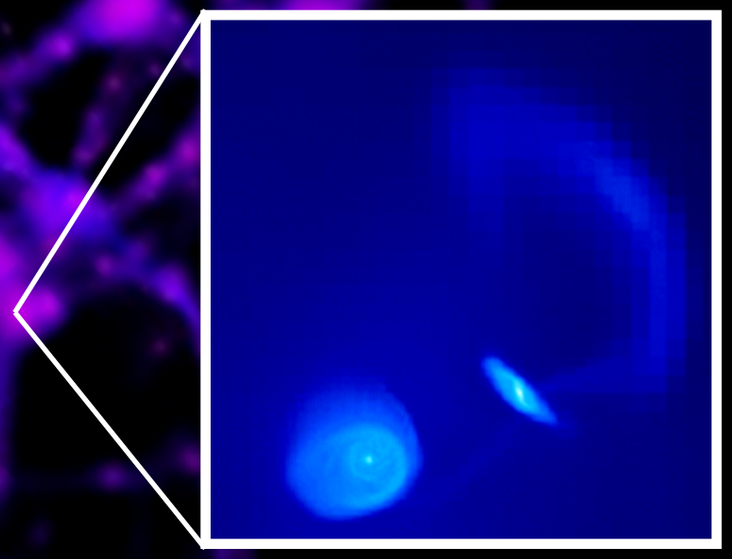
You are what you eat: galactic cannibalism and chemical evolution



Gareth Few

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E.A. Milne Centre

for Astrophysics

University of Hull

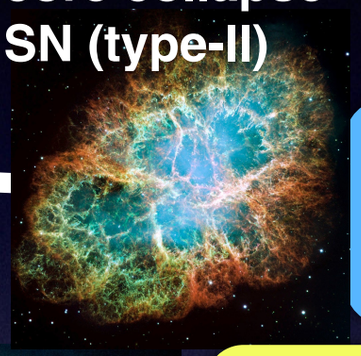
8th KIAS workshop on

Cosmology and Structure Formation

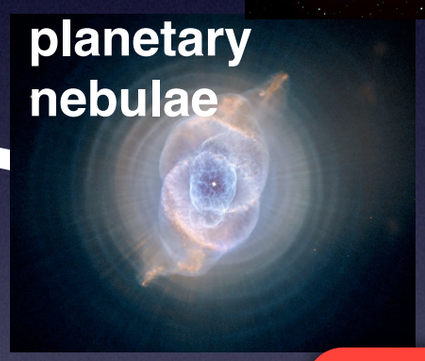
Chemical Evolution Model

Interstellar medium

star formation



Massive stars
(10 -100 $M_\odot$)



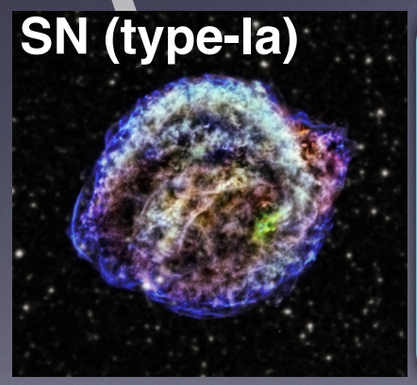
Intermediate-mass
stars
(1-10 $M_\odot$)

low-mass stars
(0.1-1 $M_\odot$)

O, Mg, Fe + energy

C, N

Fe + energy



white dwarf
+
companion mass
donor

**‘inert’ remnants:
white dwarfs, neutron stars,
black holes**

evolutionary timescale

Zoom vs. Completely Adaptive

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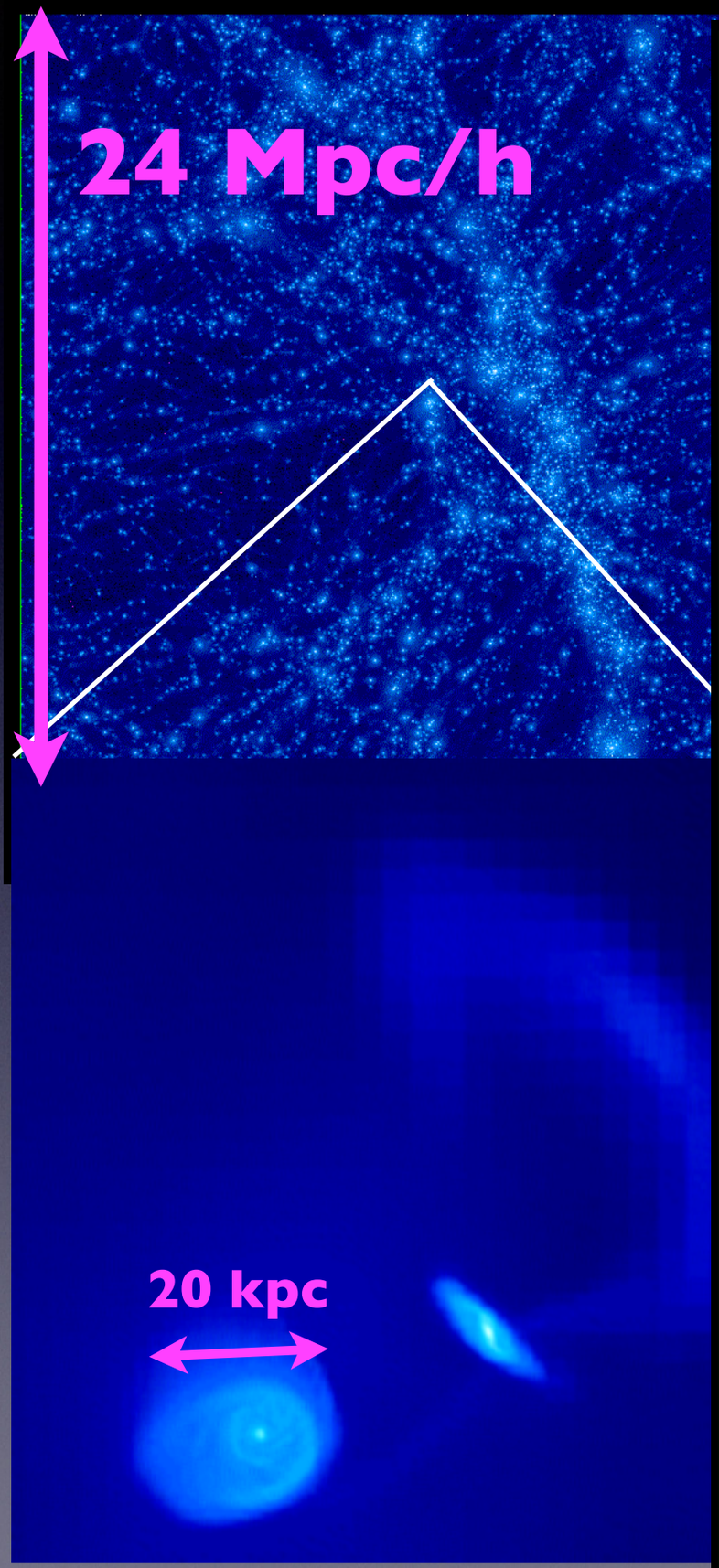
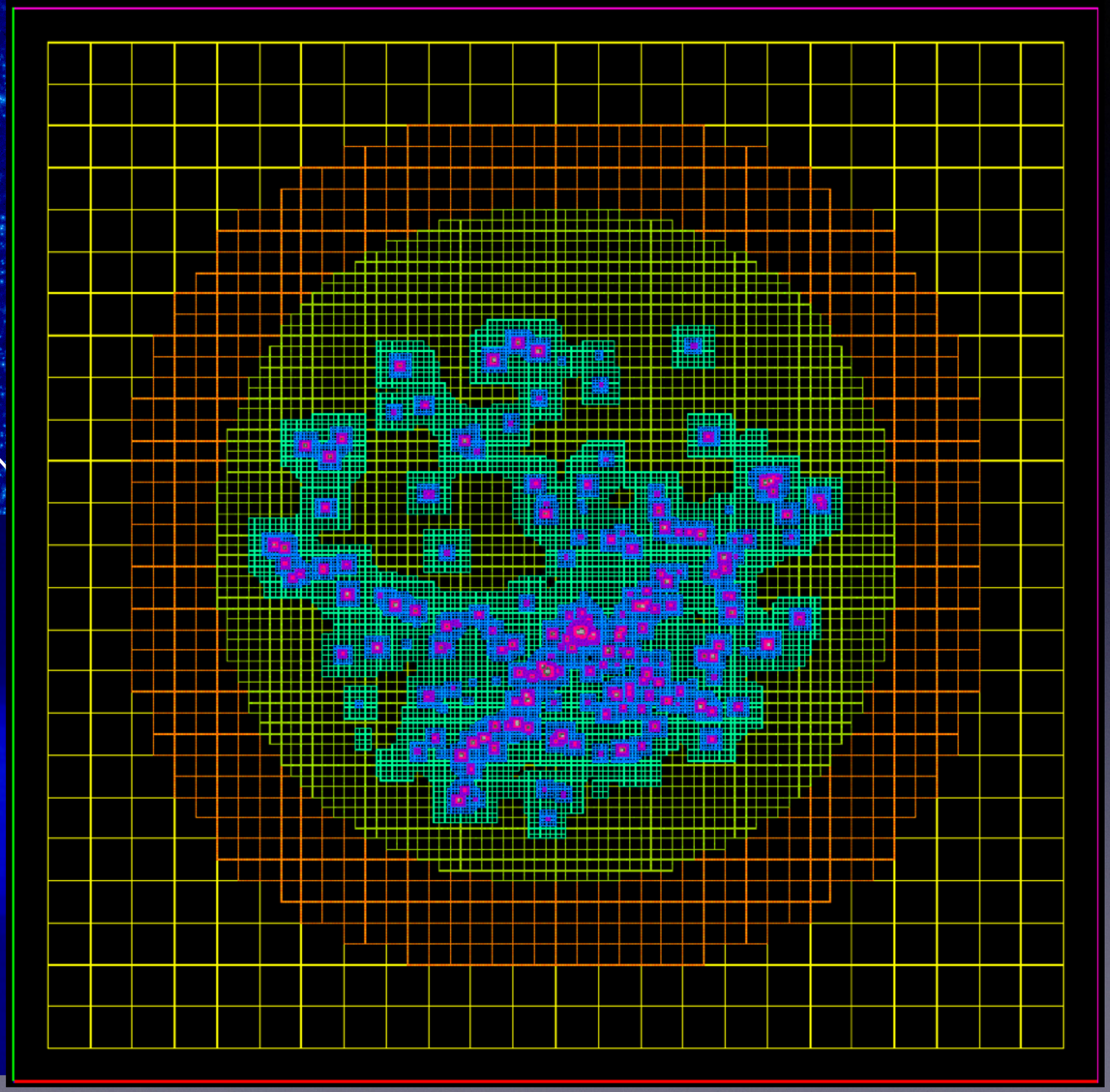
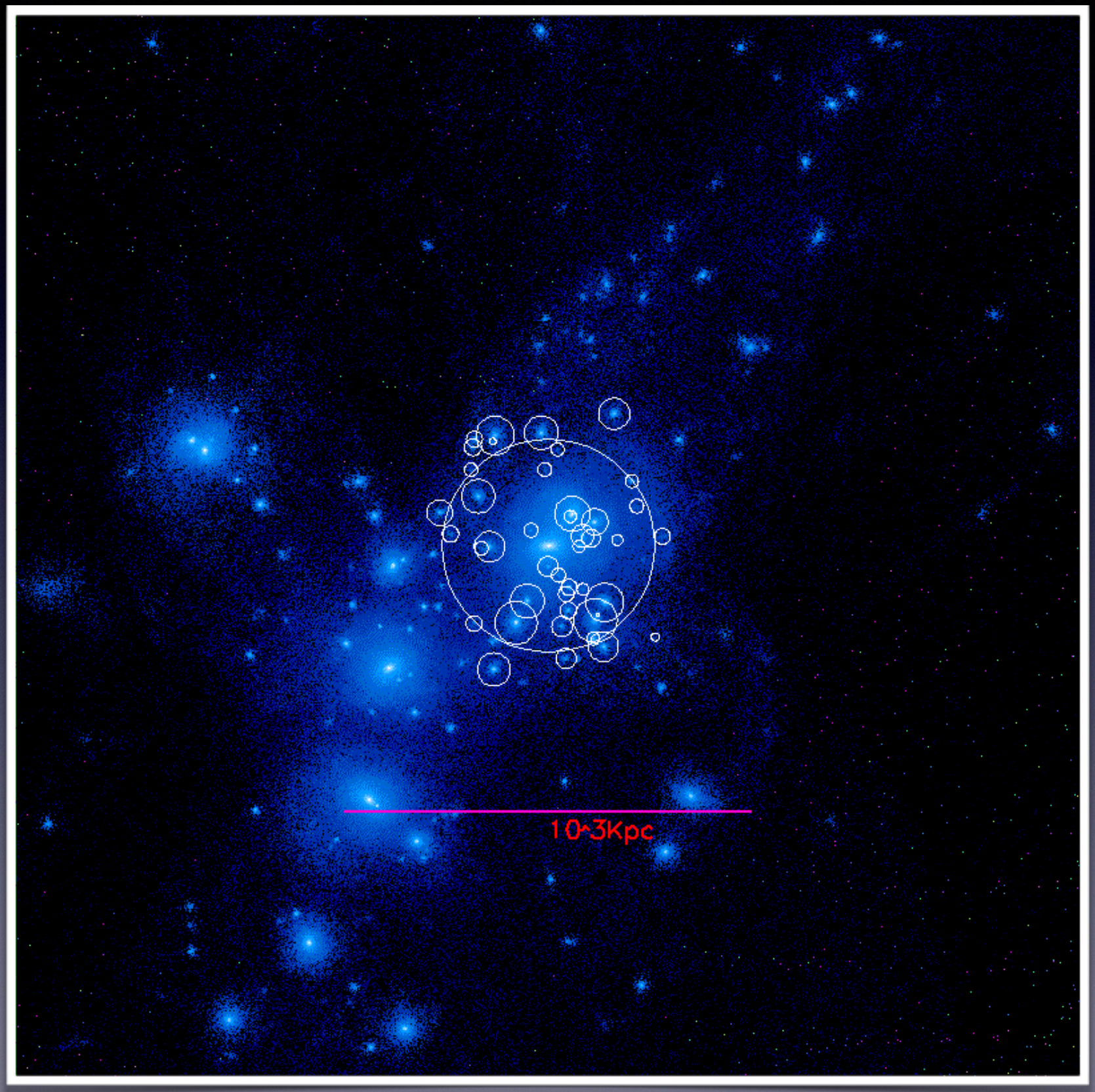
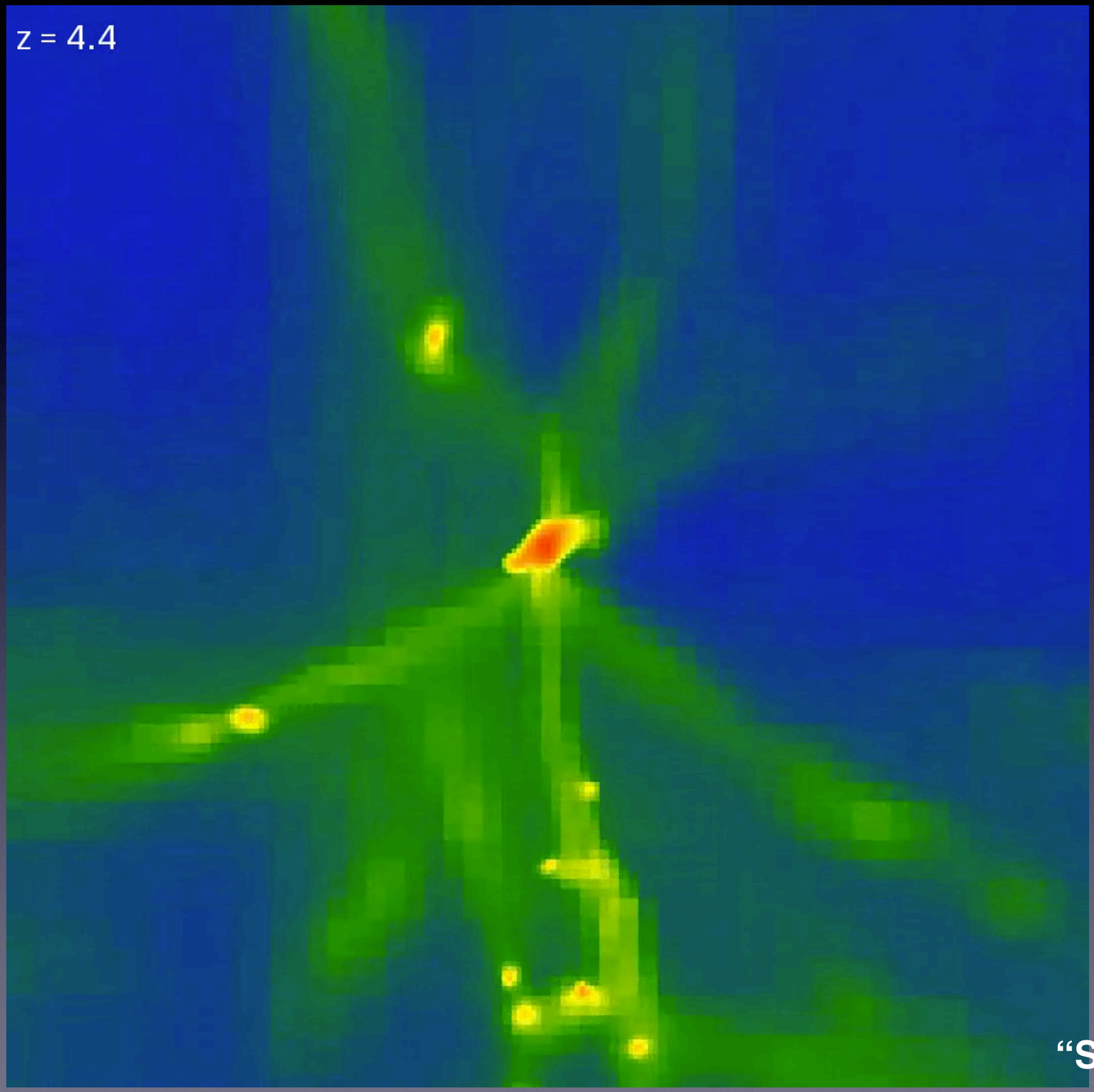


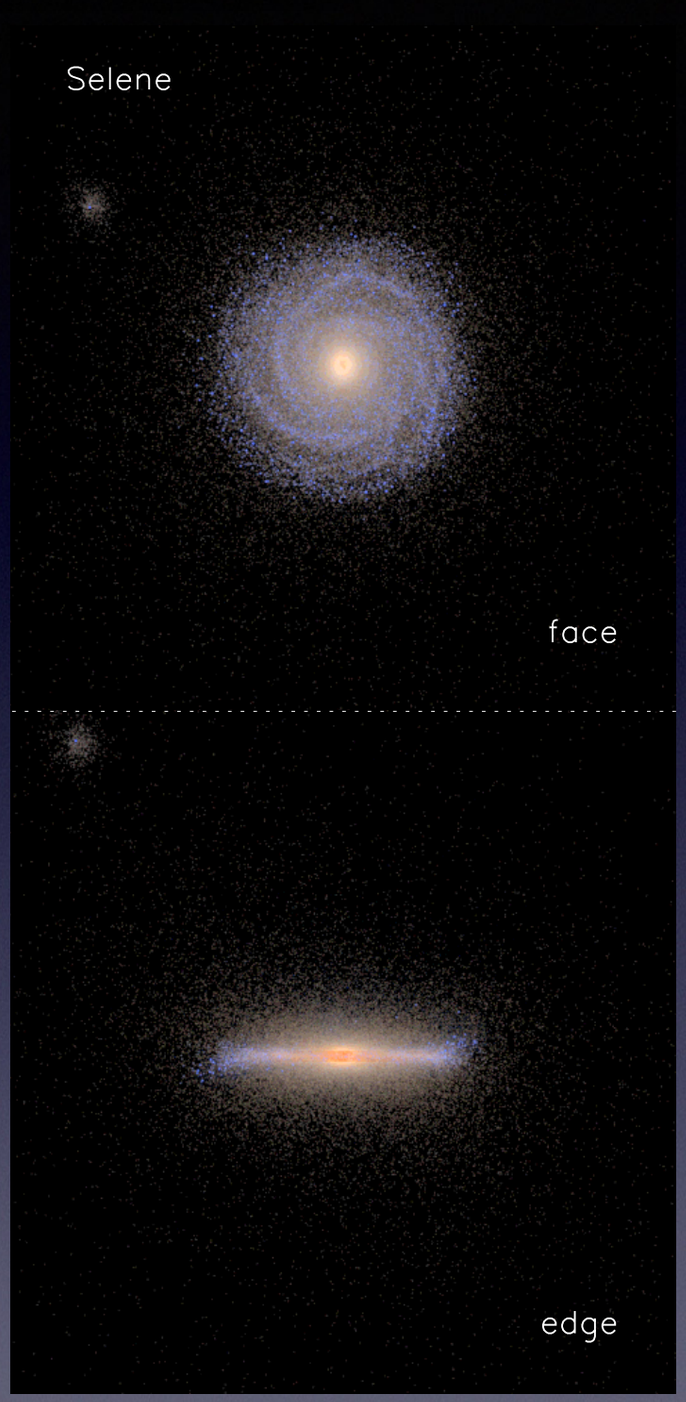


Dark matter driven satellite formation



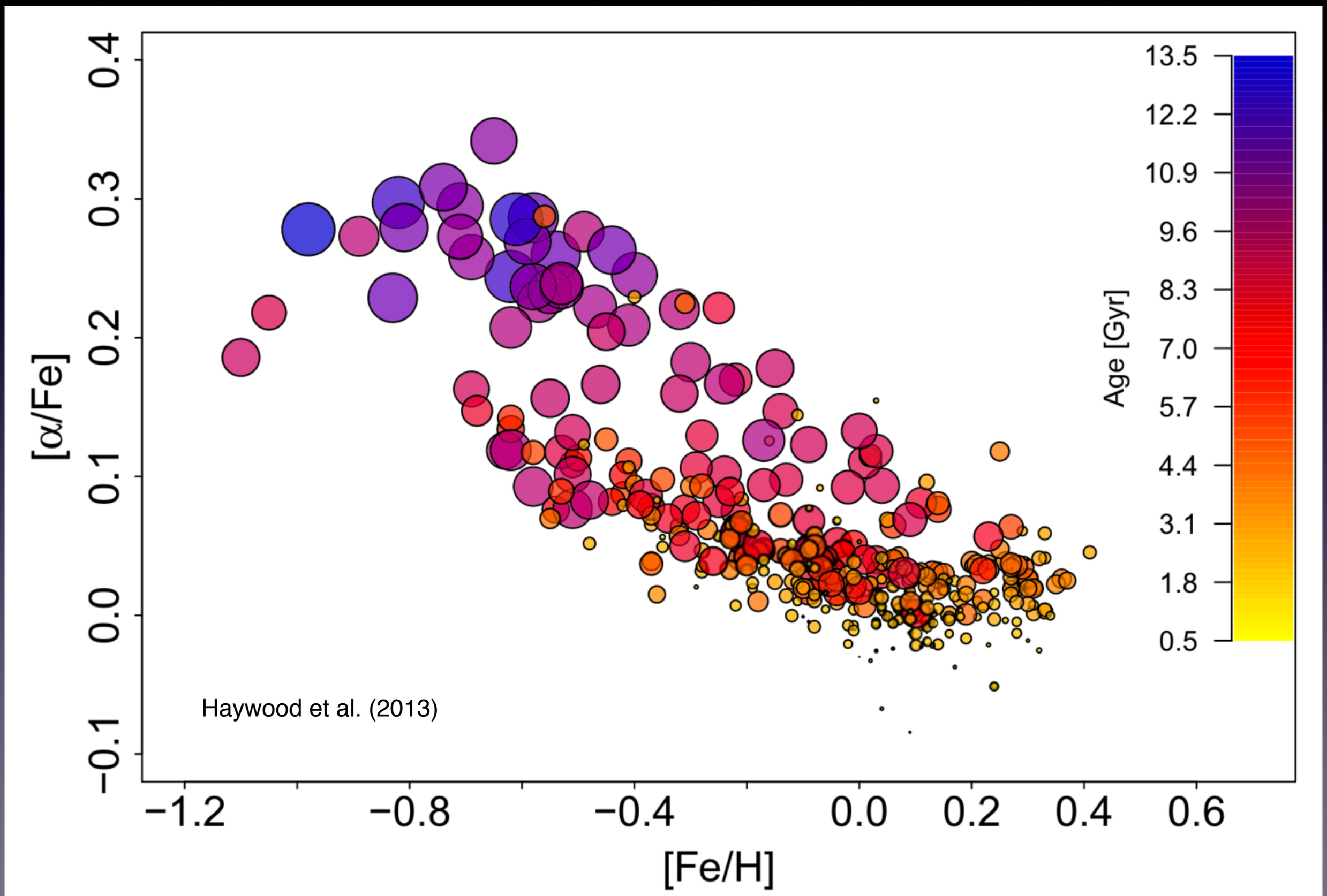
Galactic cannibalism



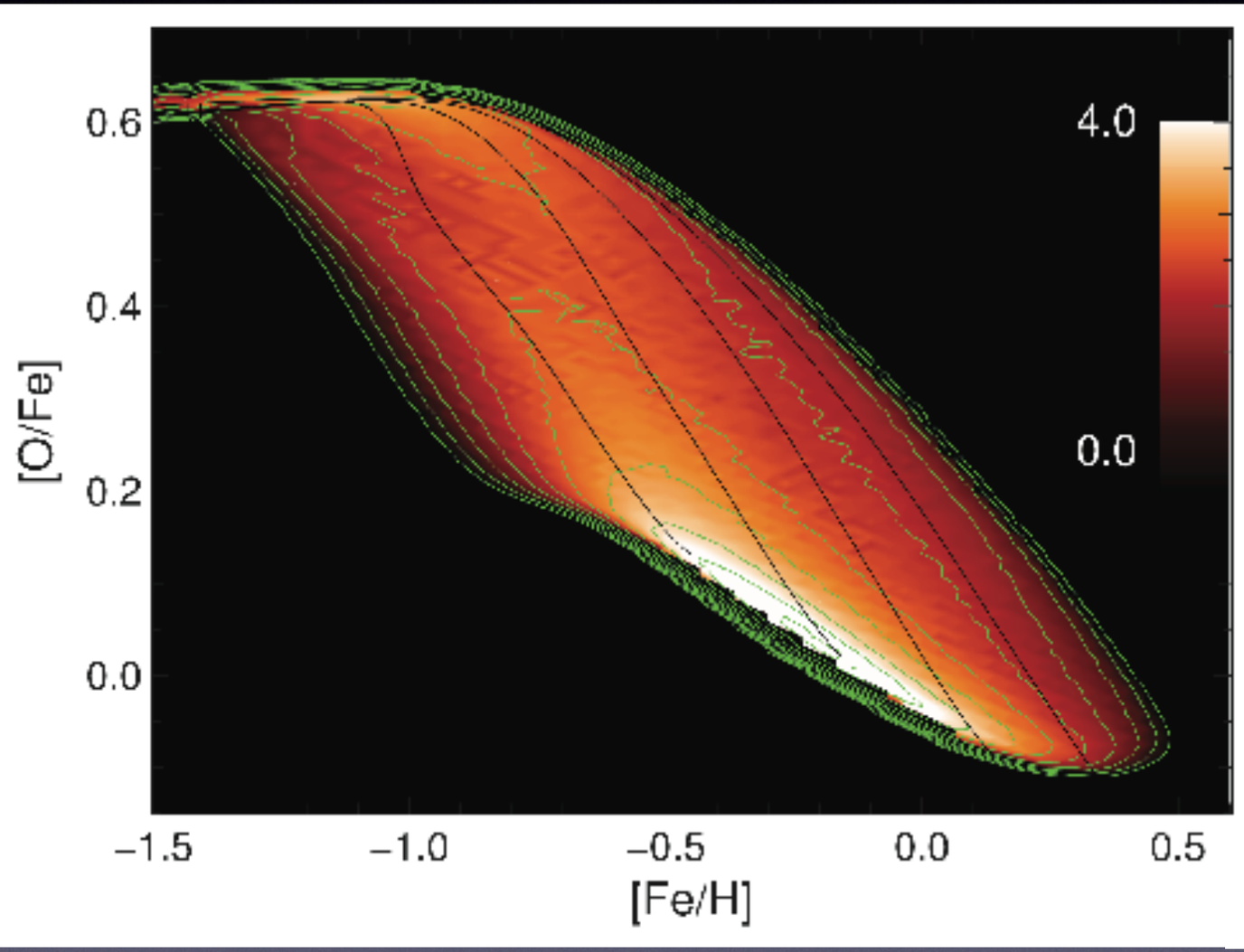


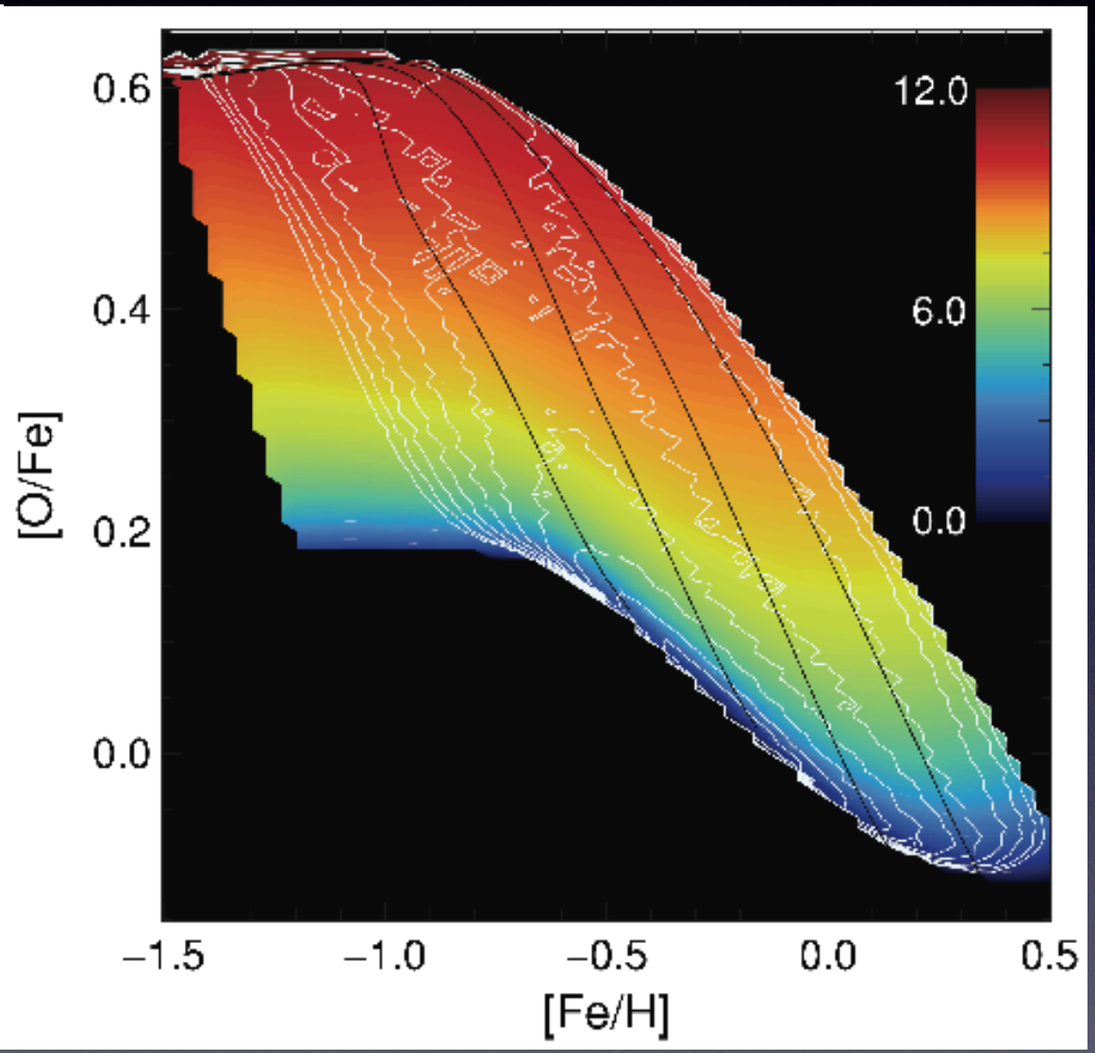
“Selene”, Few et al. 2012b

Thick and Thin Galactic Discs



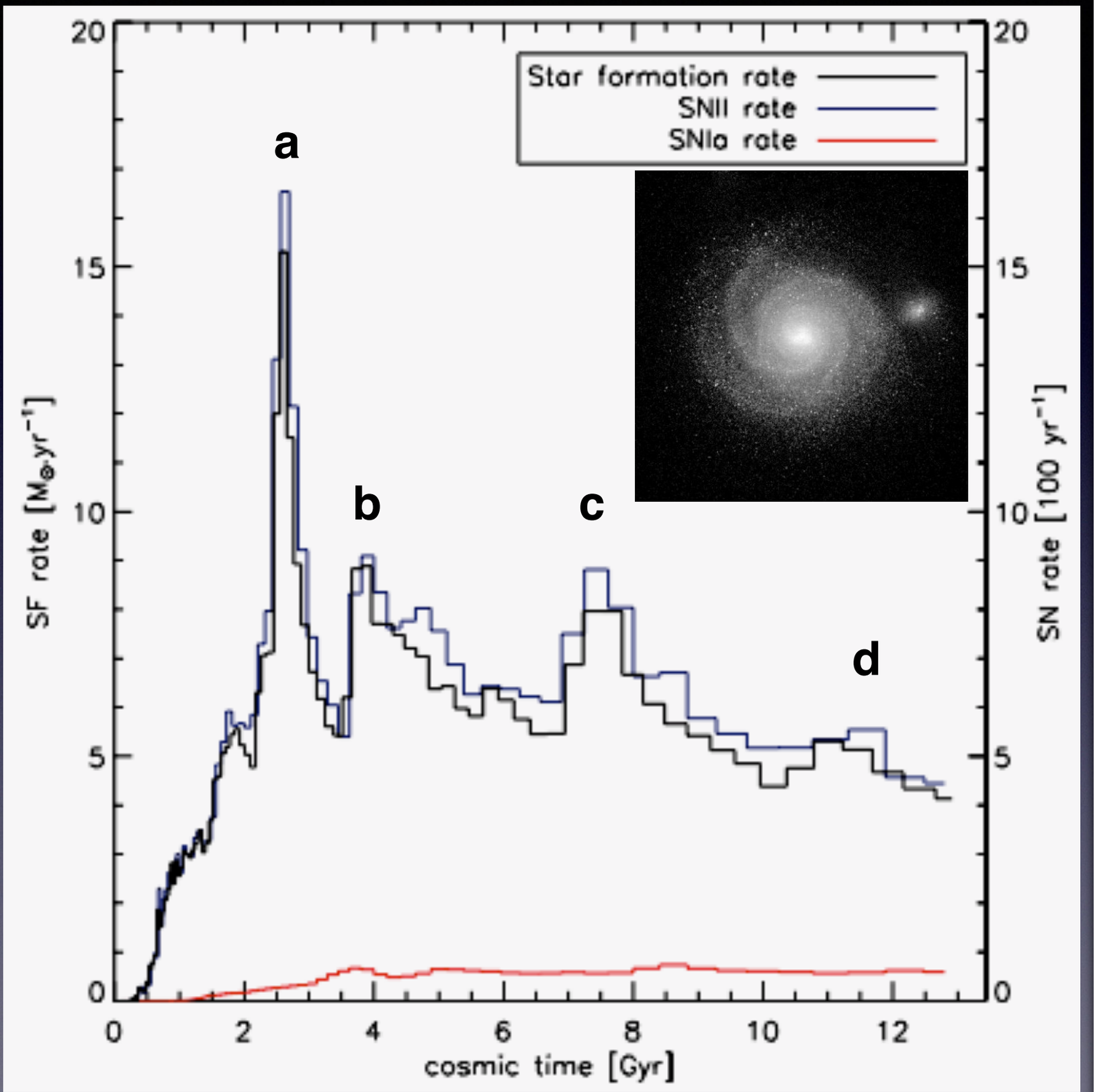
Thick and Thin Galactic Discs



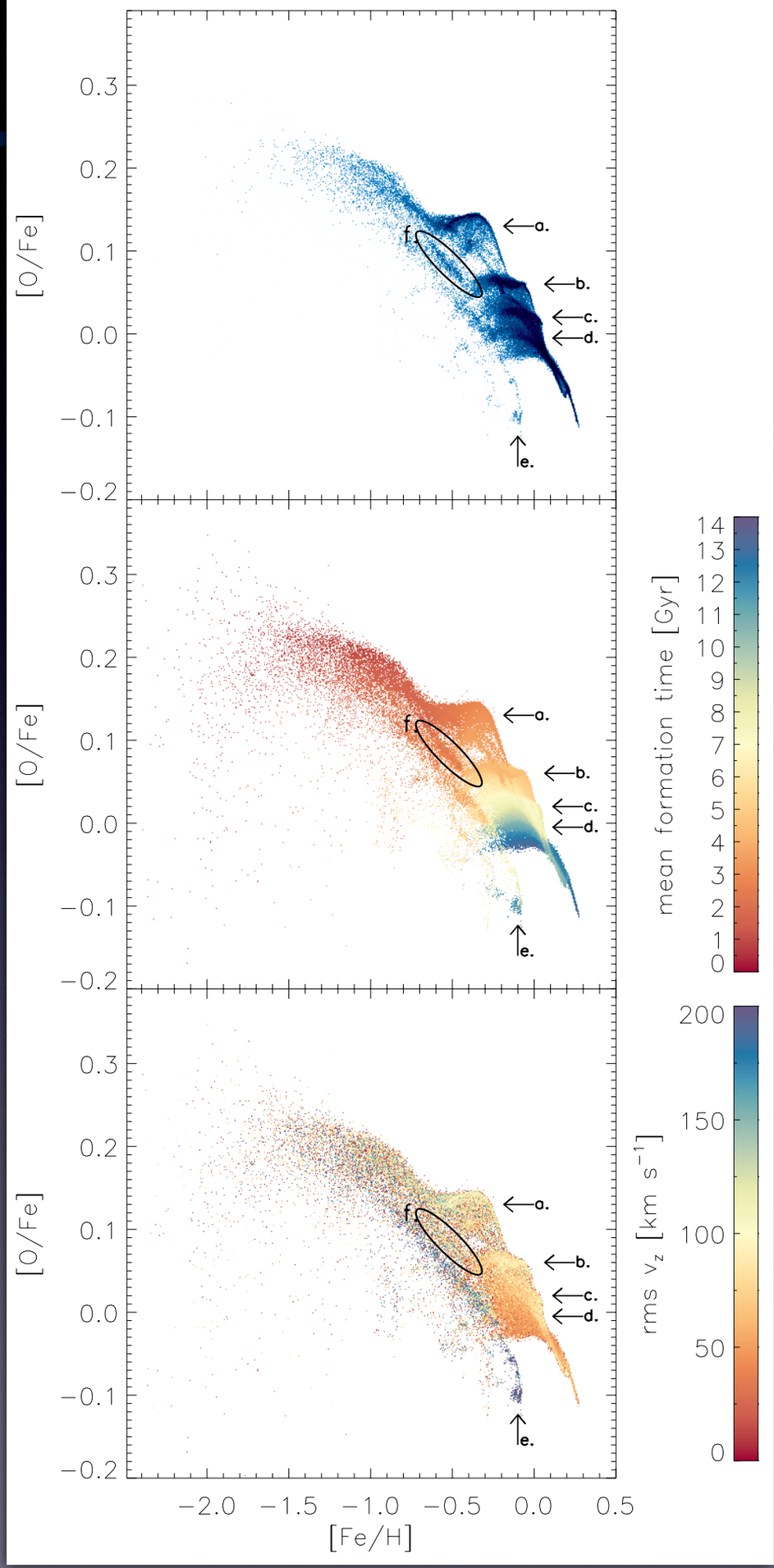


Schoenrich & Binney (2009)

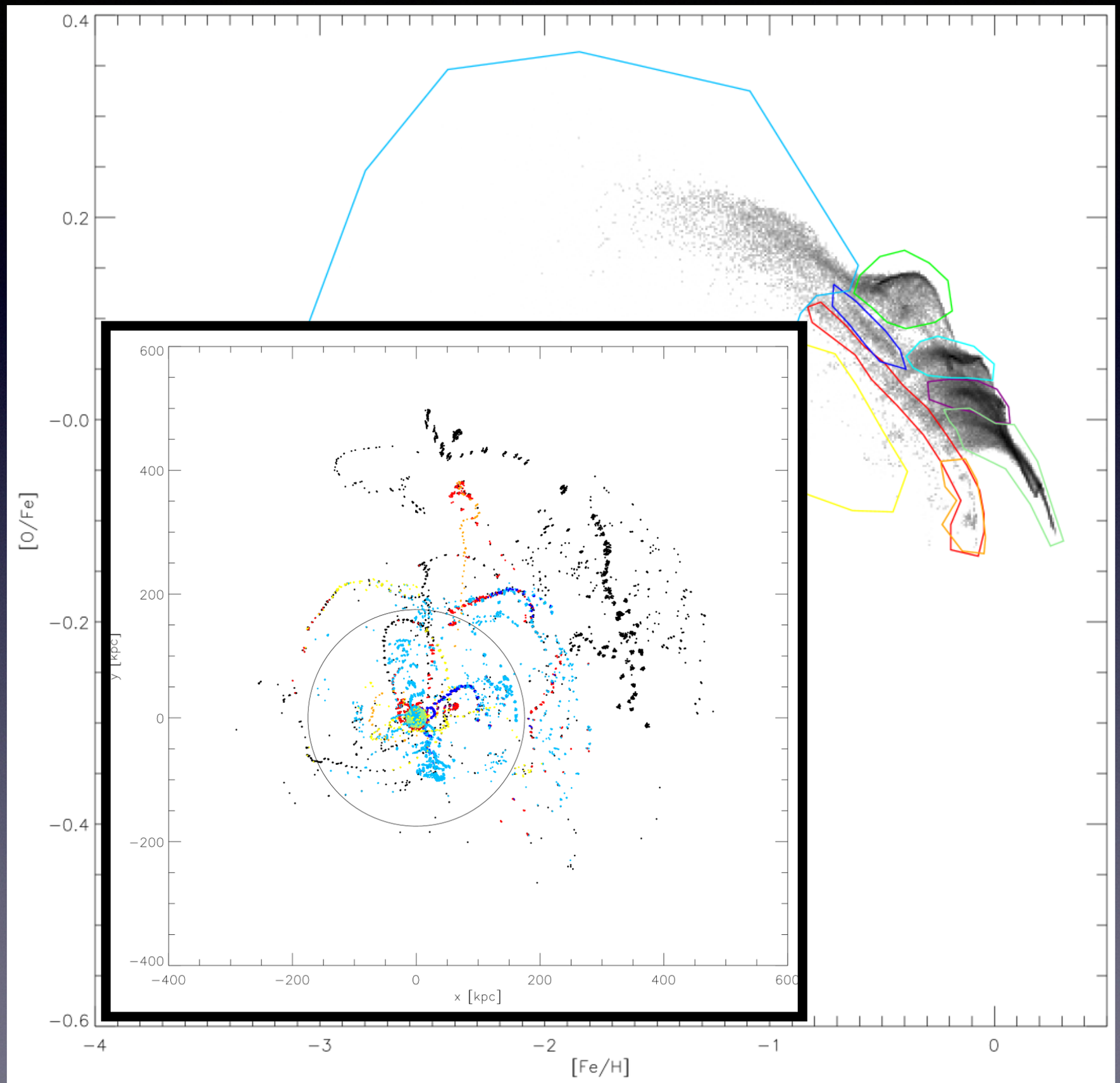
Thick disc(s?)



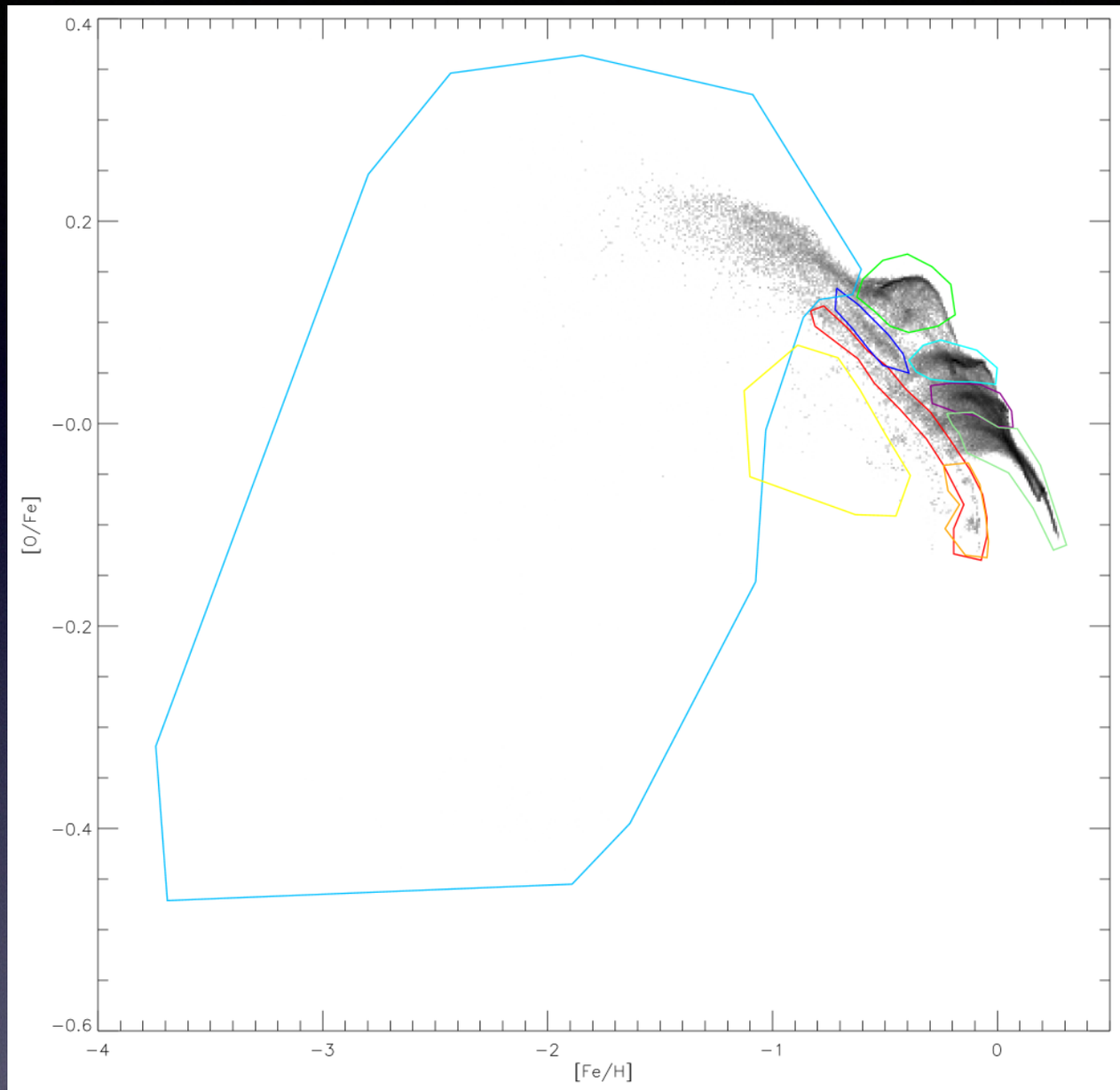
Few et al. (2014)

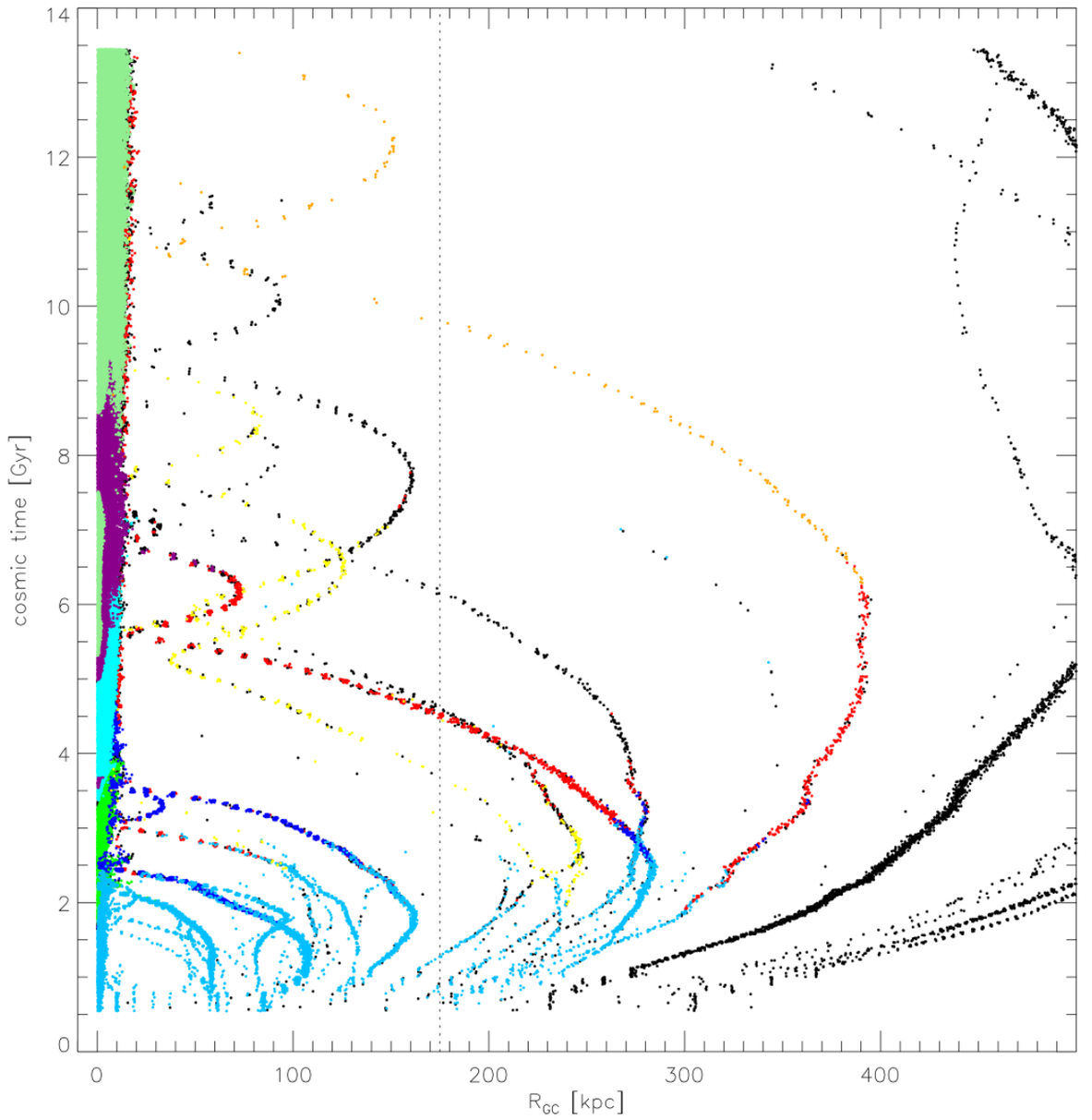


Decomposing Abundance Space



Decomposing Abundance Space





Many of these weren't born in the galaxy

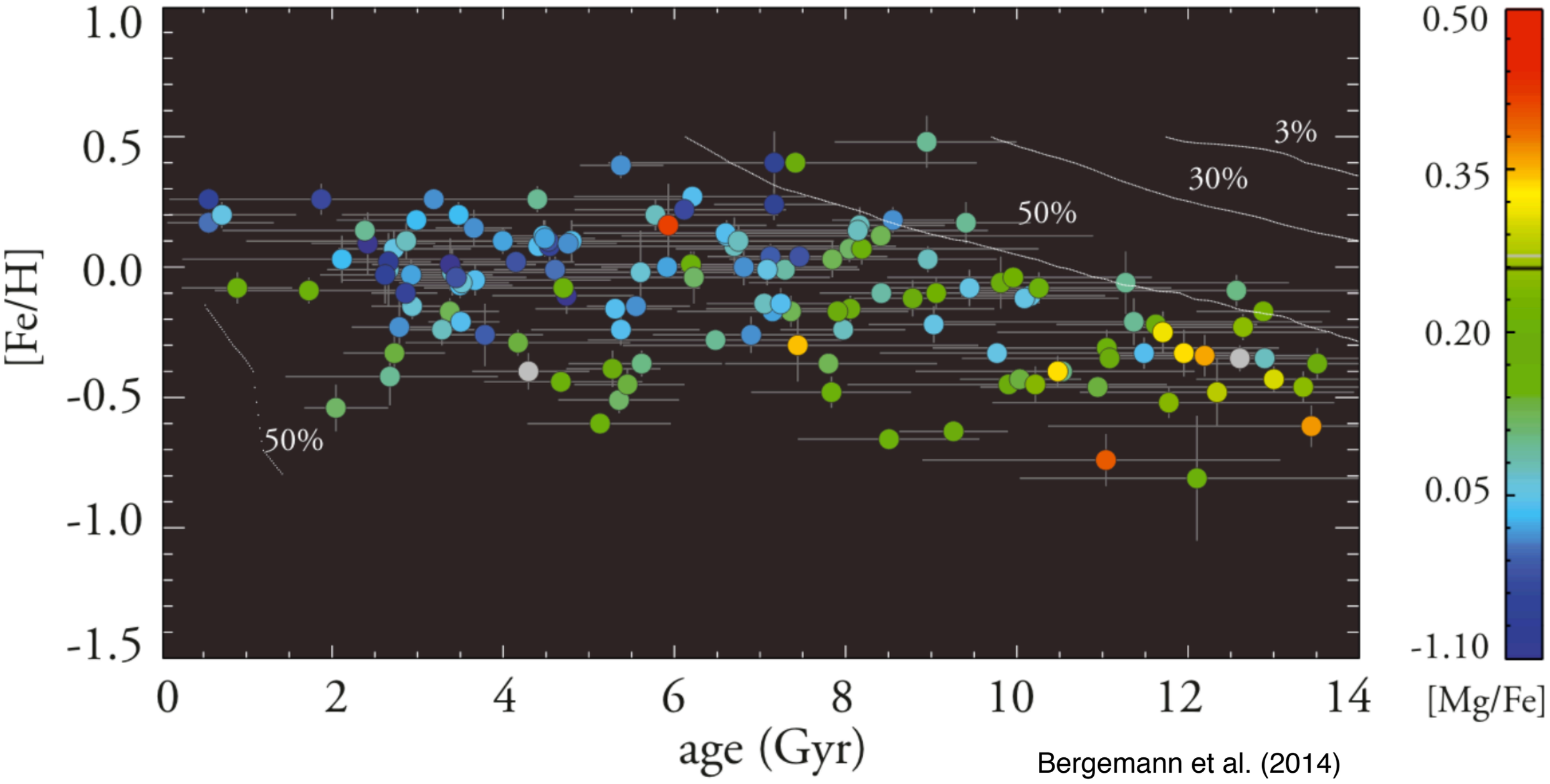
Stars born in satellites at later stages

Feature e. stars actual come from two accreted satellites

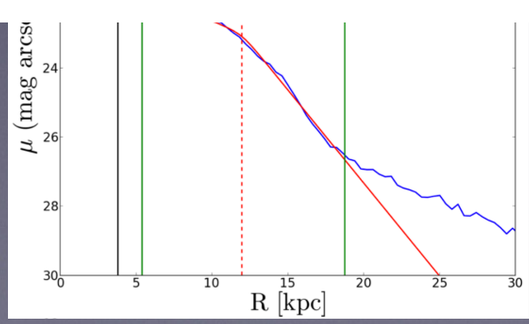
These are in-situ disk stars formed at different times

Very low mass satellites

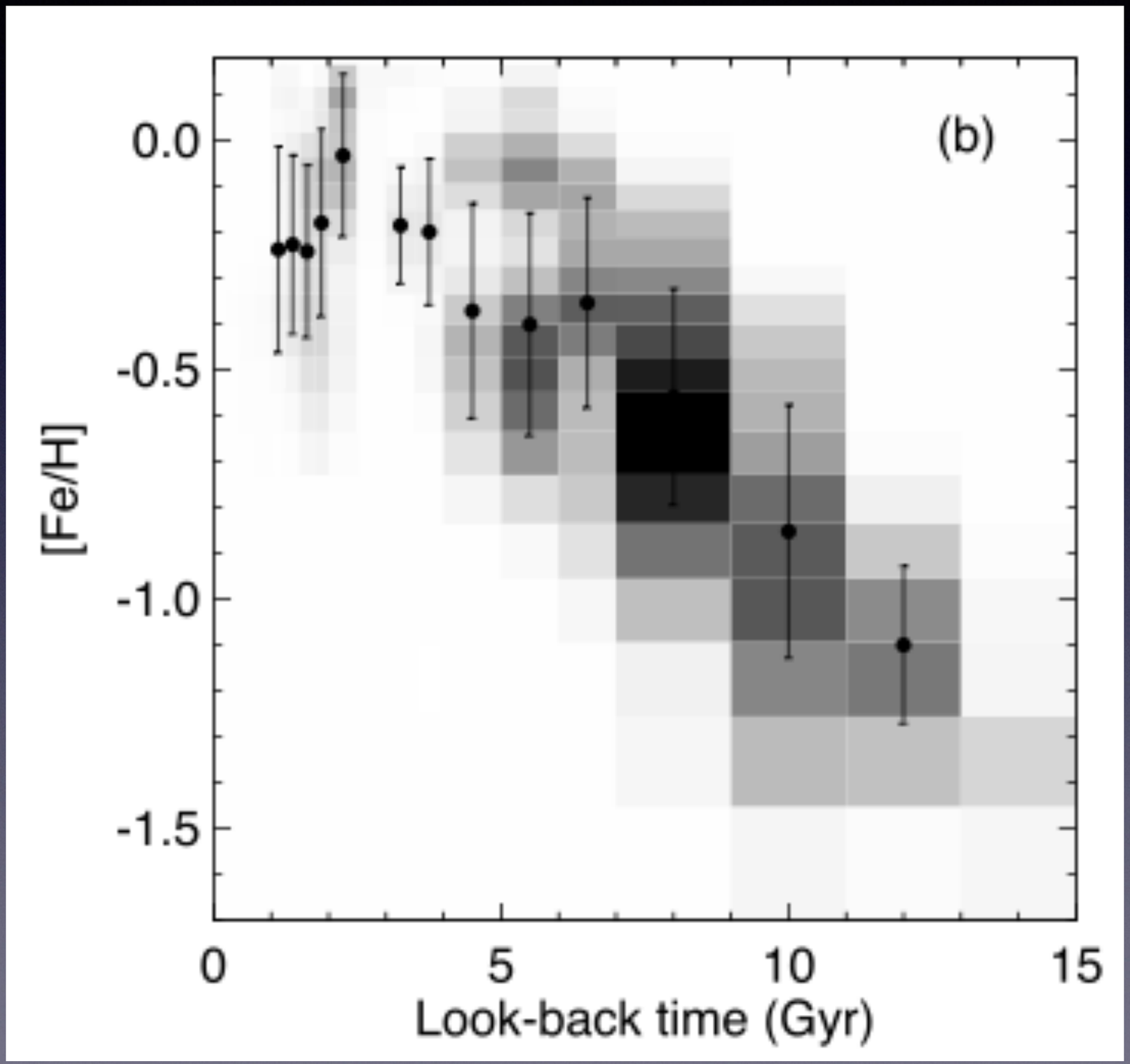
Age-metallicity relation: inverted!

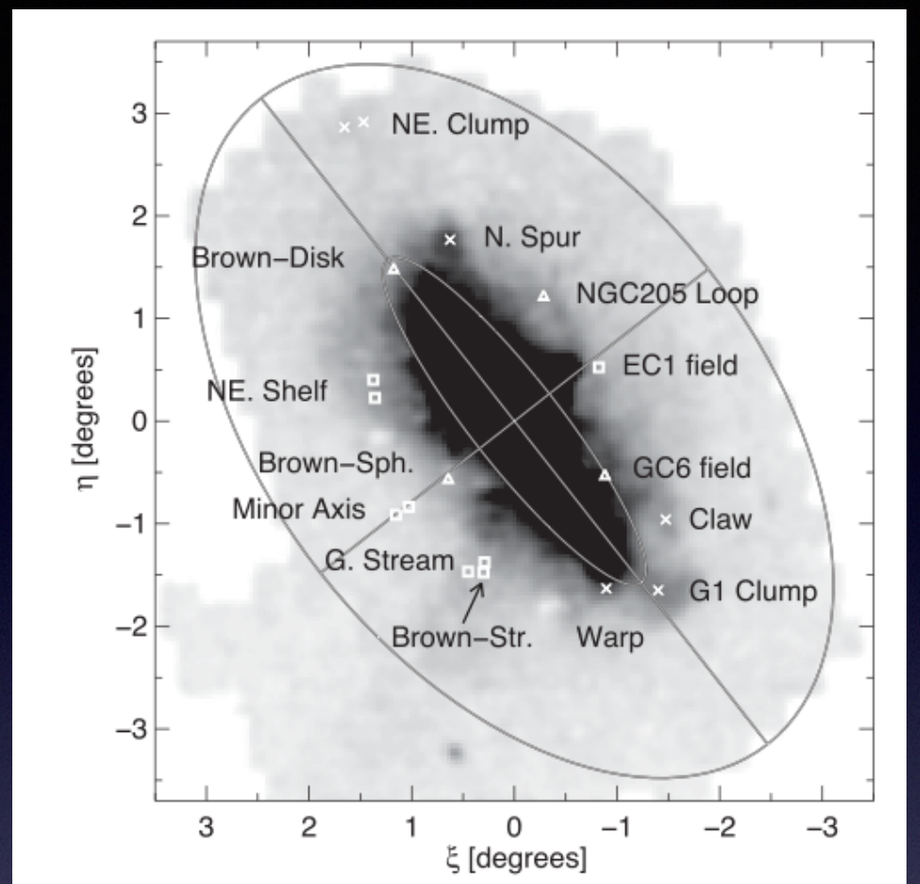


Bergemann et al. (2014)



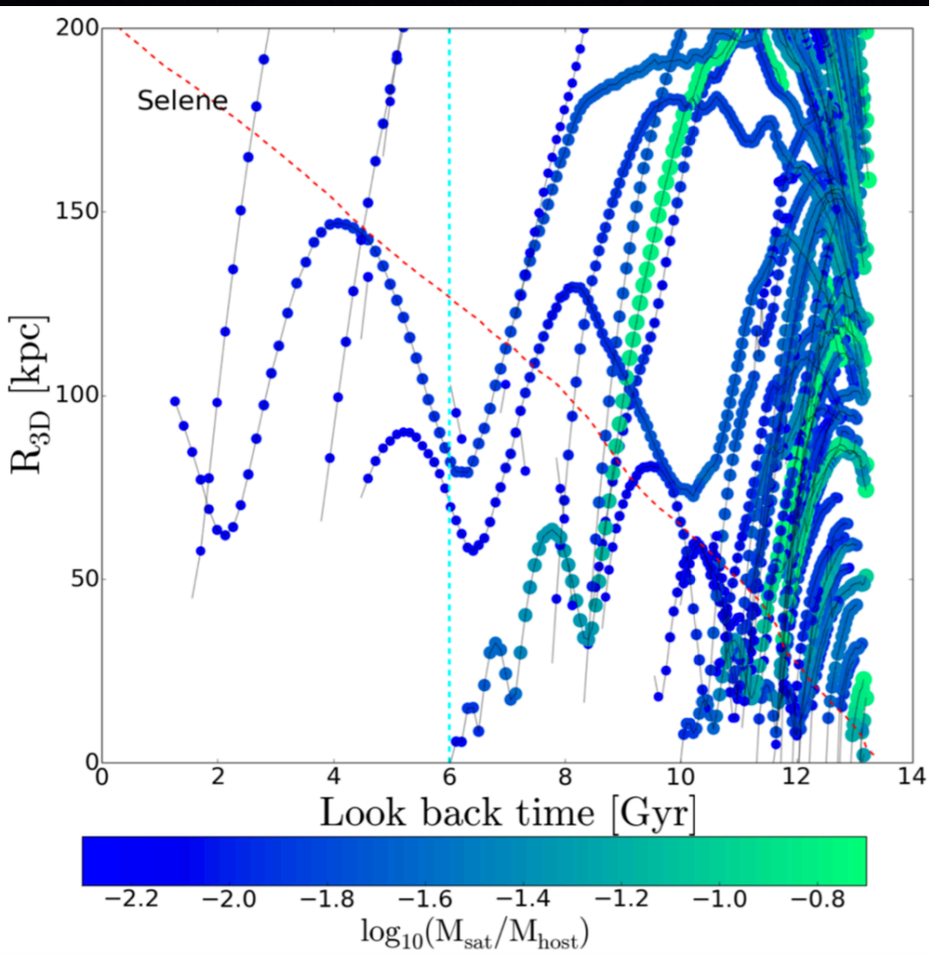
Observed AMR Inversion in M31

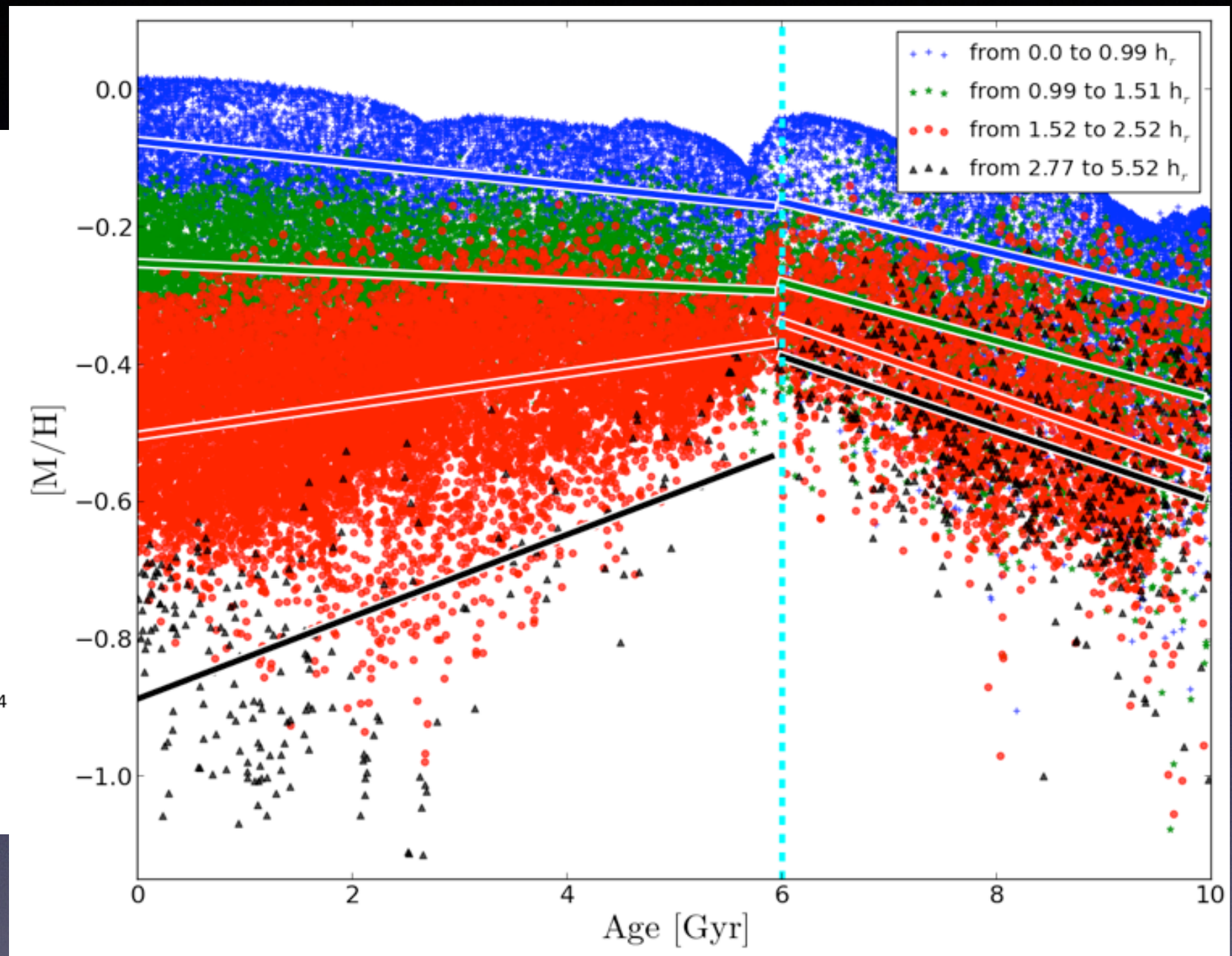




Bernard et al. (2012, 2015)

Age-metallicity relation: inverted!





Ruiz-Lara & Few et al. (2016)

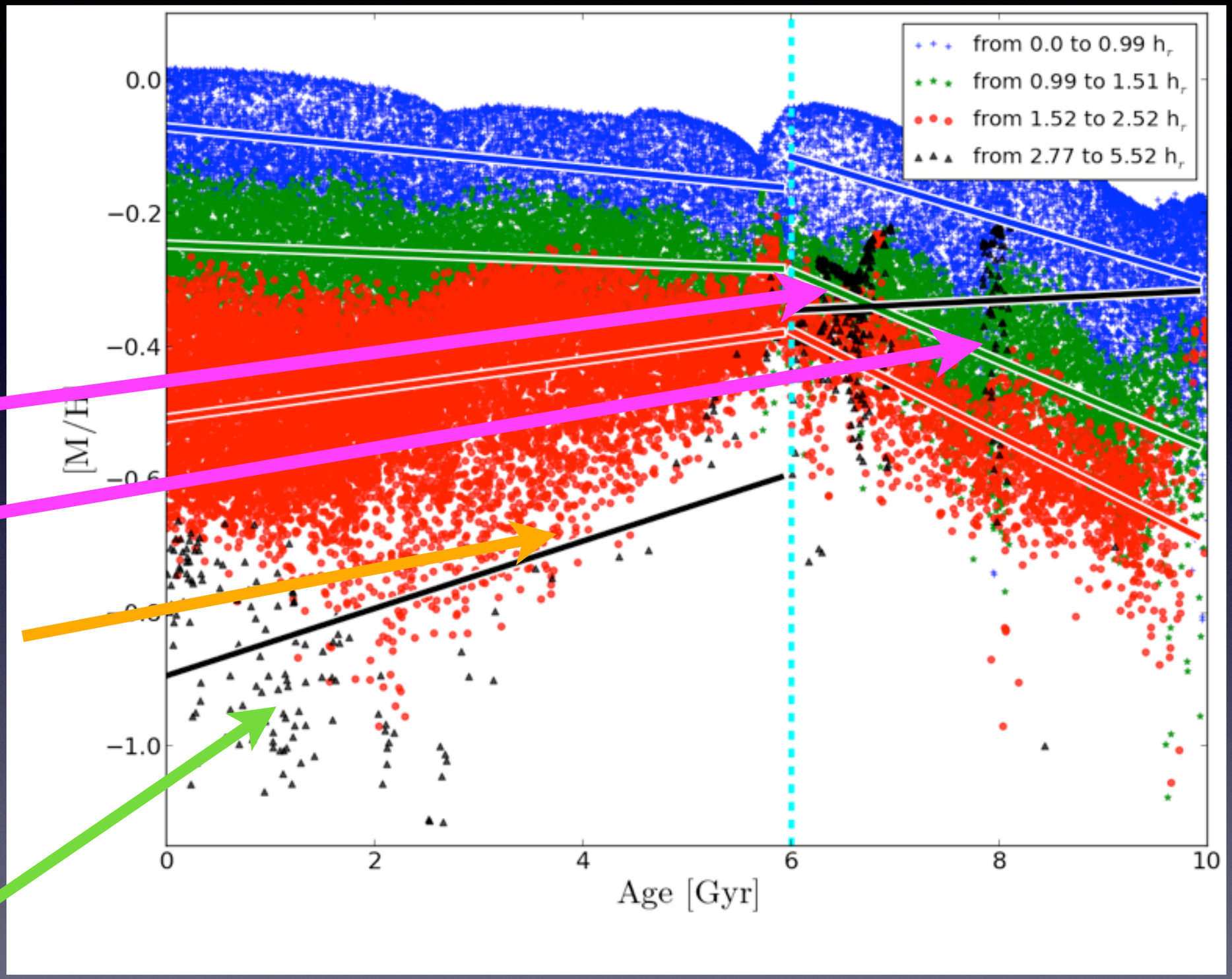
Inverted AMR in Birth Location

1: Stellar migration, secular and merger induced

2: Satellite passing through region 4

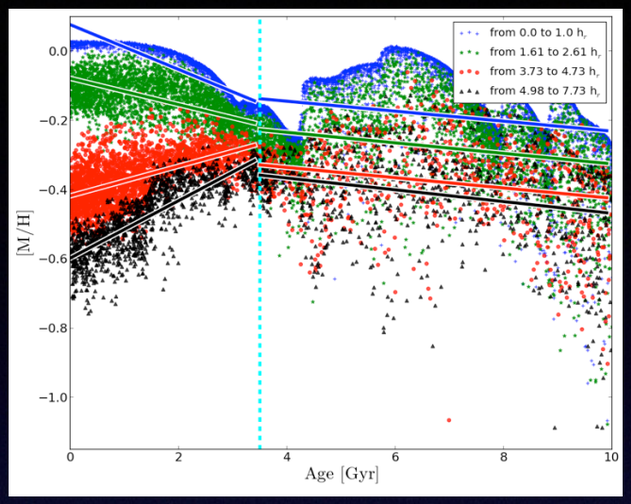
3: Decline due to lack of star formation diluted

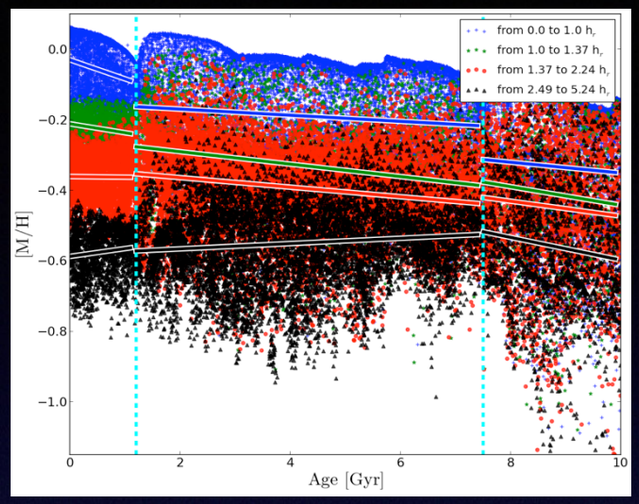
4: Star formation increases and the normal metallicity track is established

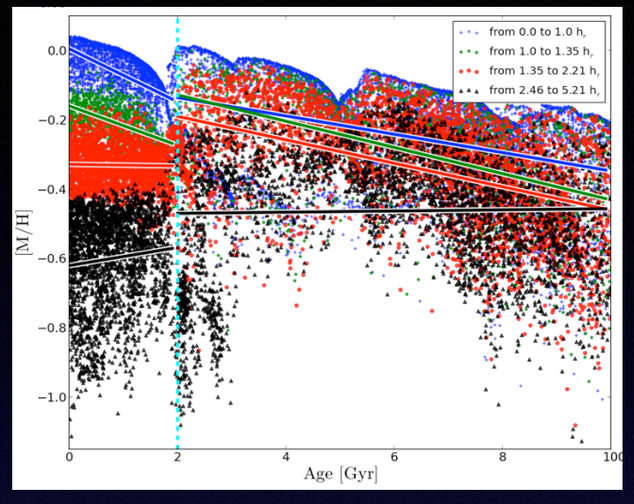


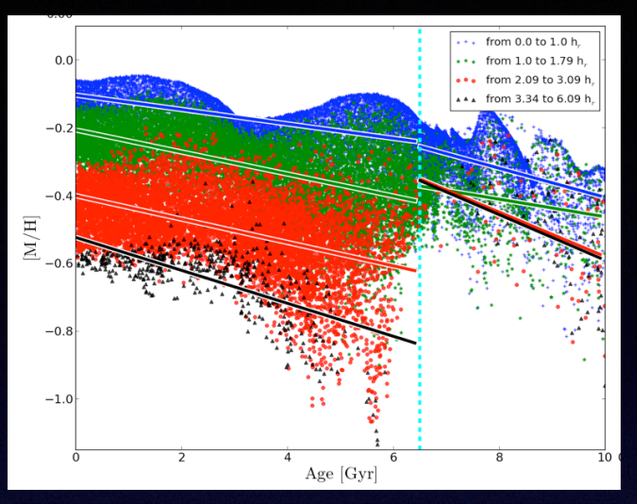
Ruiz-Lara & Few et al. (2016)

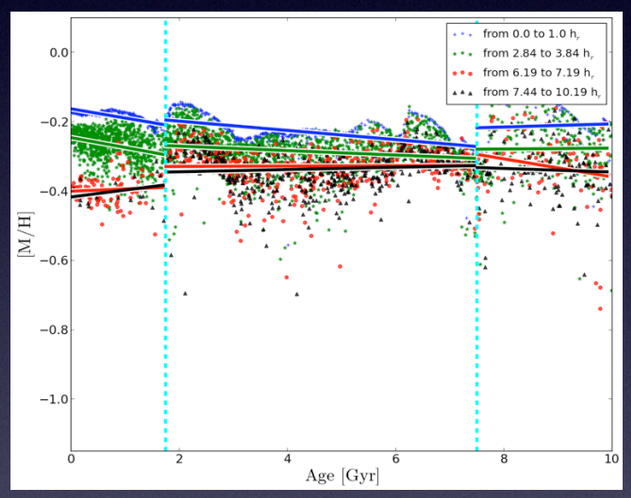
Inverted AMR in Birth Location

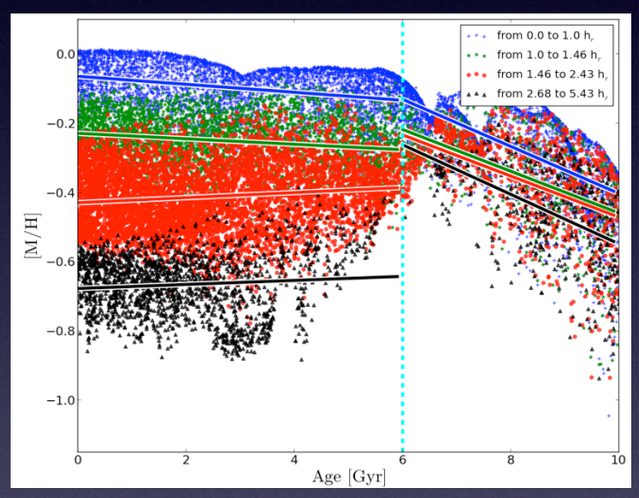


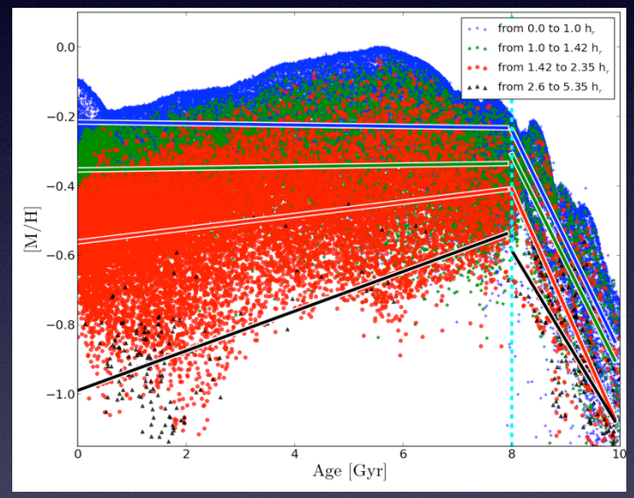


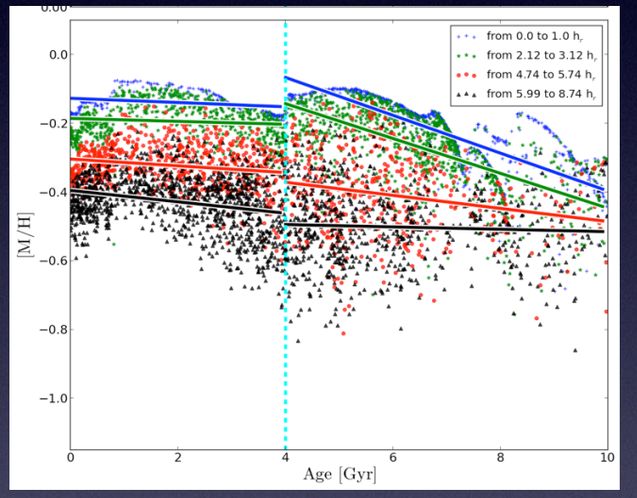


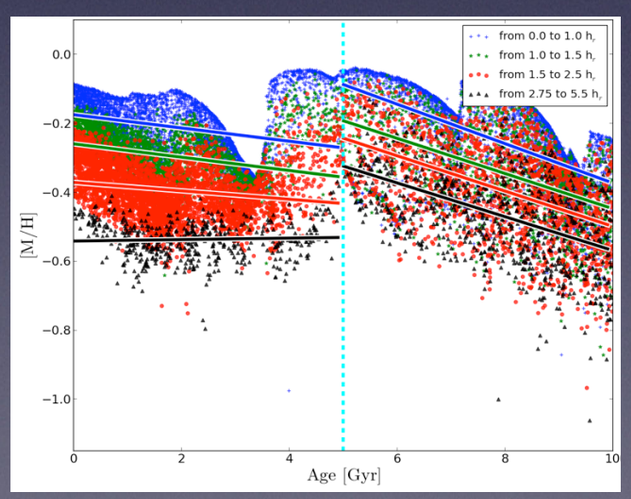


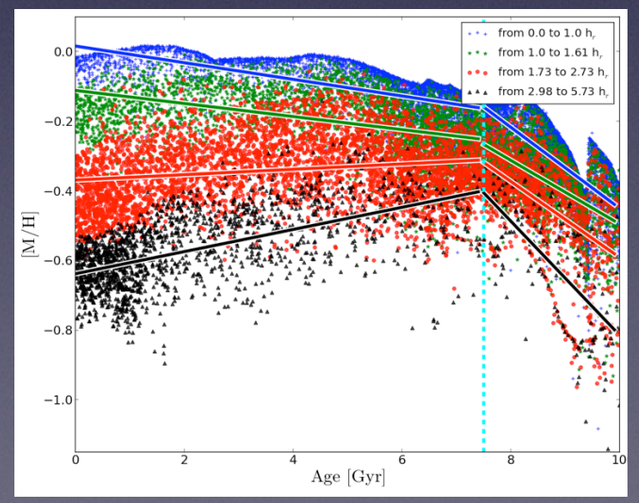


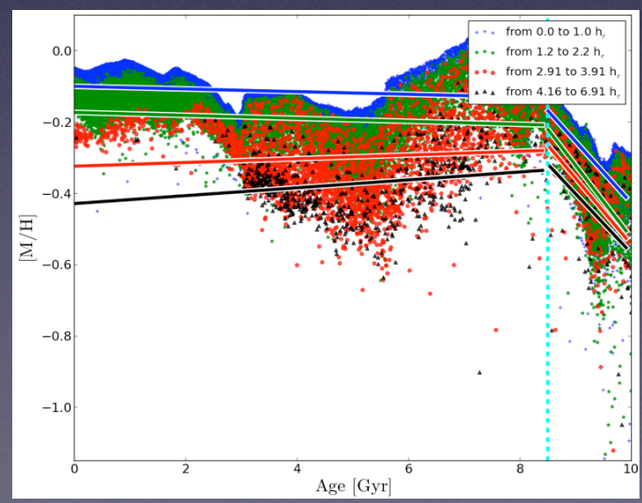


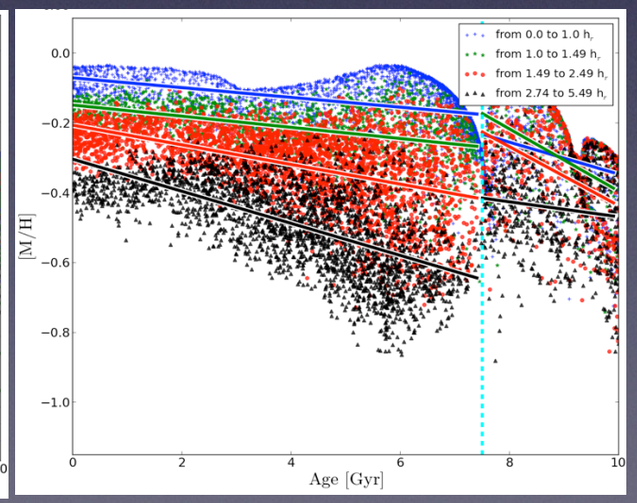












Ruiz-Lara & Few et al. (2016)

Conclusions

❖ Galactic chemical evolution is shaped by the cosmological framework of galaxy formation (mergers, satellites, infall rates, ram-pressure stripping etc)

❖ Galactic cannibalism increases dispersion and delays the decline in [O/Fe] - more than just 1 thick/thin disc?

❖ Inverted age-metallicity relation is caused by a combination of inside-out formation, satellite passages, dilution by infall and stellar migration