CHEMICAL EVOLUTION IN SIMULATED GALAXIES

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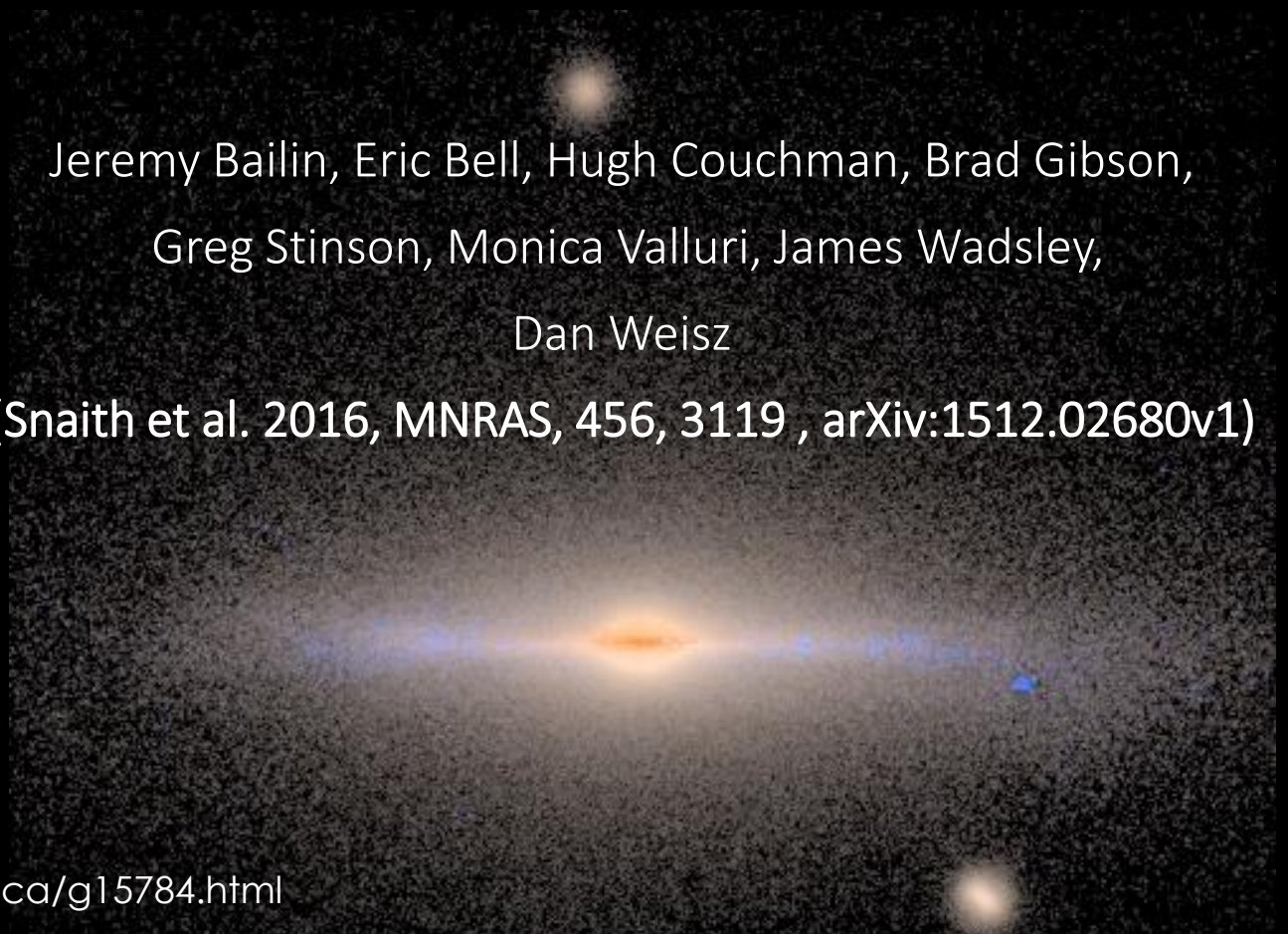
(Snaith et al. 2016, MNRAS, 456, 3119 , arXiv:1512.02680v1)



http://mugs.mcmaster.ca/g15784.html

INTRODUCTION

- Motivation
- Description of the Simulations
- Results
- Future Directions
- Conclusions

MOTIVATION

- Chemistry gives window into the assembly history of galaxies
- Gaia-ESO (+followups), APOGEE, CALIFA, MaNGA – detailed data on the chemical properties of the MW and other galaxies
- Challenges to chemodynamical models of galaxies
- Need to compare chemistry in simulations and observations

DESCRIPTION OF THE SIMULATIONS

- Two simulations – identical ICs – different stellar feedback
- MUGS (Stinson et al. 2010) & MaGICC (Stinson et al. 2013)

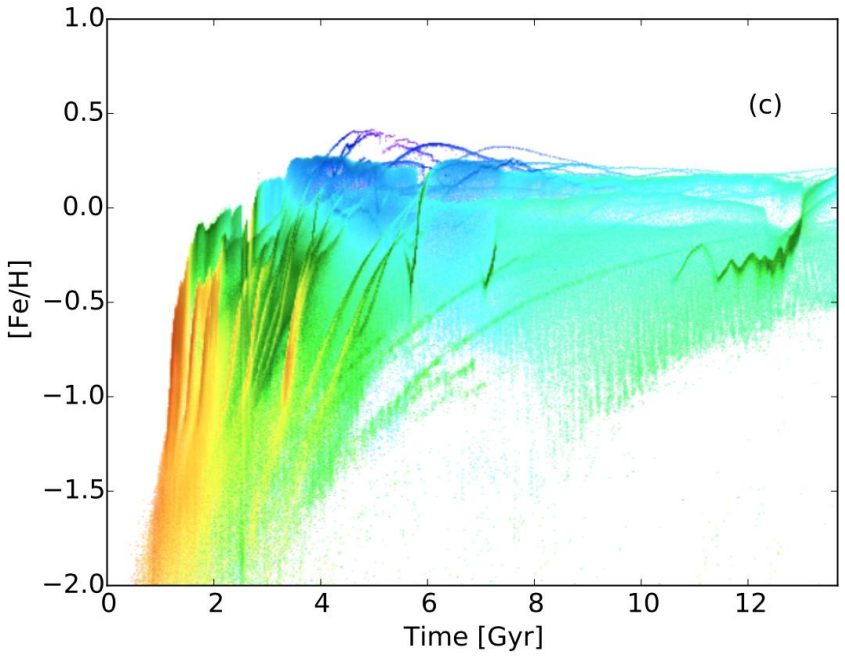
DIFFERENCES BETWEEN SIMULATIONS

- MUGS
  - Traditional SN feedback (Stinson et al. 2006)
- MaGICC
  - Traditional + early radiative feedback (Stinson et al. 2013)
  - Stars start introducing energy into the simulation as soon as they are formed.
  - Different IMF

RESULTS – AGE-Z RELATION

- Histogram equalisation technique to bring out substructures

- MUGS

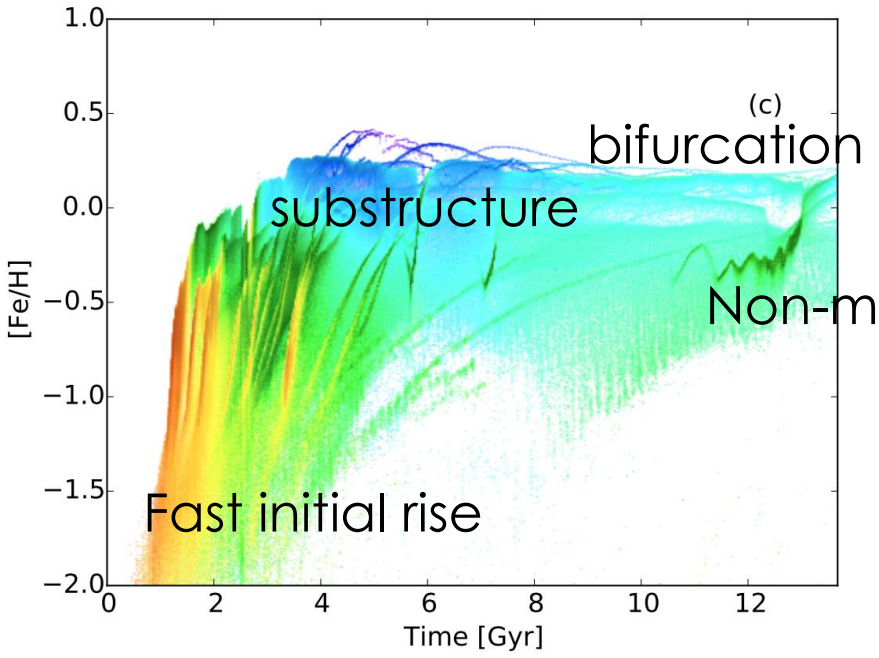


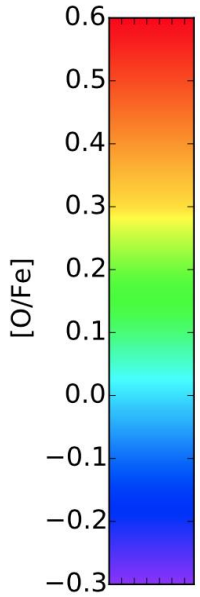
MaGICC

RESULTS – AGE-Z RELATION

- MUGS

MaGICC

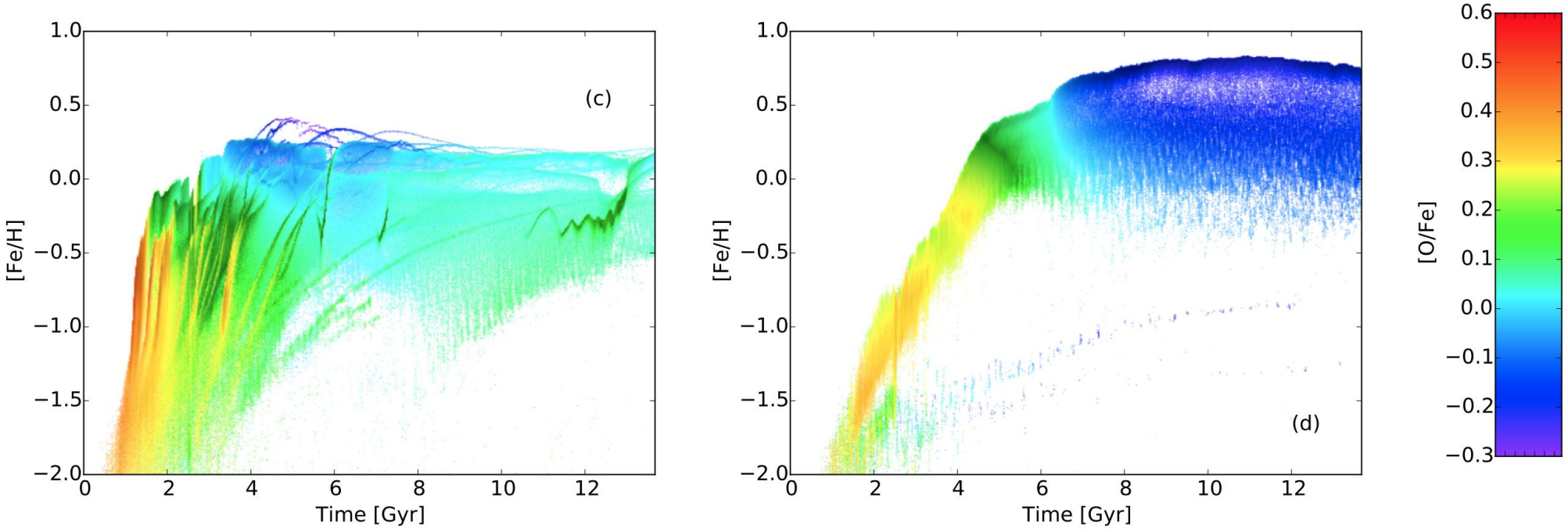




RESULTS – AGE-Z RELATION

- MUGS

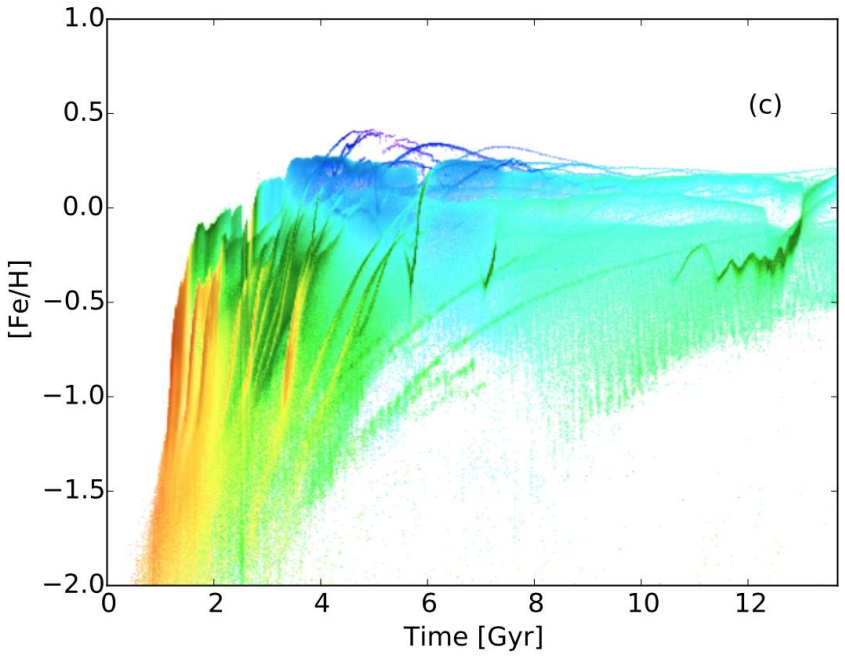
MaGICC

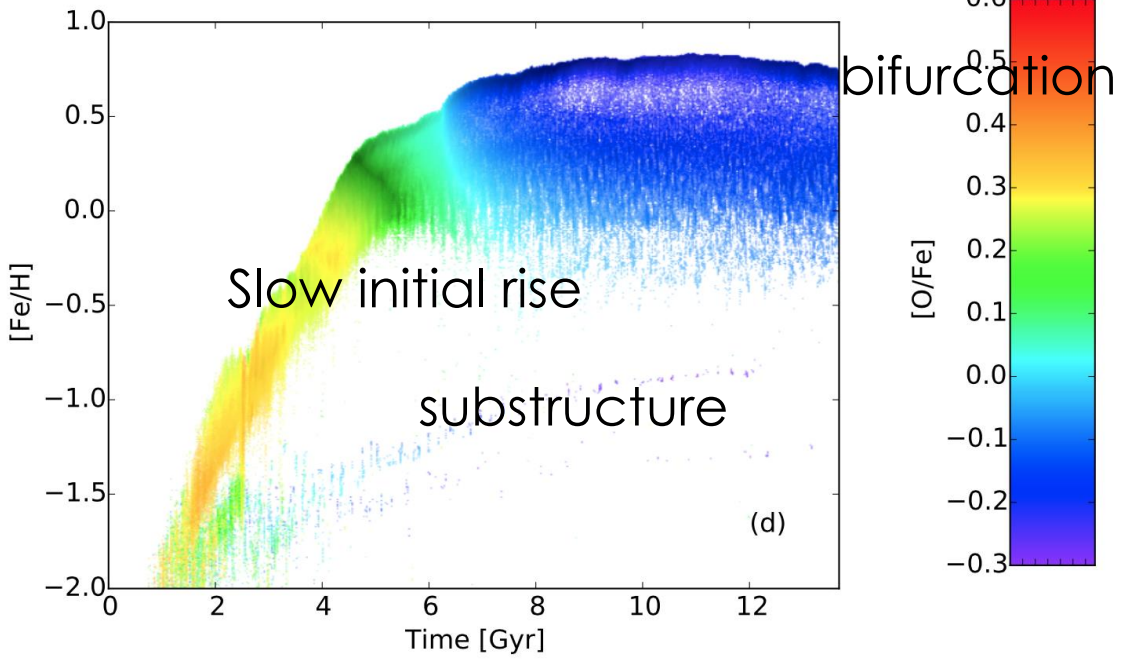


RESULTS – AGE-Z RELATION

- MUGS

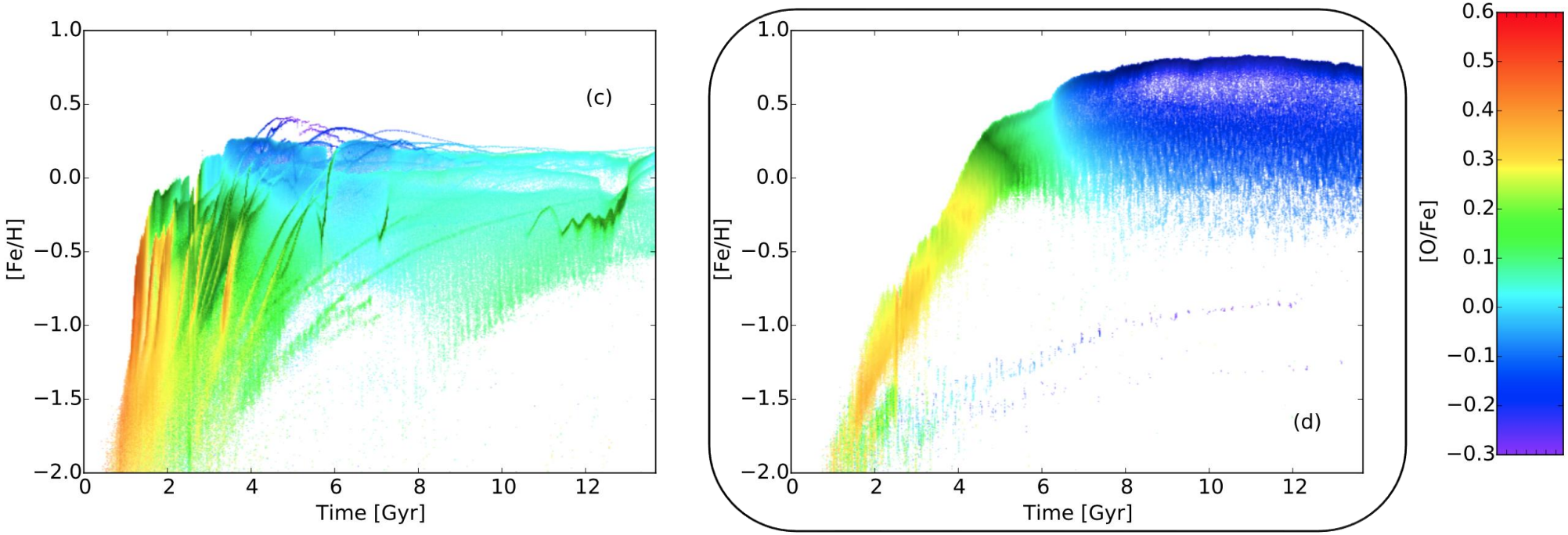
MaGICC





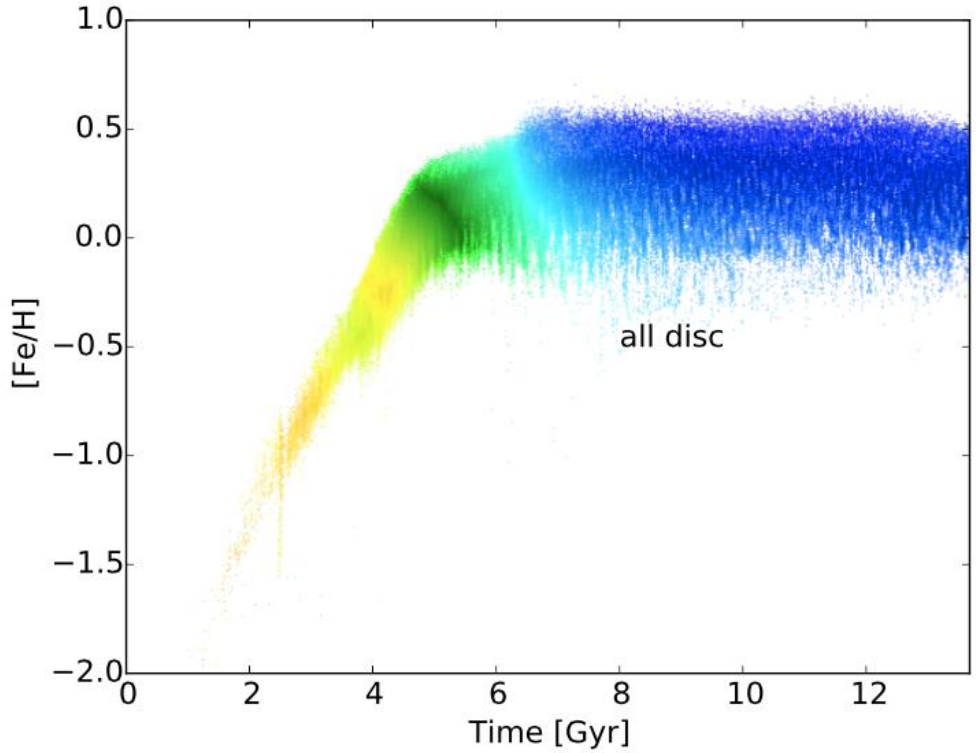
ORIGIN OF THE SPINE/SKIRT

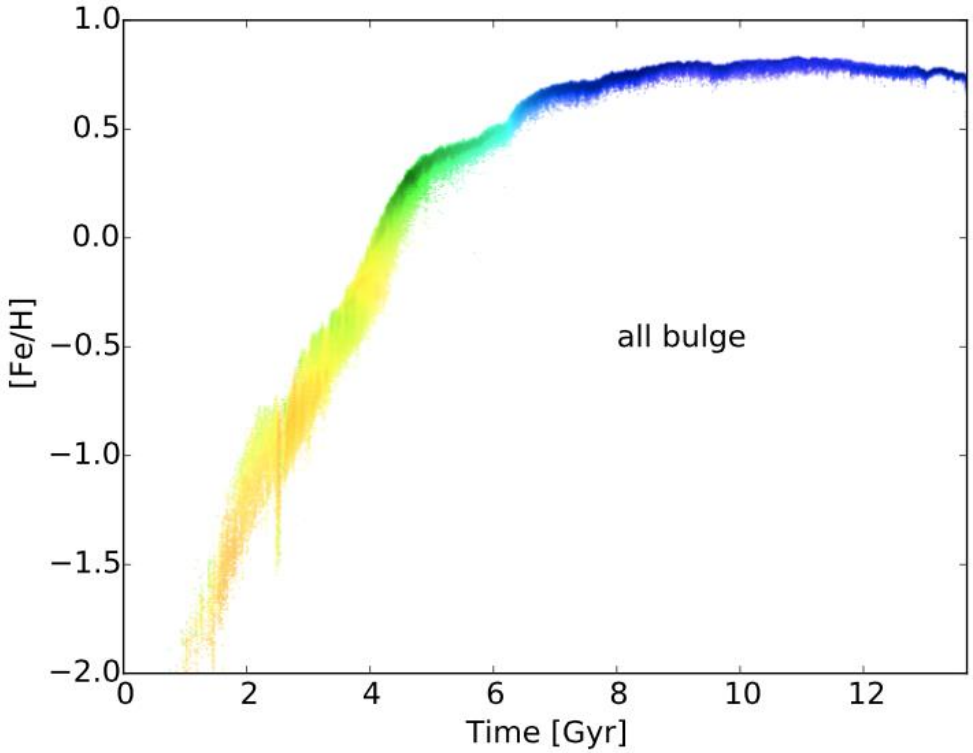
- Two parallel sequences in the AMR
- One is narrow, the other very broad



ORIGIN OF THE SPINE/SKIRT

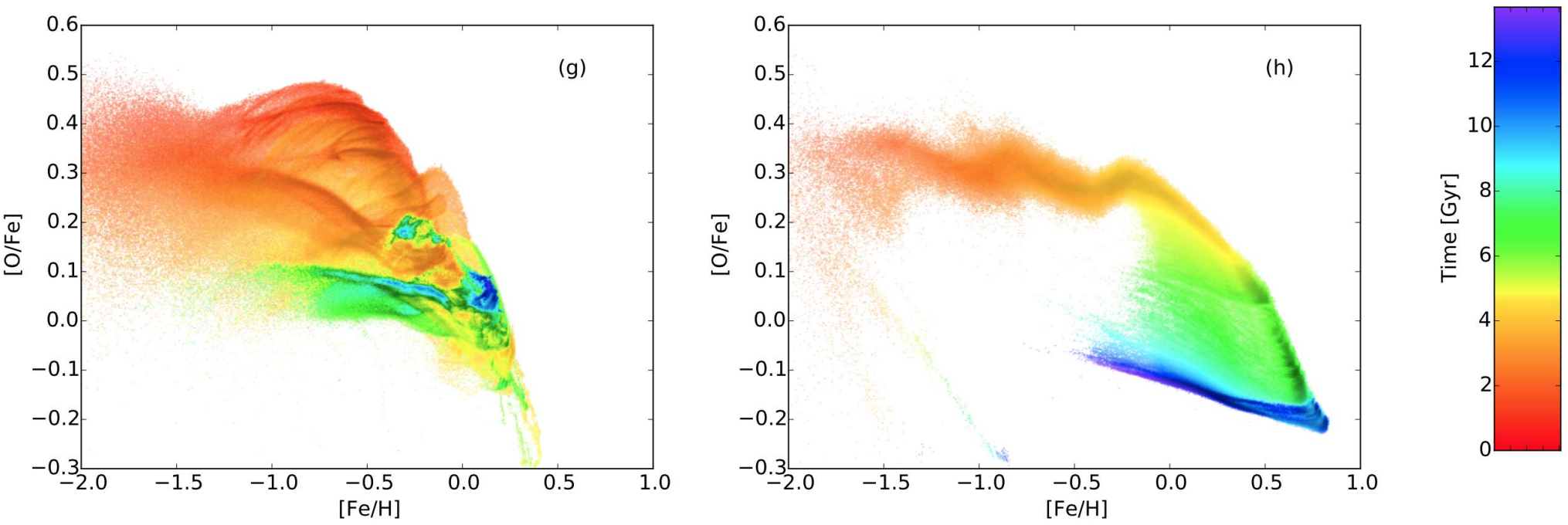
- Two parallel sequences in the AMR
- One is narrow, the other very broad
- Implies different environments…. bulge, disc, halo?





COMPARE WITH OBSERVATIONS

- Ages are hard so look in [Fe/H]-[O/Fe]
- Substructure apparent.



COMPARE TO OBSERVATIONS

- Something's missing… errors.
- The observations have errors (0.08 dex for abundances,, Hayden et al. 2015, 1.5 Gyr for ages, Haywood et al. 2015)
- All that substructure in MUGS might be there but can we see it?

COMPARING WITH S

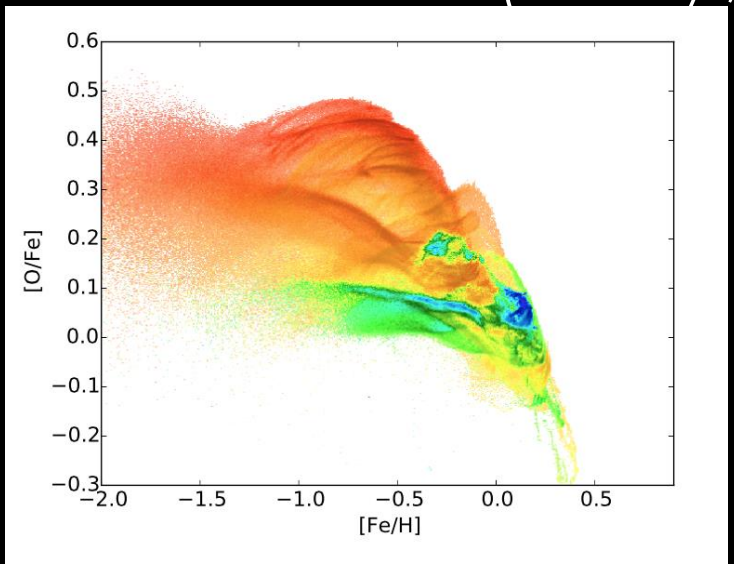
- When we convolve the [O/Fe]-[Fe/H] distribution with errors we go from…

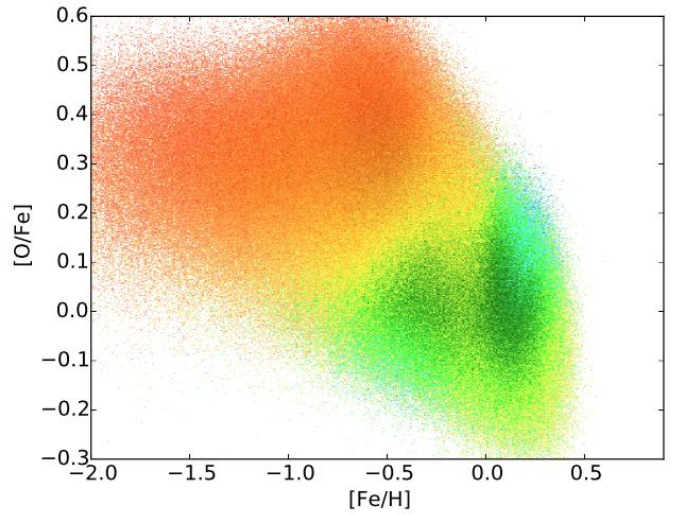
  $(\sigma_{age}, \sigma_{[Fe/H]}, \sigma_{[O/Fe]})$ =

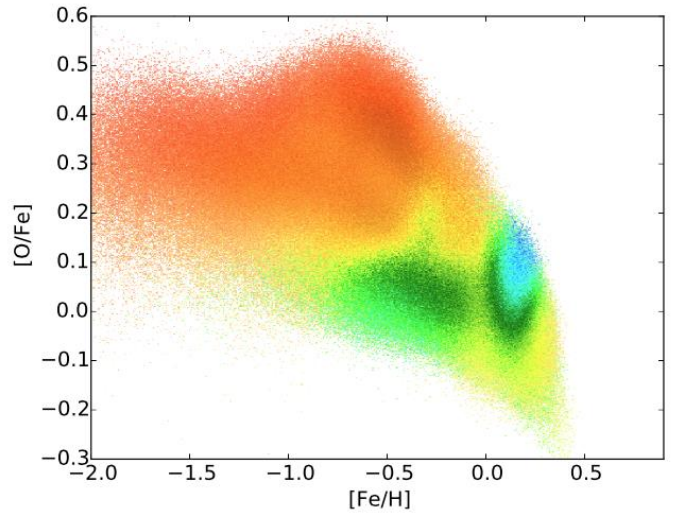
  (1 Gyr, 0.1 dex, 0.1 dex),

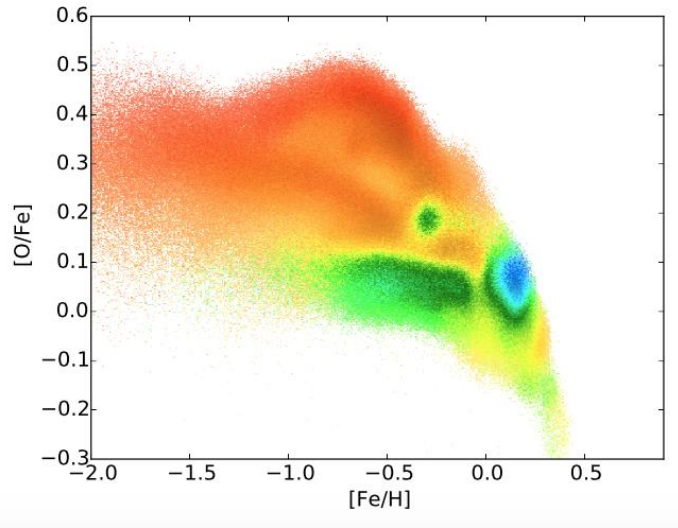
  (0.5 Gyr, 0.05 dex, 0.05 dex),

  (0.25 Gyr, 0.025 dex, 0.025 dex)







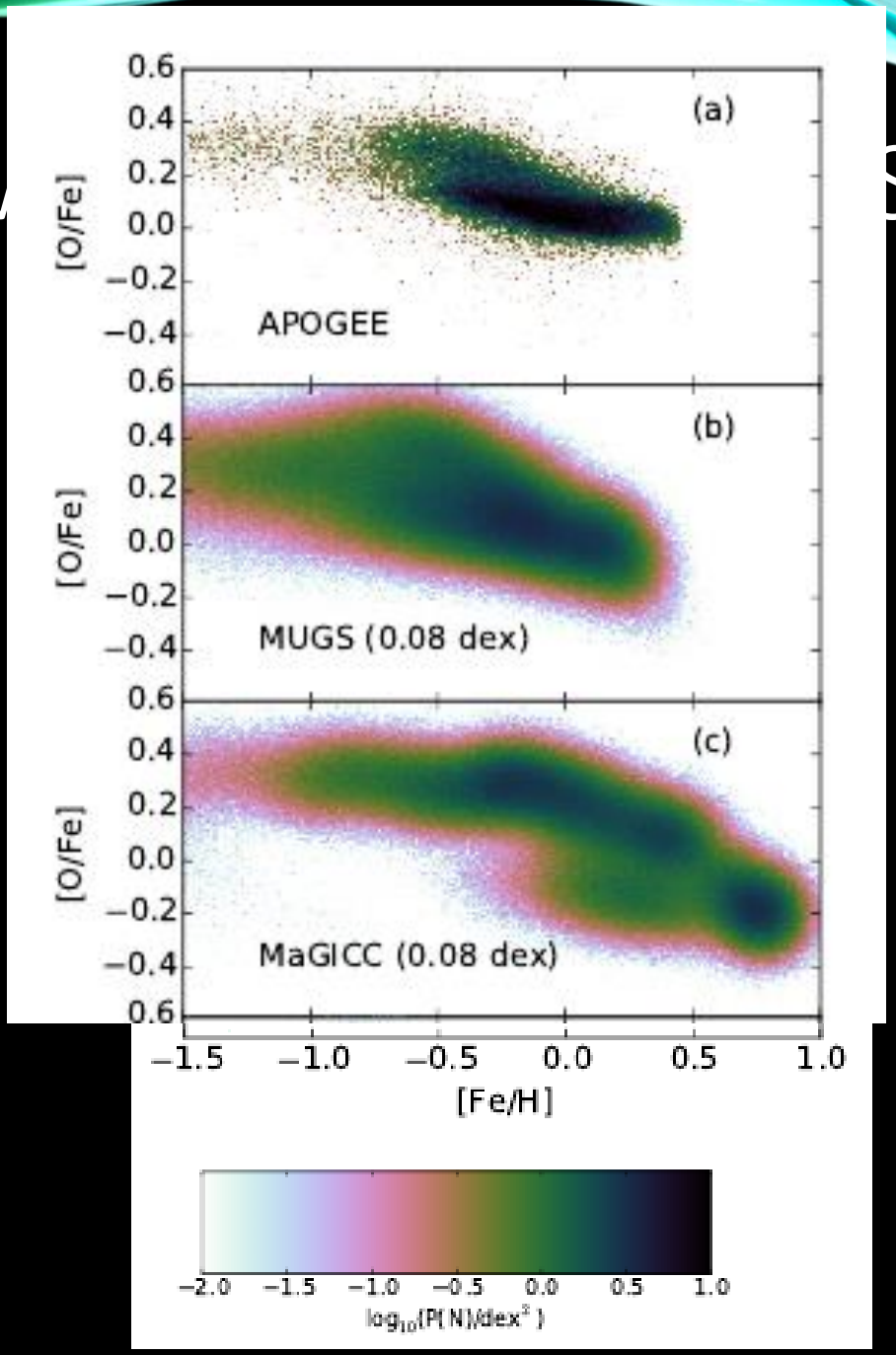


COMPARING W S

- The density distribution of stars –

APOGEE (Hayden et al. 2015) v. simulations

- Two sequences in APOGEE, MUGS and MaGICC
- MUGS more similar to APOGEE
- Can we do better?



FUTURE WORK

- Generate mock observations
- Treat the result as if we were observers
- Compare with what is really there in the simulation
- How much detail can we recover?

CONCLUSIONS

- The chemical evolution of galaxies is vital to our understanding of galaxy formation and evolution
- Use simulations to link observed properties to events in a galaxy's history
- Not trivial
- Different parts of a galaxy leave different signatures in the chemical abundances and ages of stars
- More work to do in future to make ready for new surveys