Hunting for the first stars

Martin Asplund

(really on behalf of Louise Howes)

THE AUSTRALIAN NATIONAL UNIVERSITY

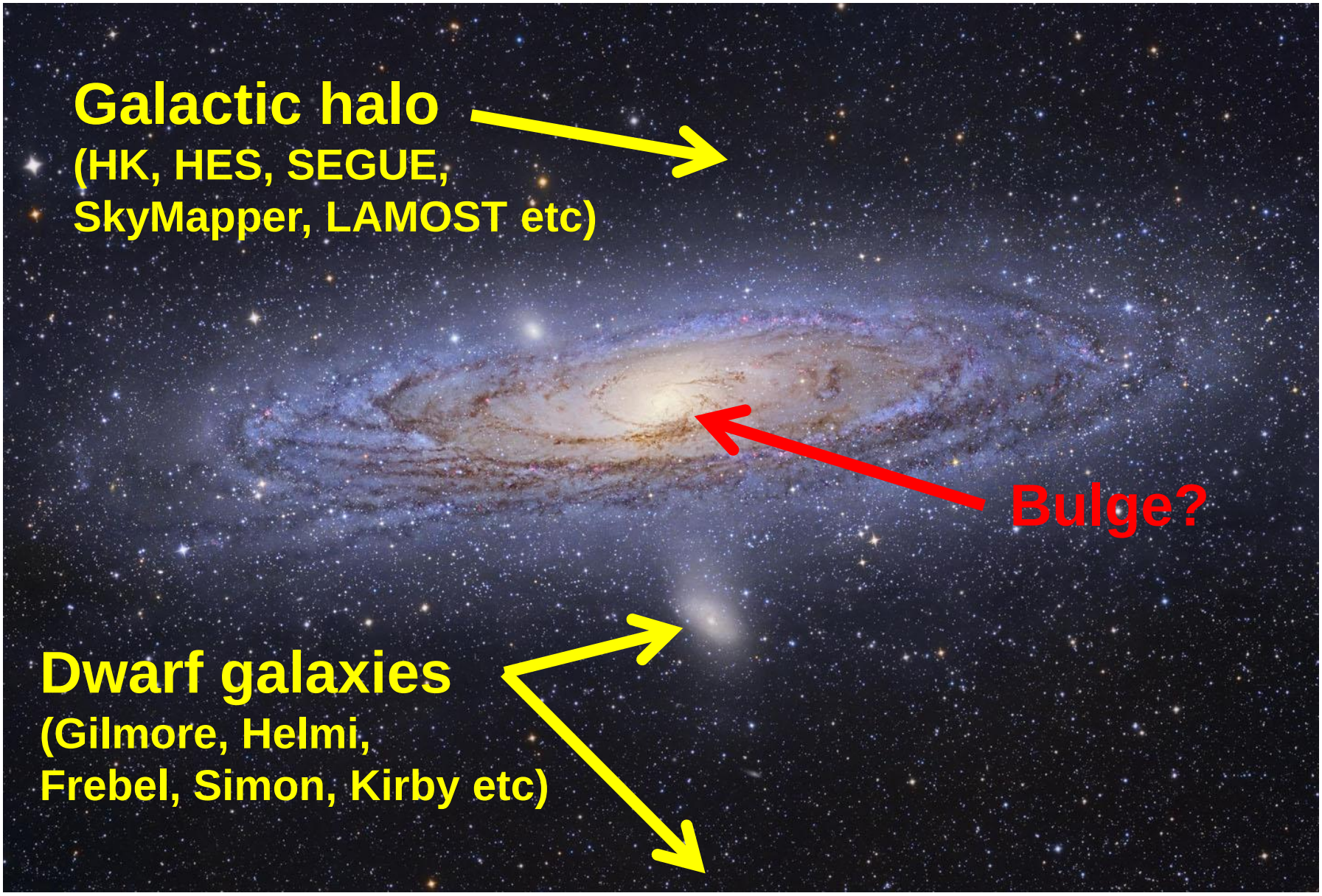
Australian Government

Australian Research Council

Disclaimer

I'm totally innocent!
My talk was ready and I was here!

Where are the first stars?



Oldest

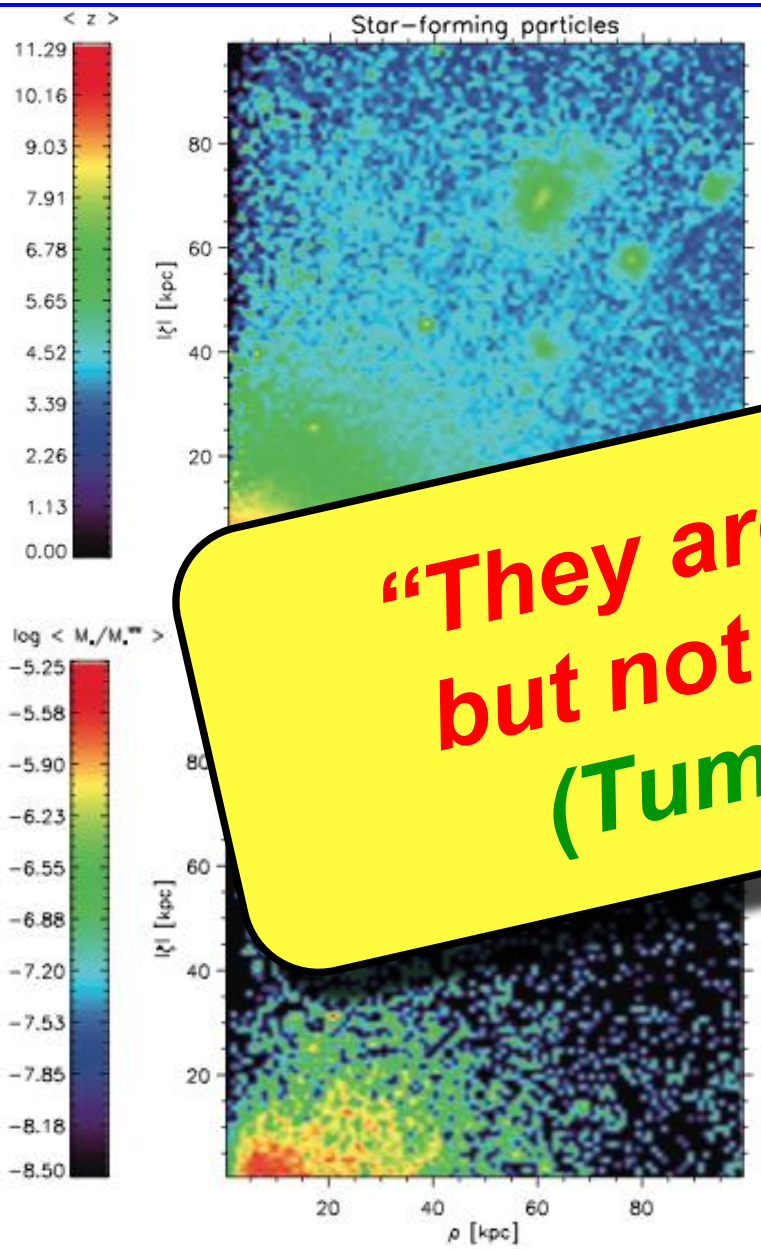
≠

Lowest [Fe/H]

≠

Most metal-poor

Oldest stars in the bulge



Salvadori et al. 2010:

Metal-poor bulge stars with [Fe/H] <-1

"They are in the bulge but not of the bulge" (Tumlinson 2010)

The most metal-poor stars are concentrated towards bulge

The needles in the haystack

Problem: bulge is mostly metal-rich + crowded

Solution: pre-select metal-poor stars from colour

Bulge EMP team

PI=Martin Asplund

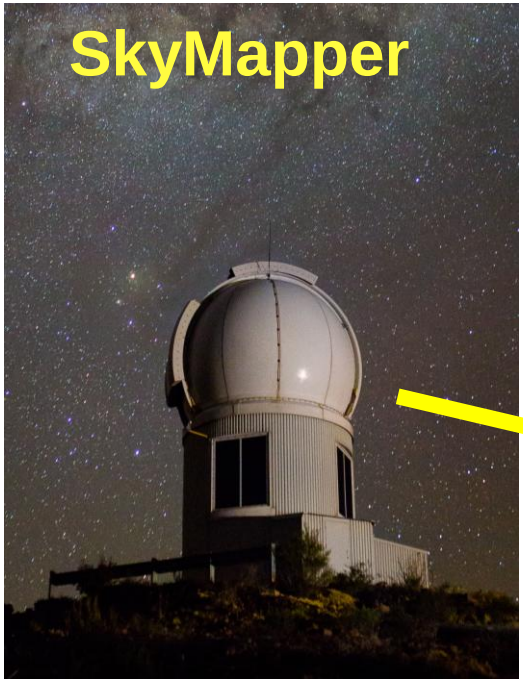
Stefan Keller

Louise Howes
(soon to be Dr)

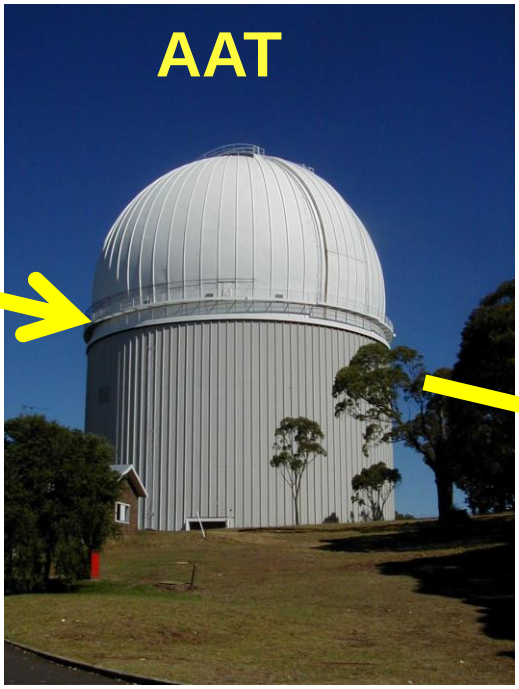
Andy Casey

Alan Alves Brito, Karin Lind, Anna Marino,
David Nataf, Melissa Ness, David Yong et al.

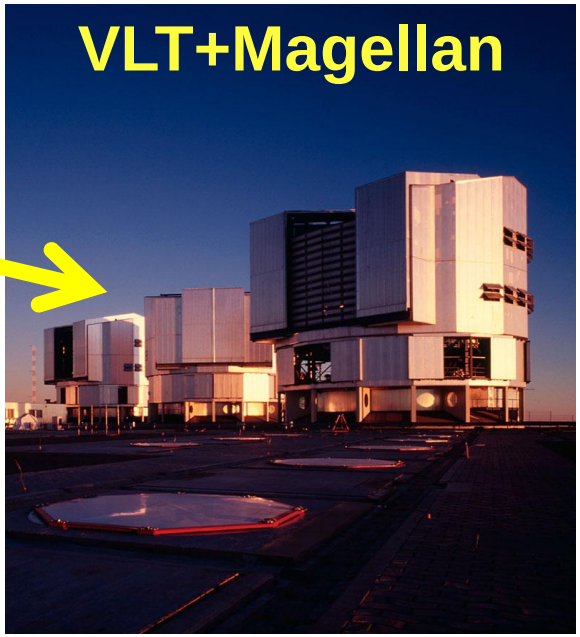
SkyMapper bulge EMP survey



Photometry
Candidates
~10^7 stars

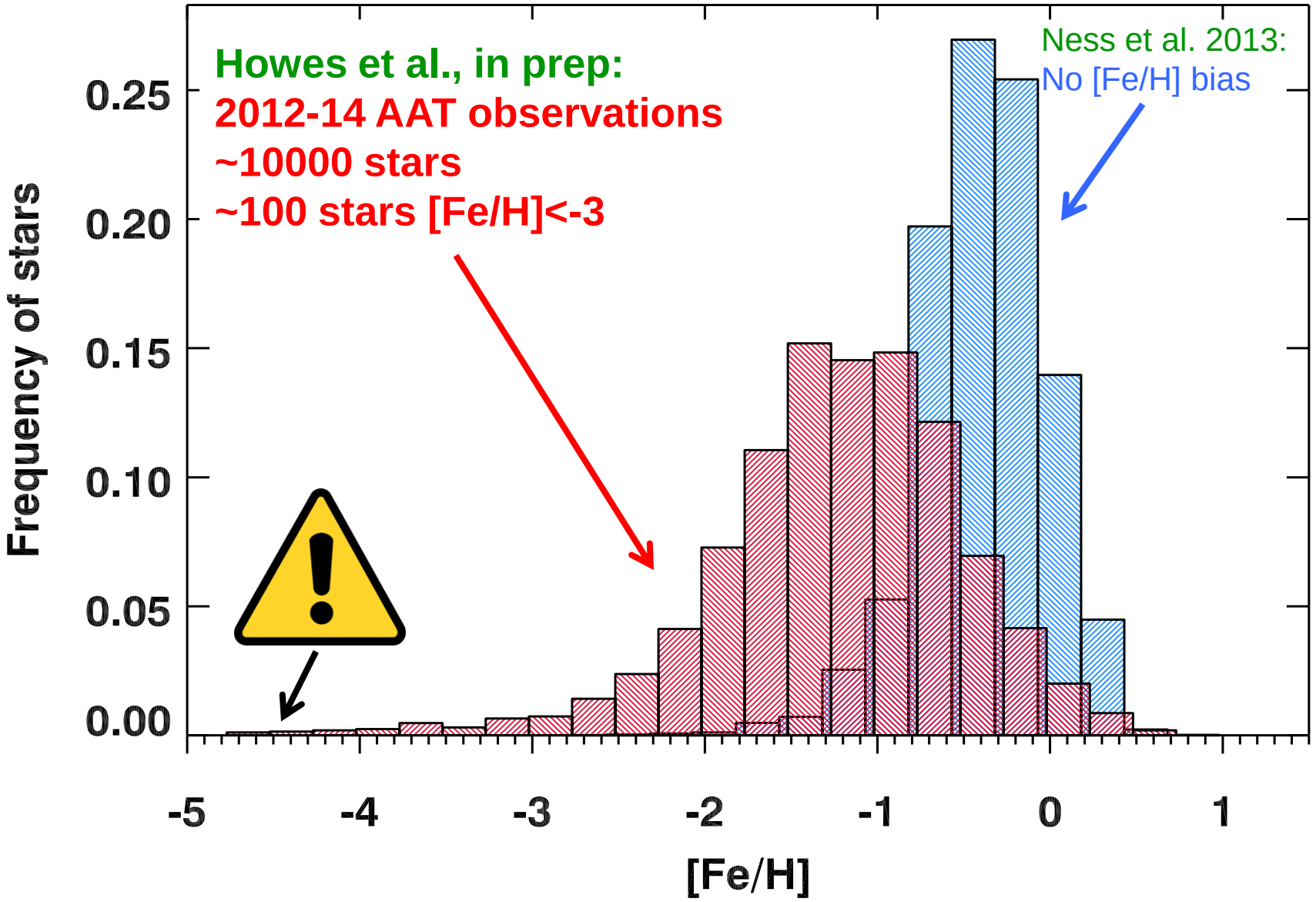


Med-res (R=10k)
400 stars @ 2dF
Confirmation
~10,000 stars



High-res (R>40k)
Chemistry
~100 stars

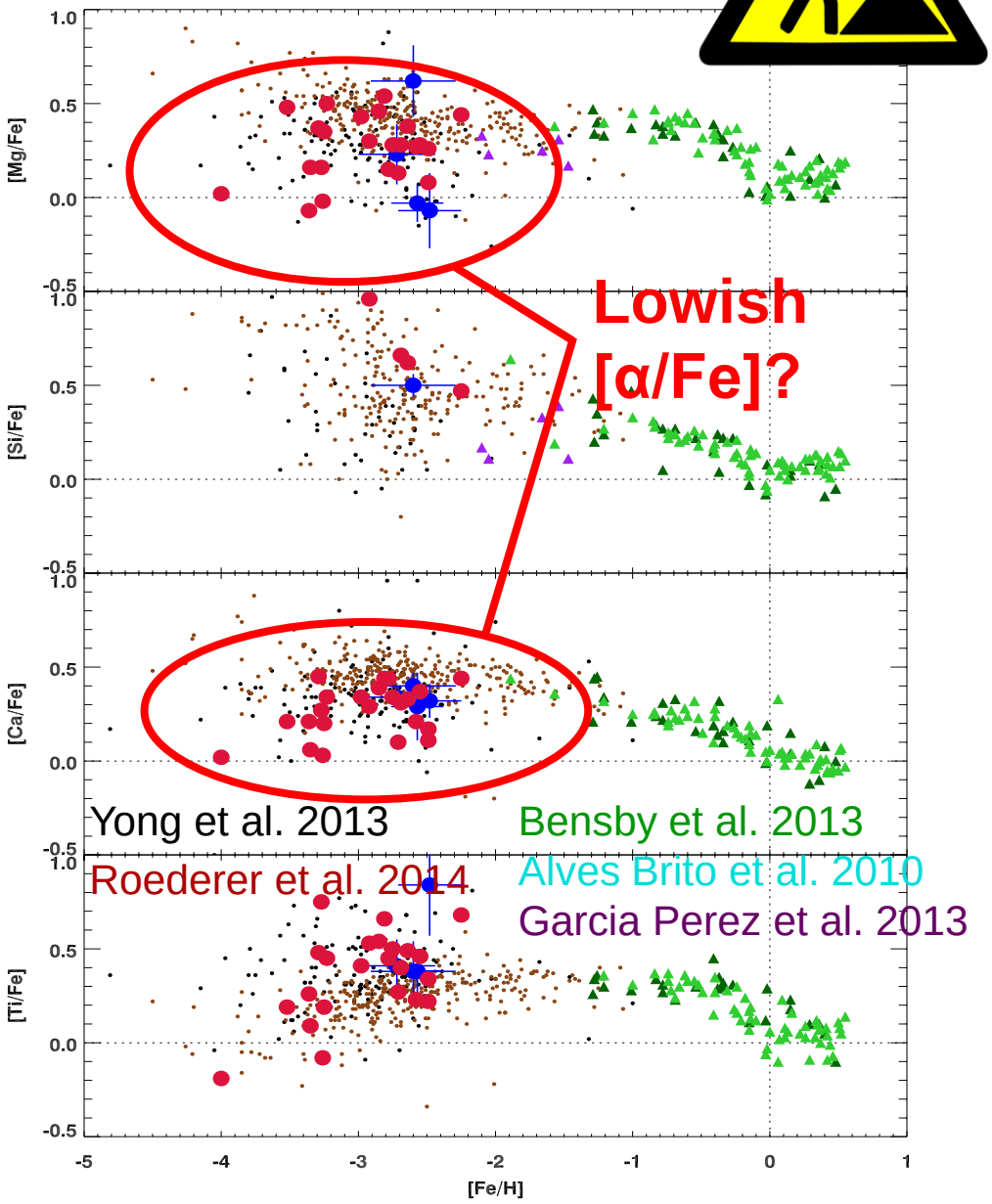
Metal-poor bulge stars



Bulge EMP: alphas

Howes et al. 2014, 2015a,b:
High-resolution spectroscopy:
VLT (Gaia-ESO)
Magellan (3n in 2014)
VLT (3n in 2014)

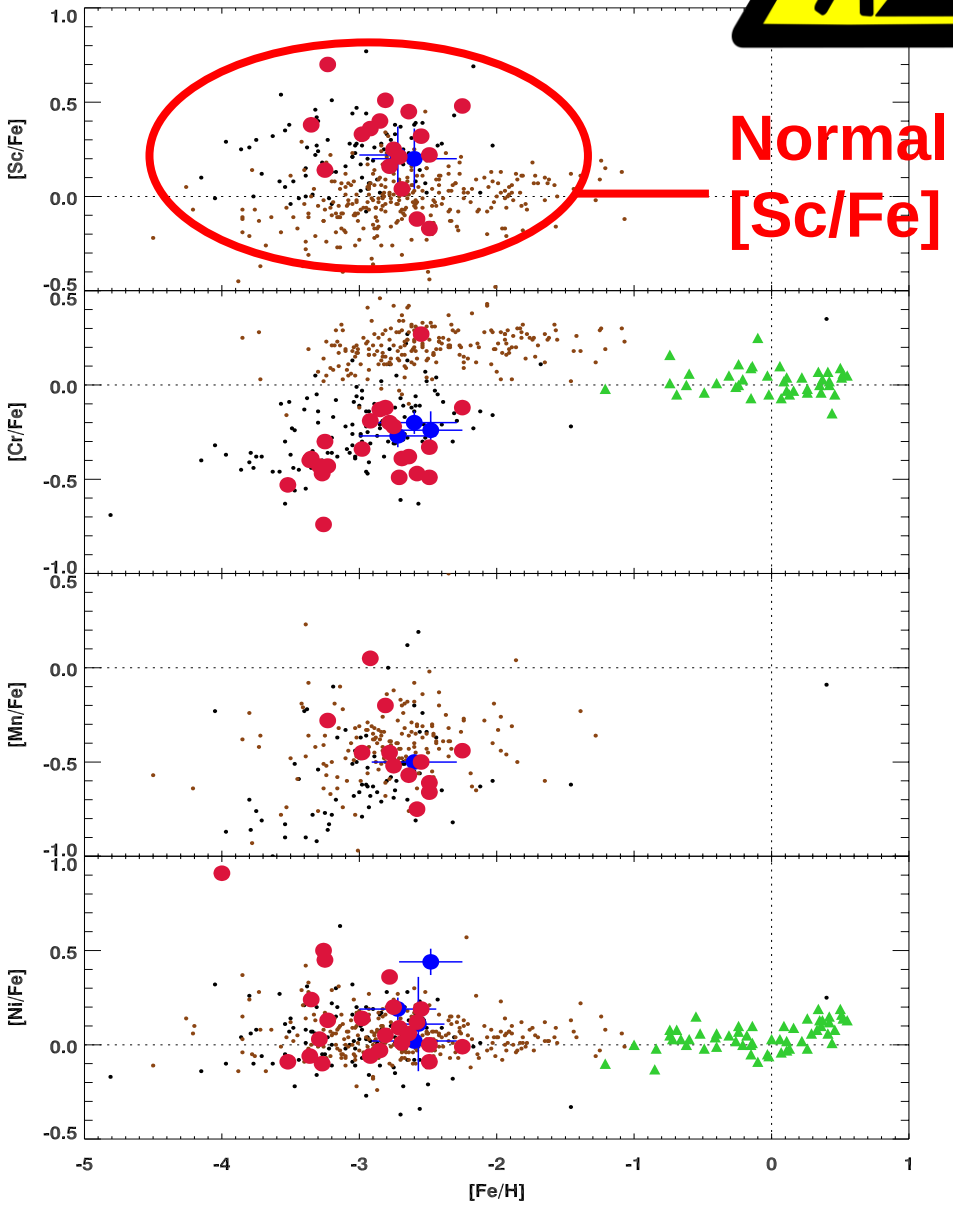
Analysis details:
SMH code: Casey
1D + <3D> models
T_{eff}: H lines
log*g*: FeI/FeII
NLTE: Lind et al.
Spectroscopic distances
Orbits w/ galpy: Bovy



Bulge EMP: Fe-peak

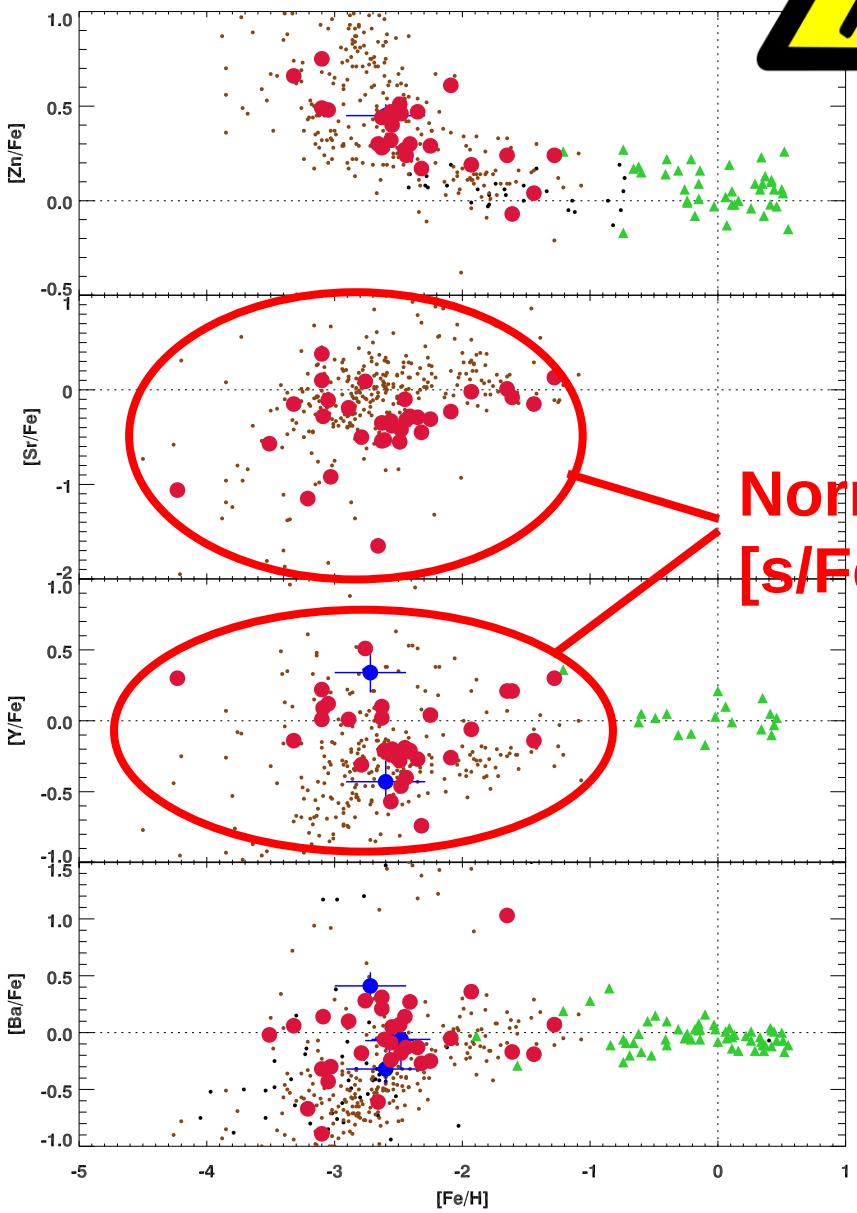
Howes et al. 2014, 2015a,b:
High-resolution spectroscopy:
VLT (Gaia-ESO)
Magellan (3n in 2014)
VLT (3n in 2014)

Analysis details:
SMH code: Casey
1D + <3D> models
T_{eff}: H lines
log*g*: FeI/FeII
NLTE: Lind et al.
Spectroscopic distances
Orbits w/ galpy: Bovy



Bulge EMP: n-capture

Howes et al. 2014, 2015a,b:
High-resolution spectroscopy:
VLT (Gaia-ESO)
Magellan (3n in 2014)
VLT (3n in 2014)



Analysis details:
SMH code: Casey
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T_{eff}: H lines
log*g*: FeI/FeII
NLTE: Lind et al.
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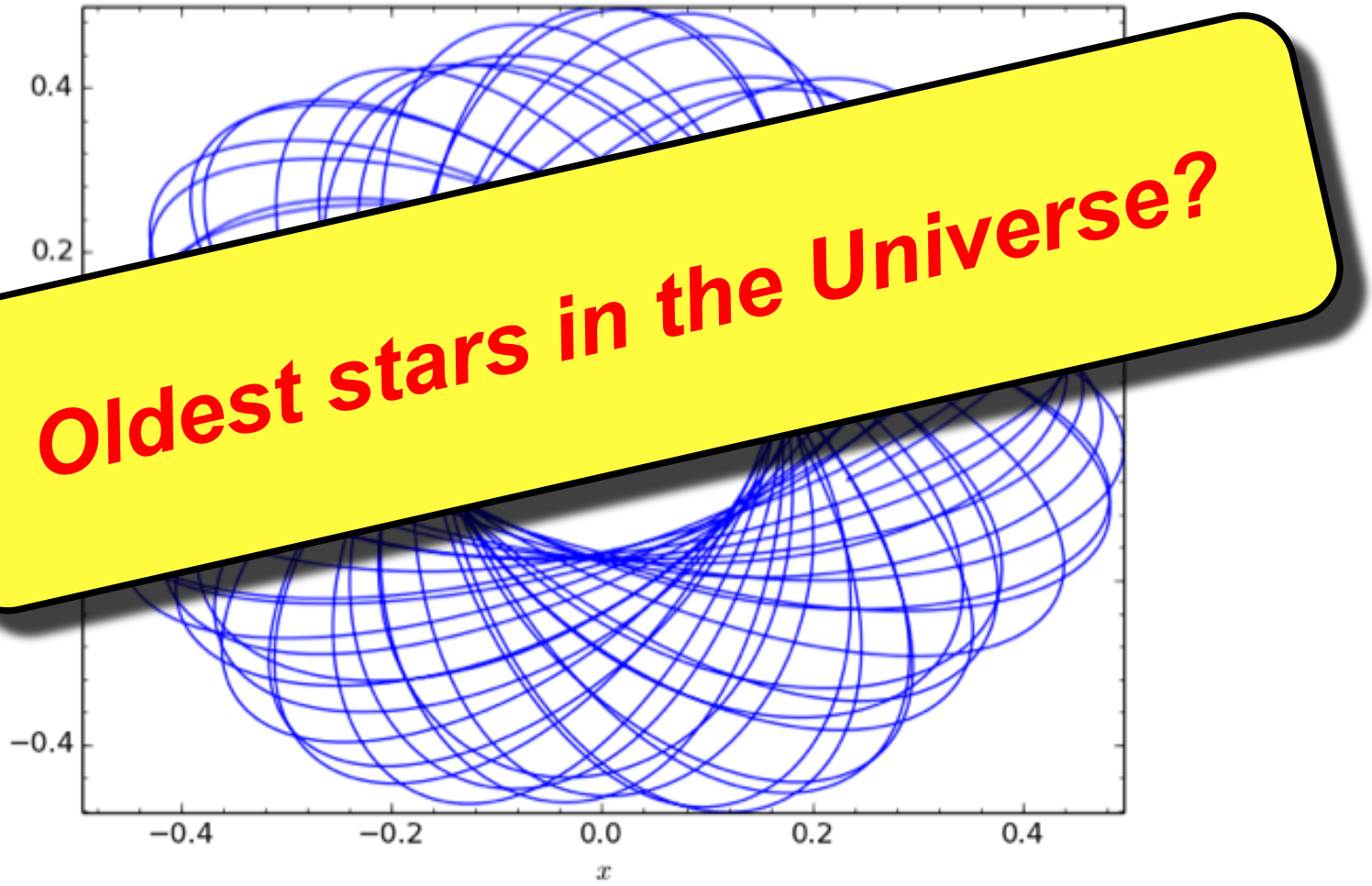
Orbits w/ galpy: Bovy

Bulge- or halo-like orbits?

~Half of our bulge stars have orbits within bulge

(Spectroscopic distances, UCAC4 proper motions, galpy integrator: Gaia may help soon)



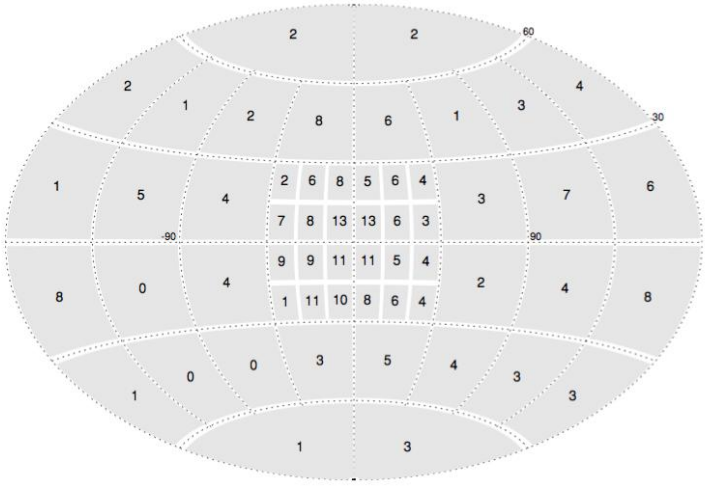
Oldest stars in the Universe?

Stellar ages

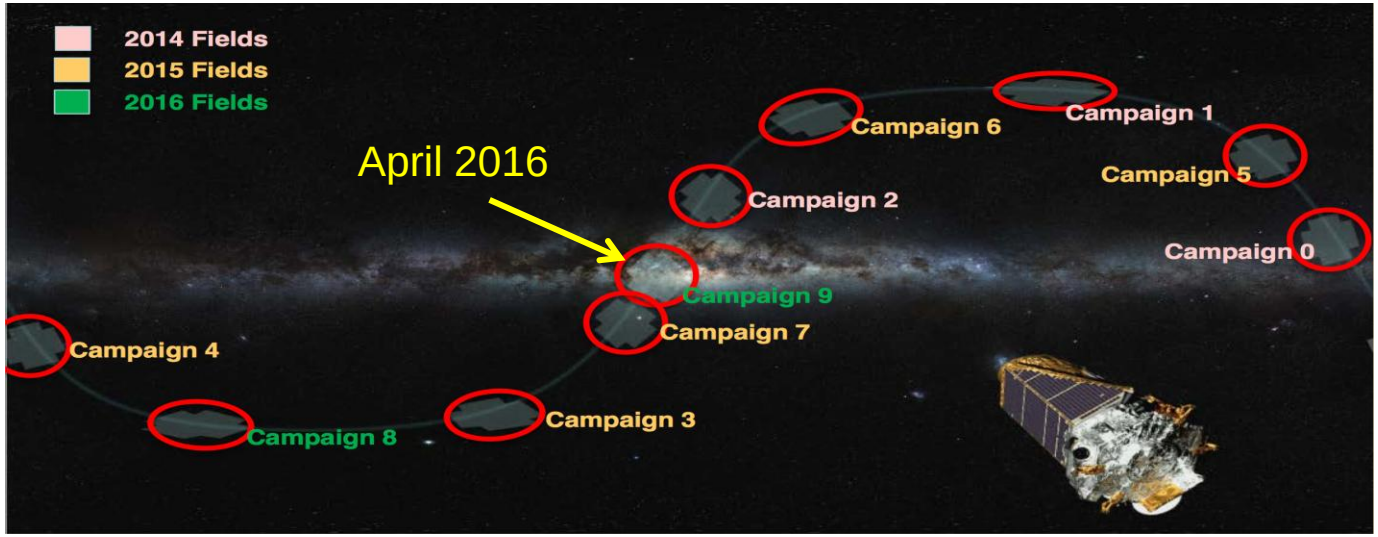
Tumlinson 2010:

~10% of bulge stars with [Fe/H]<-3 formed at z>15

(note: z=15 corresponds to t=270Myr, z=5 to t=1.2Gyr)



Would it not be cool with asteroseismic ages for a sample of bulge EMP giants?



Outlook

- More bulge EMP stars with VLT+Magellan
- Improve stellar parameters (distances: Gaia)
- Better kinematics (proper motion, orbits)
- Homogeneous bulge vs halo comparison
- Final analysis of AAT data (MDF, CEMP freq.)
- SkyMapper+IR selection (Schlaufman & Casey)
- Kepler-2 asteroseismic ages?