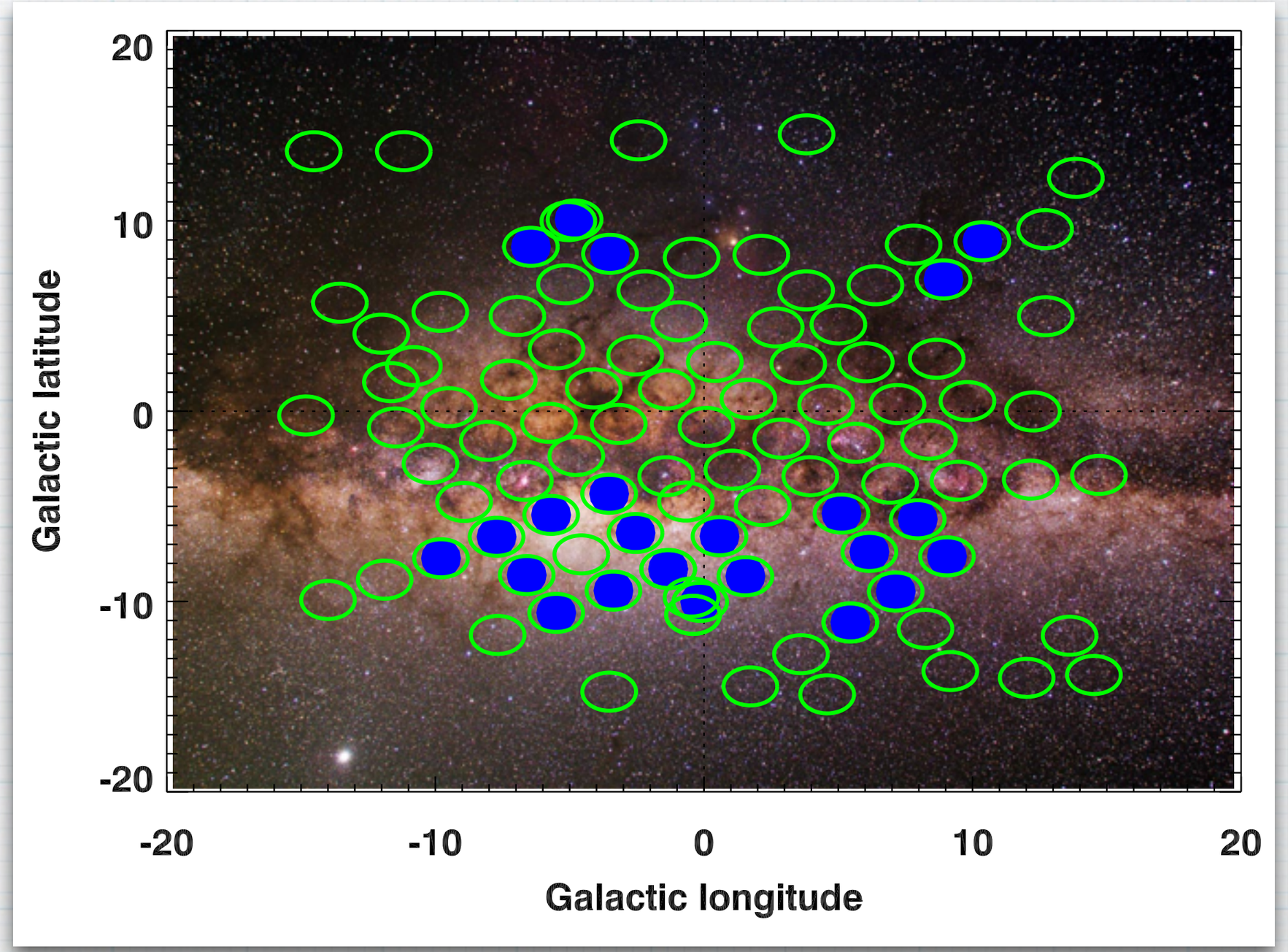


Solution in the meantime...



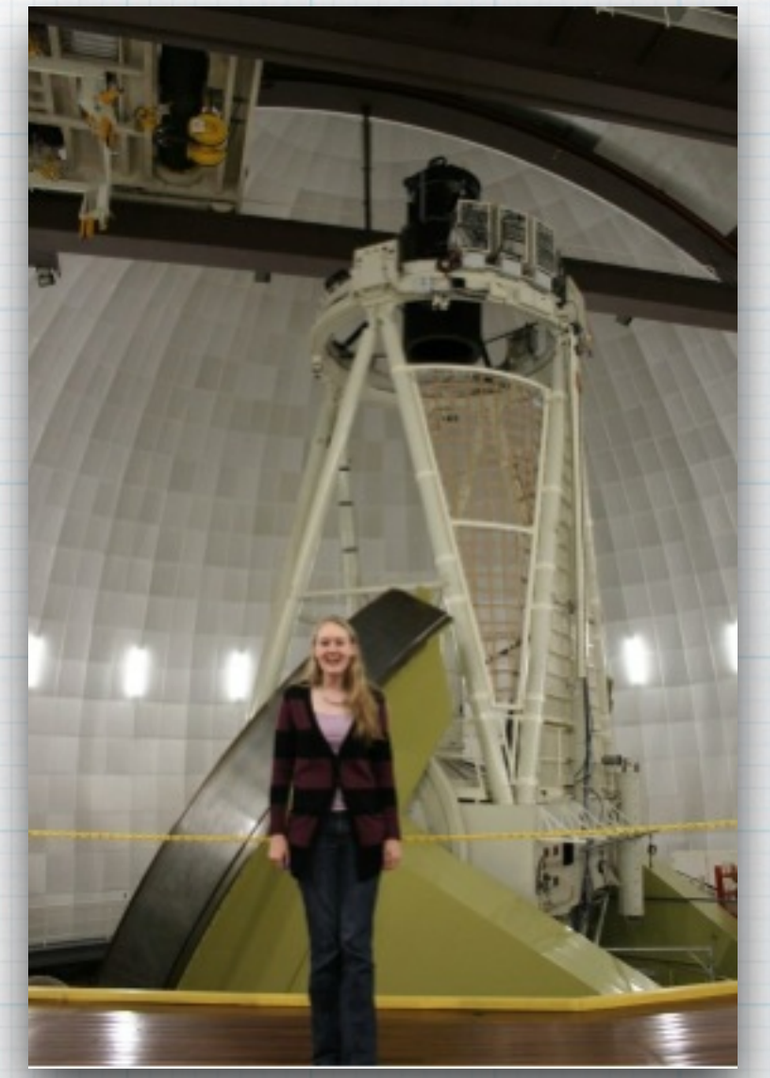
Surveying with SkyMapper

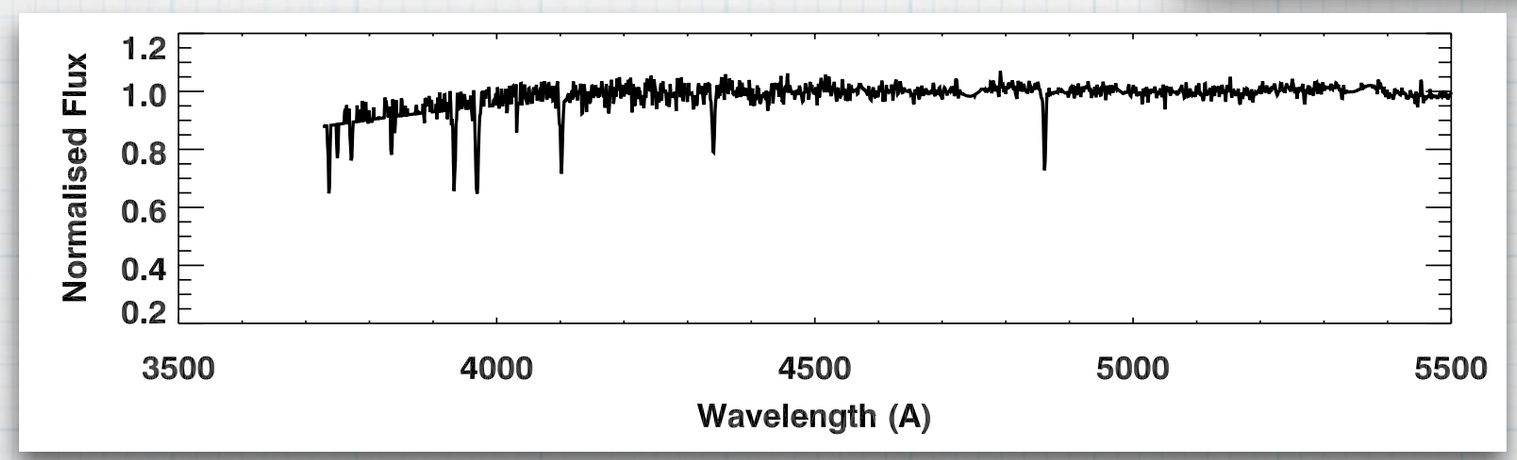
* More than 60 fields to choose from, providing full coverage of the inner 10°x10° region.



Spectroscopy from the AAT

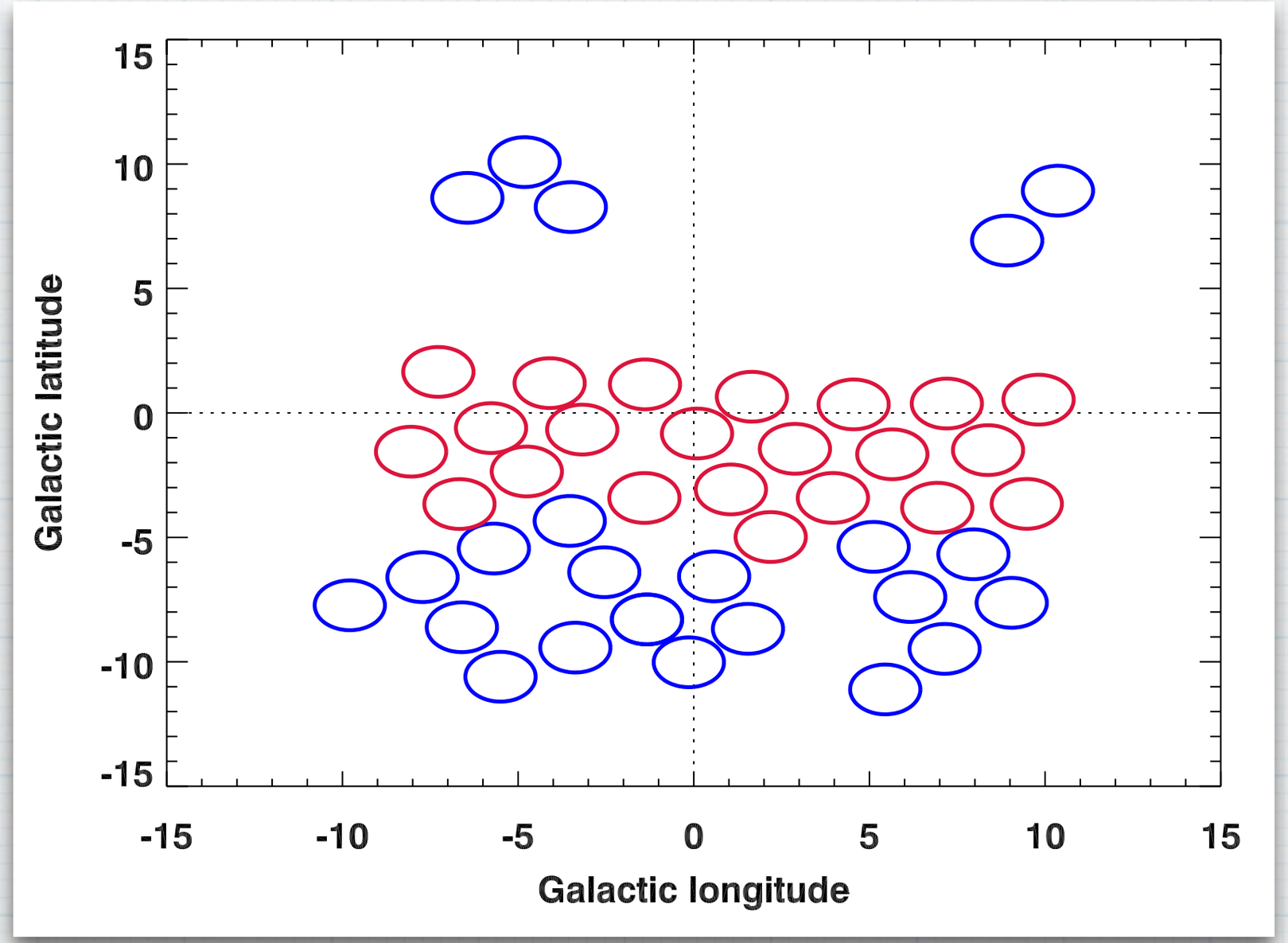
* Follow up candidates on AAOmega@AAT, observing ~350 stars in each field for 120 mins.
* With blue spectra (370-580nm) and calcium triplet, we can derive accurate stellar parameters (T_{eff}, log(g), and [Fe/H]).





Observed so far...

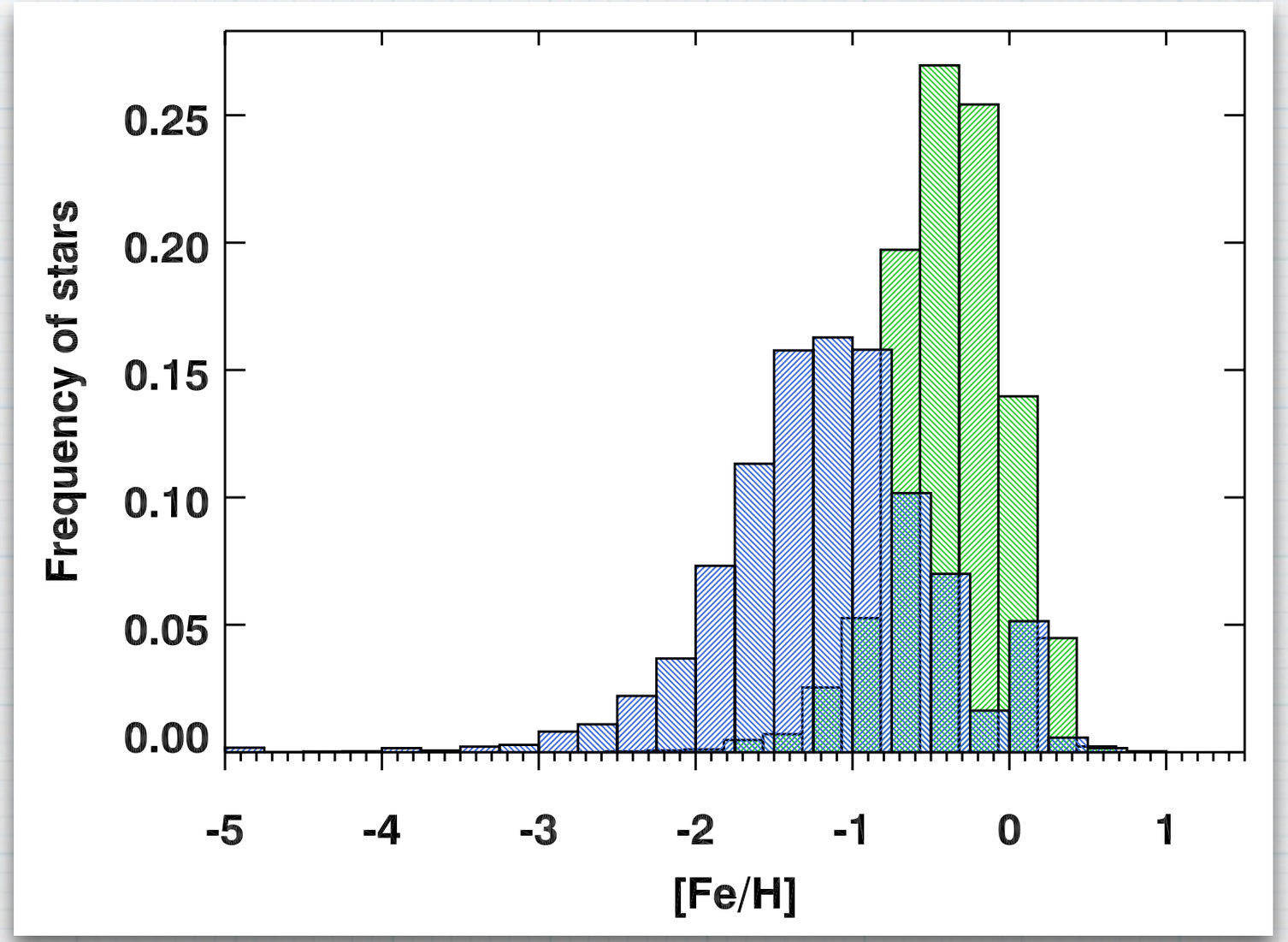
* Despite worse than normal SSO weather, we still have 25 fields, mainly focused on -10<b<-5.
* Approximately 8,500 decent spectra



* Blue: observed fields (2012 and 2013)
* Red: to be observed (2014)

The Resulting MDF

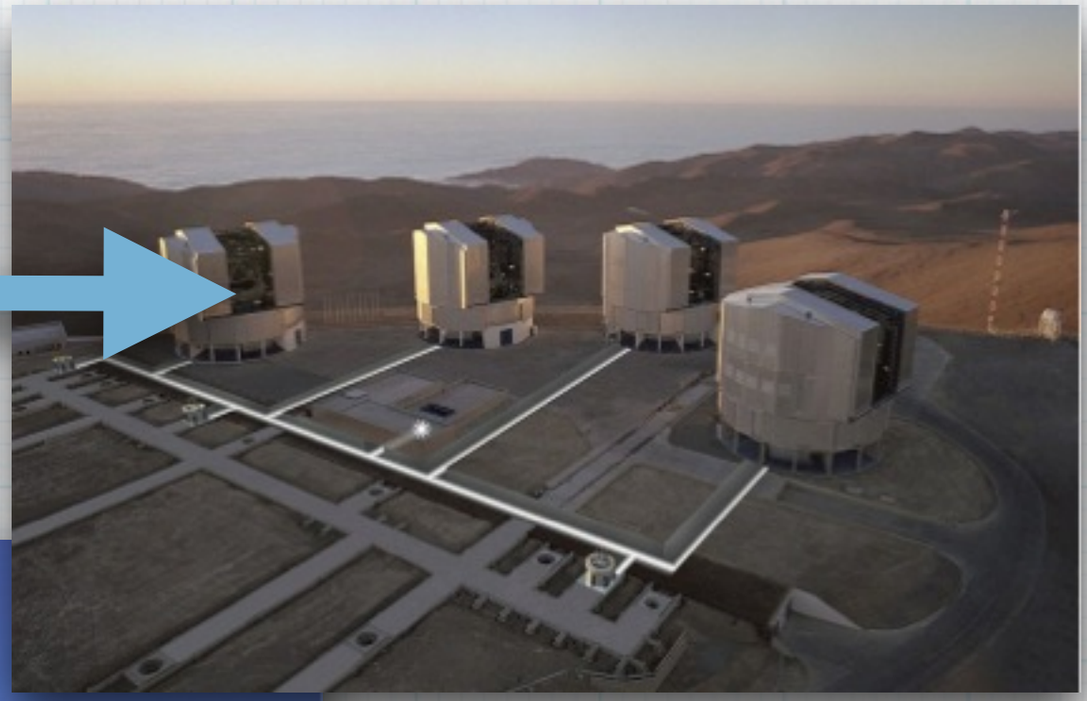
* We have found a significantly more metal poor population than an unbiased sample.
* Over 60% have [Fe/H] < -1.
* Approx. 50 stars with [Fe/H] < -3.
* No previous star found in the bulge below [Fe/H] = -3!



* Blue: our survey
* Green: data from ARGOS survey

High-Resolution Data to come

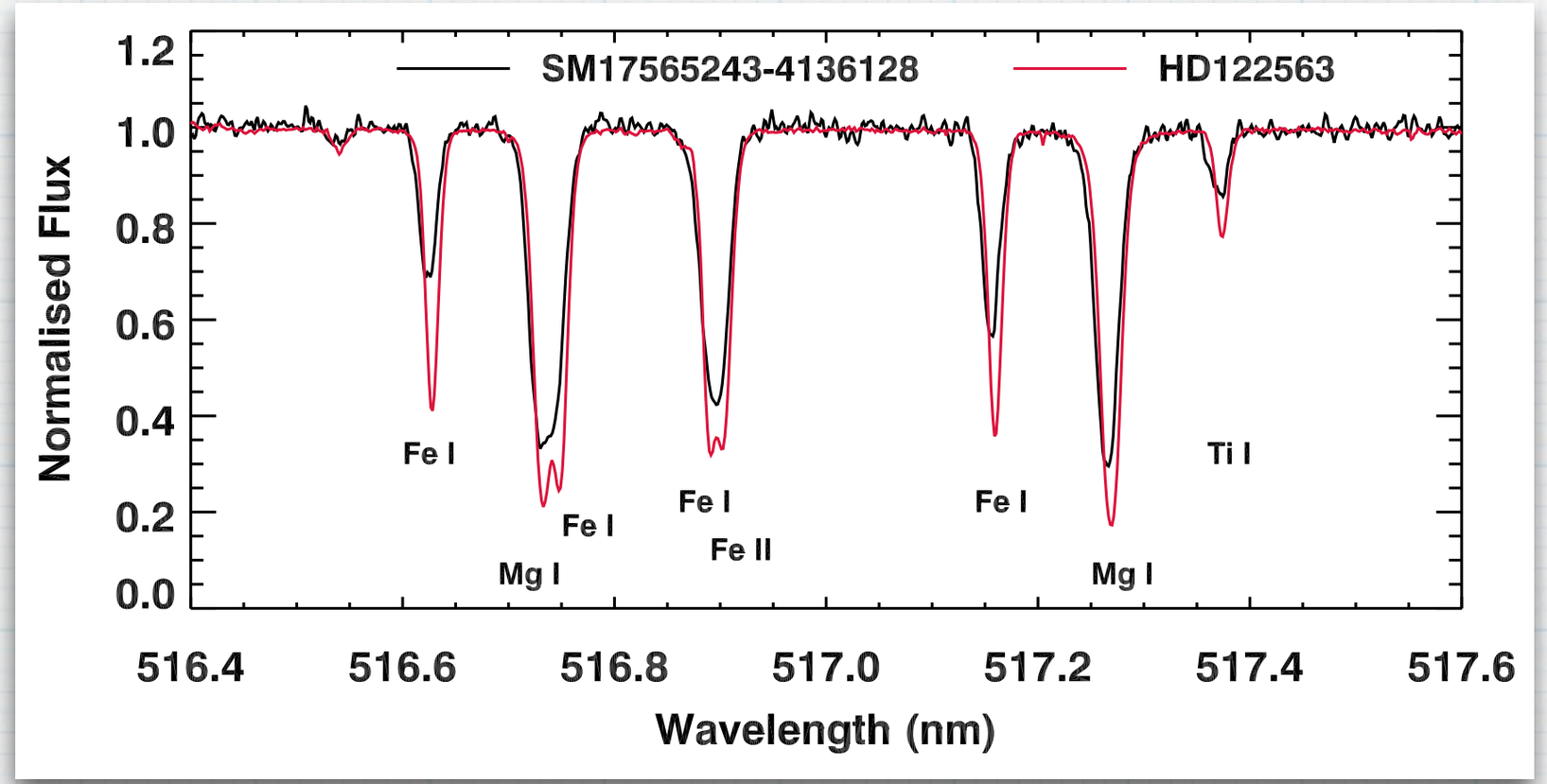
Gaia-ESO survey:
FLAMES/UVES fibres
on our targets using
the VLT (ongoing)



3 nights on
Magellan in
June 2014

3 nights on the
VLT in July
2014

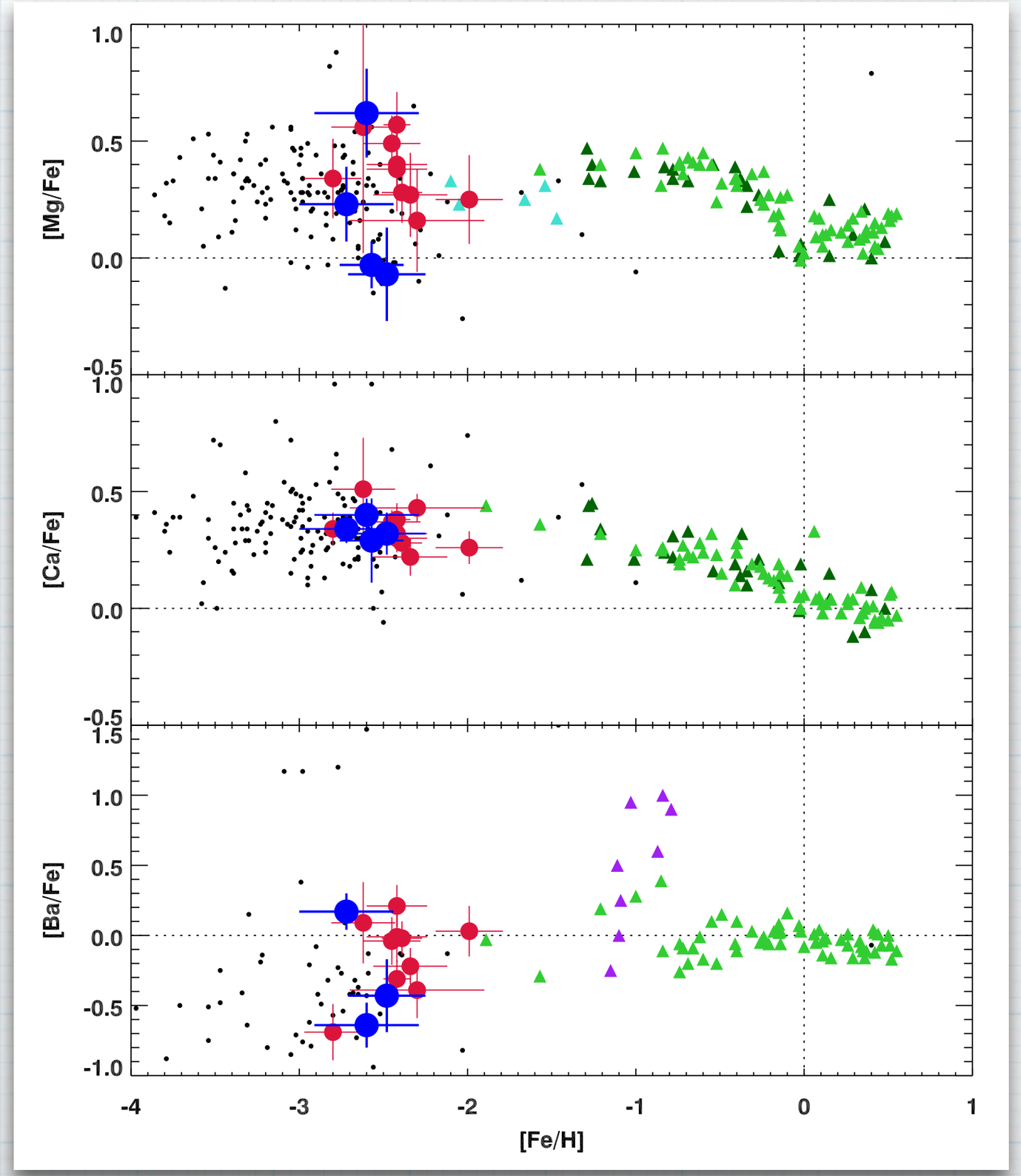
Initial Data from Magellan and Gaia-ESO



- 10 stars observed on Magellan (2012).
- 4 stars observed on UVES/VLT as part of Gaia-ESO.
- 10 have metallicities -3<[Fe/H]<-2.

Abundances

- Gaia-ESO bulge stars.
- Gaia-ESO halo stars.
- Bensby et al. (2013).
- Alves-Brito et al. (2012).
- Garcia-Perez (2012).
- Yong et al. (2013).
- Chiappini et al. (2011)



Future Steps

* New photometry taken in July-Oct 2013 with 15x3s v exposures.
* Time on the AAT this winter to follow up this new photometry, allowing us to go closer to the plane.
* Problems still to solve: crowded field photometry, and extreme reddening.