Metallicity Gradients In Simulated Dwarf Galaxies

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GalFRESCA 2018

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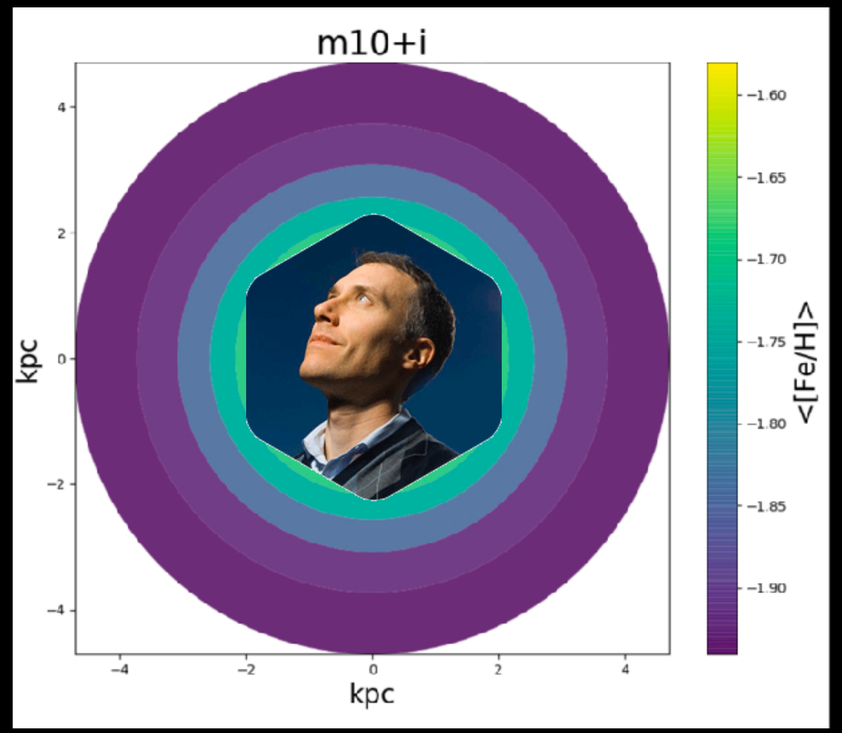
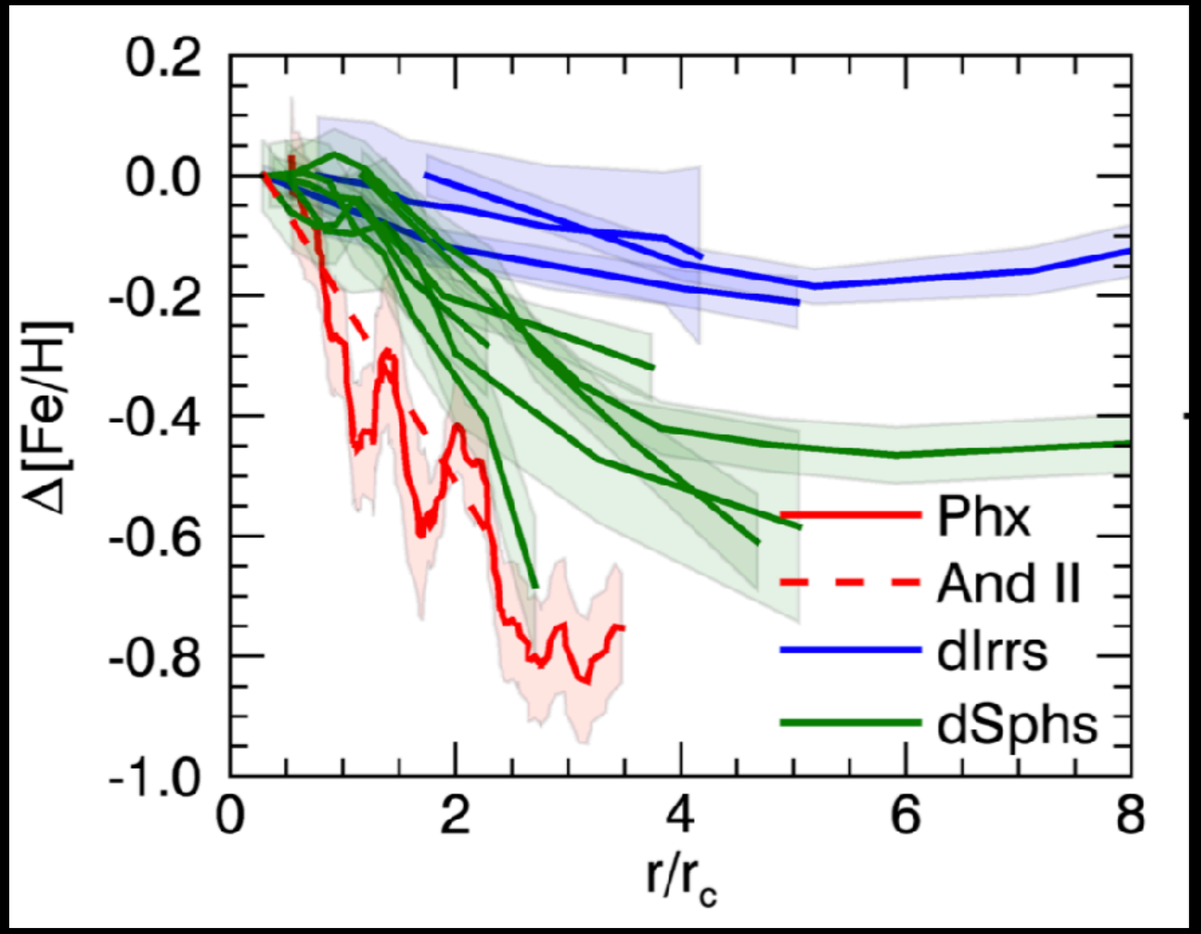


Metallicity gradients in LG dwarf galaxies

- MDFs from spectroscopic & photometric data (e.g. Grebel et al. 2003; Kirby et al. 2013)
- Metallicity gradients observed in LG dwarfs (Tolstoy et al. 2004; Koch et al. 2006; Kacharov et al. 2016)
- Often data taken from small regions of galaxies may not reflect their true global metallicities.

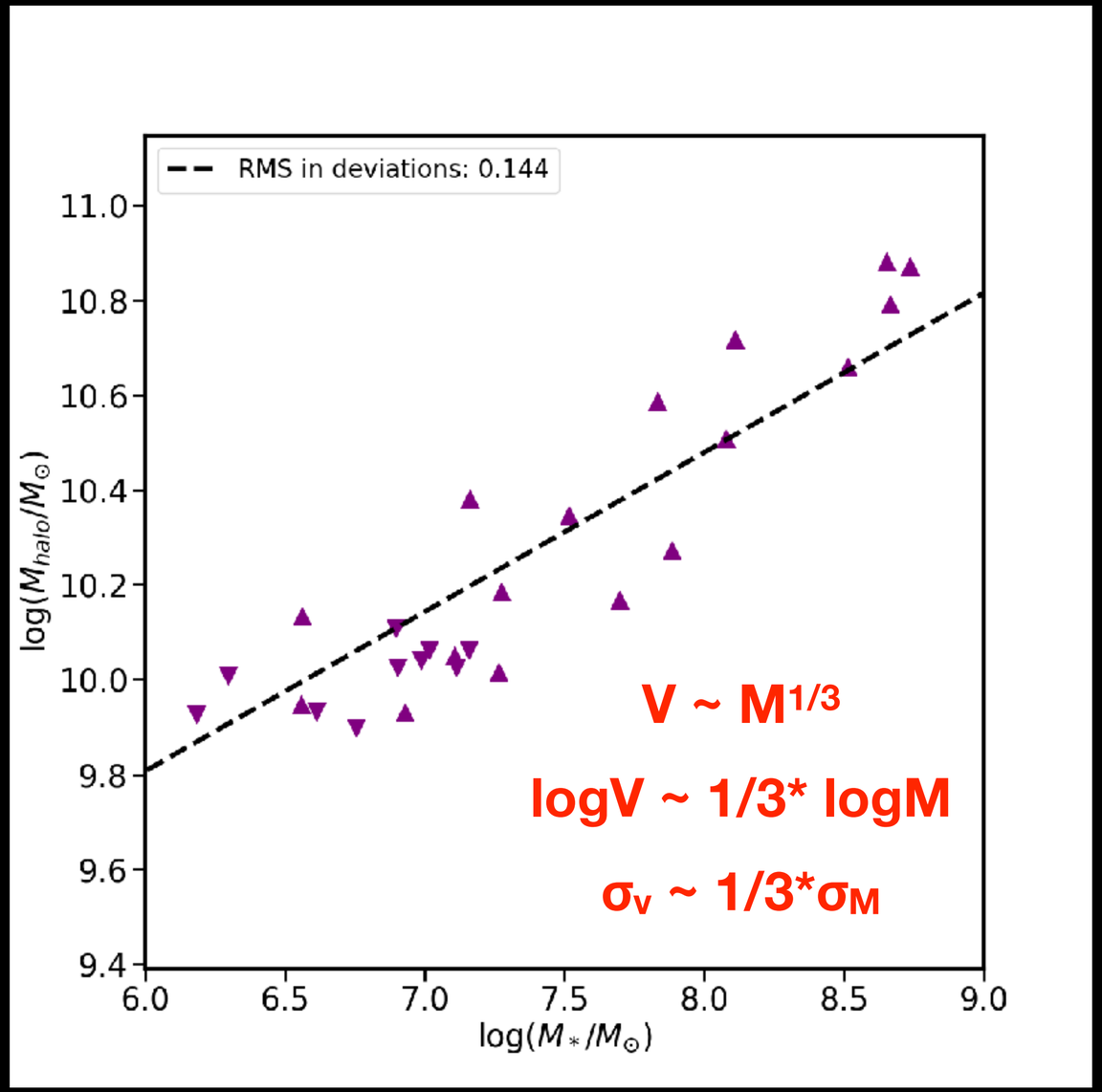


Kacharov et al. (2016)

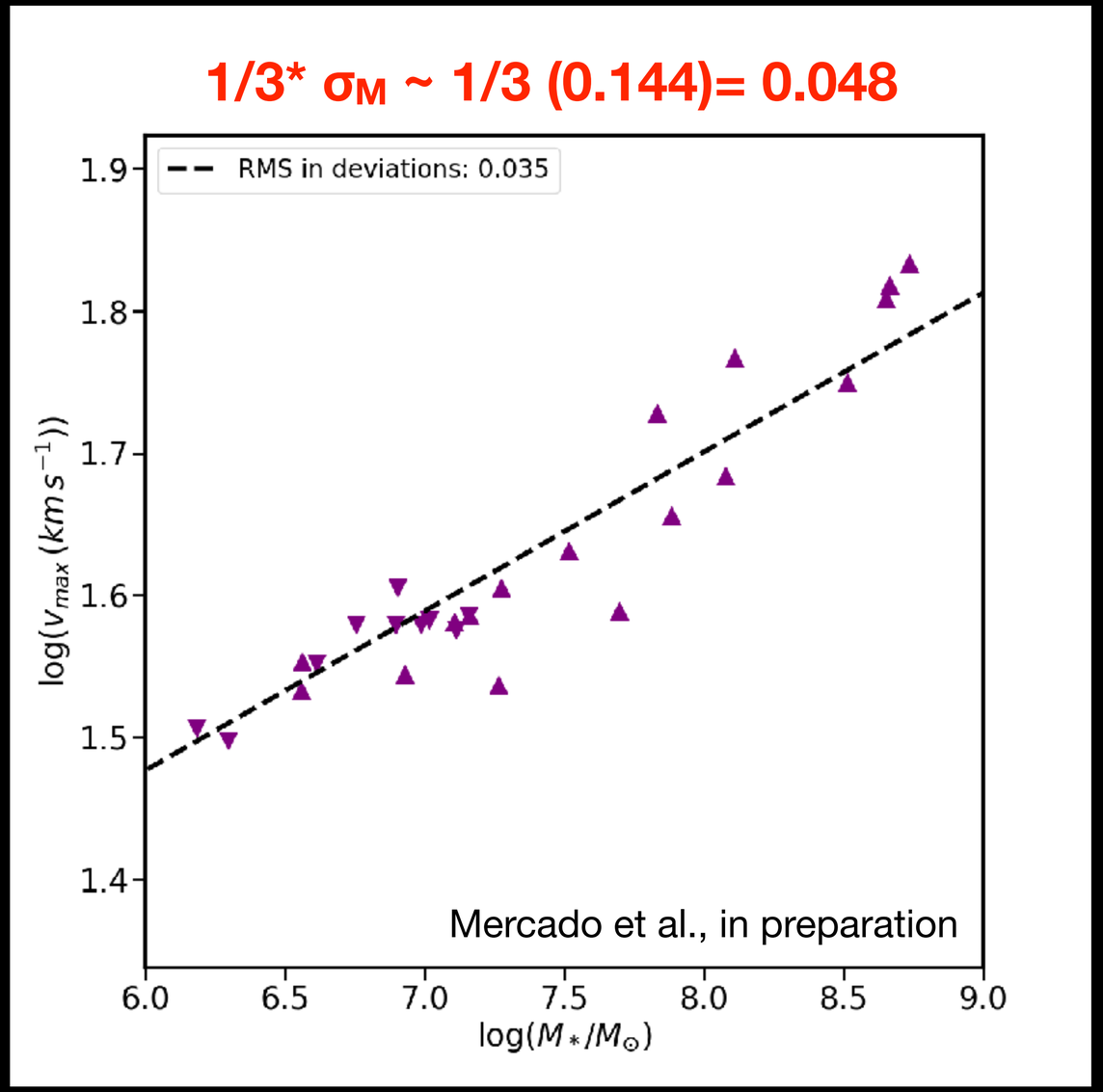
Simulations

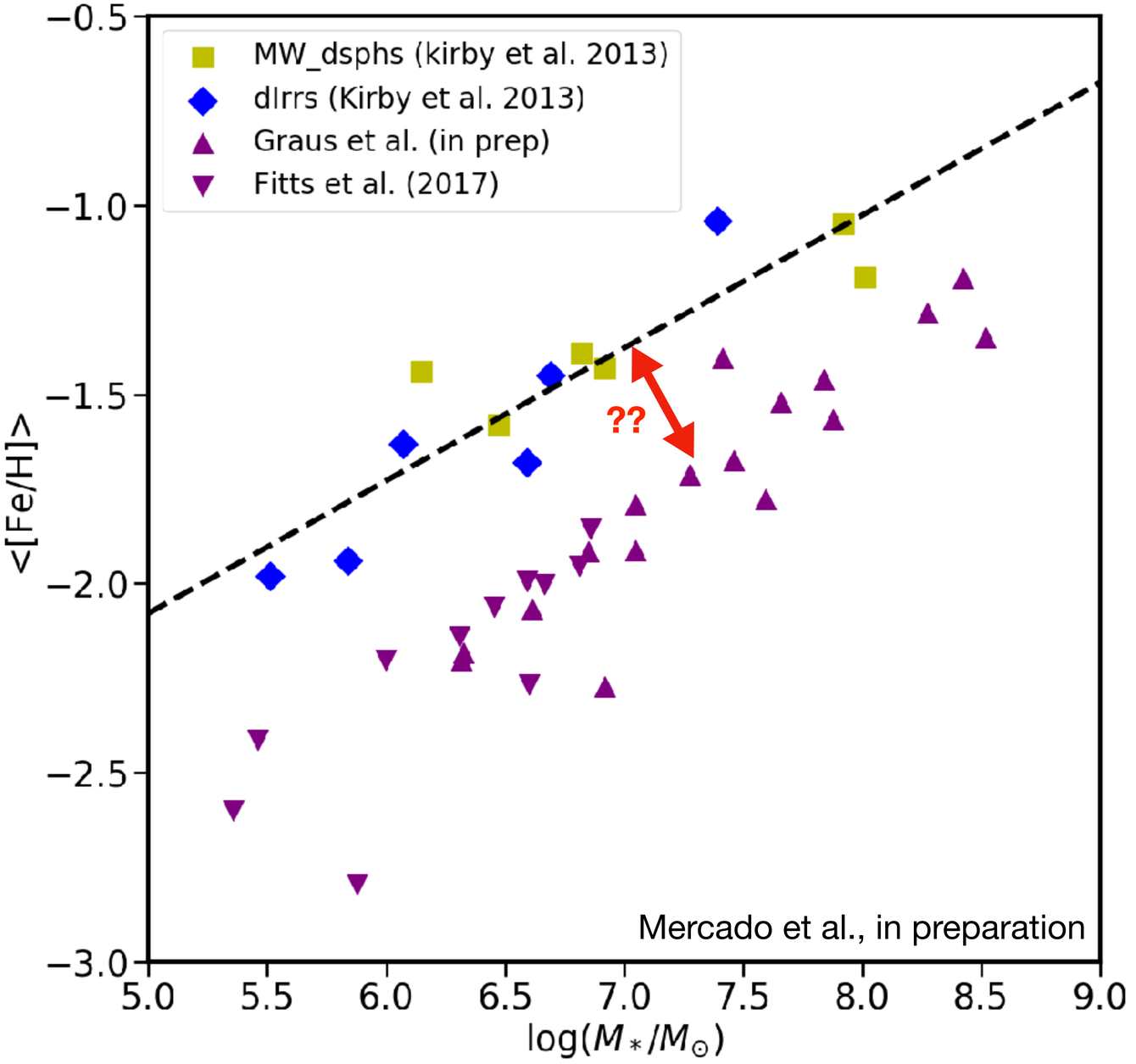
- 11 presented in Fitts et al. (2017)
  - m_{baryon} = 500 M_{sun}
  - m_{dm} = 2500 M_{sun}
  - 8.5e9 M_{sun} < M_{vir} < 1.3e10 M_{sun}
  - 10^5 M_{sun} < M_{star} < 10^7 M_{sun}
- 17 presented in Graus et al. (in prep)
  - m_{baryon} = 4000 M_{sun}
  - m_{dm} = 20000 M_{sun}
  - 10^{10} M_{sun} < M_{vir} < $10^{10.9}$ M_{sun}
  - 10^6 M_{sun} < M_{star} < 10^8 M_{sun}

M_{halo}-m_{star} vs. v_{max}-m_{star}



1/3* σ_M ~ 1/3 (0.144)= 0.048

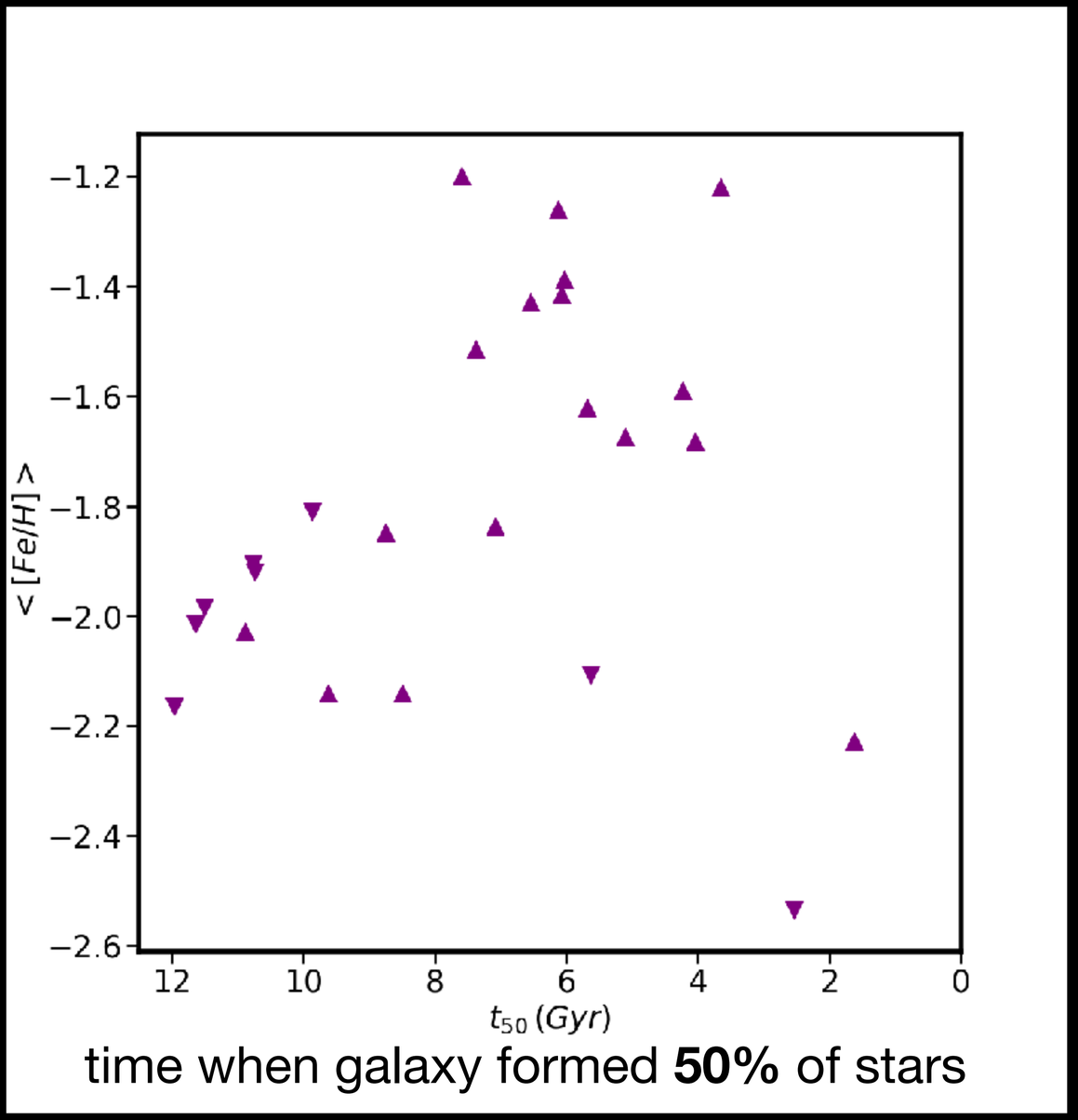



MW_dsphs (kirby et al. 2013)
dIrrs (Kirby et al. 2013)
Graus et al. (in prep)
Fitts et al. (2017)
??
Mercado et al., in preparation
<[Fe/H]>
log(M∗/M⊙)
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0

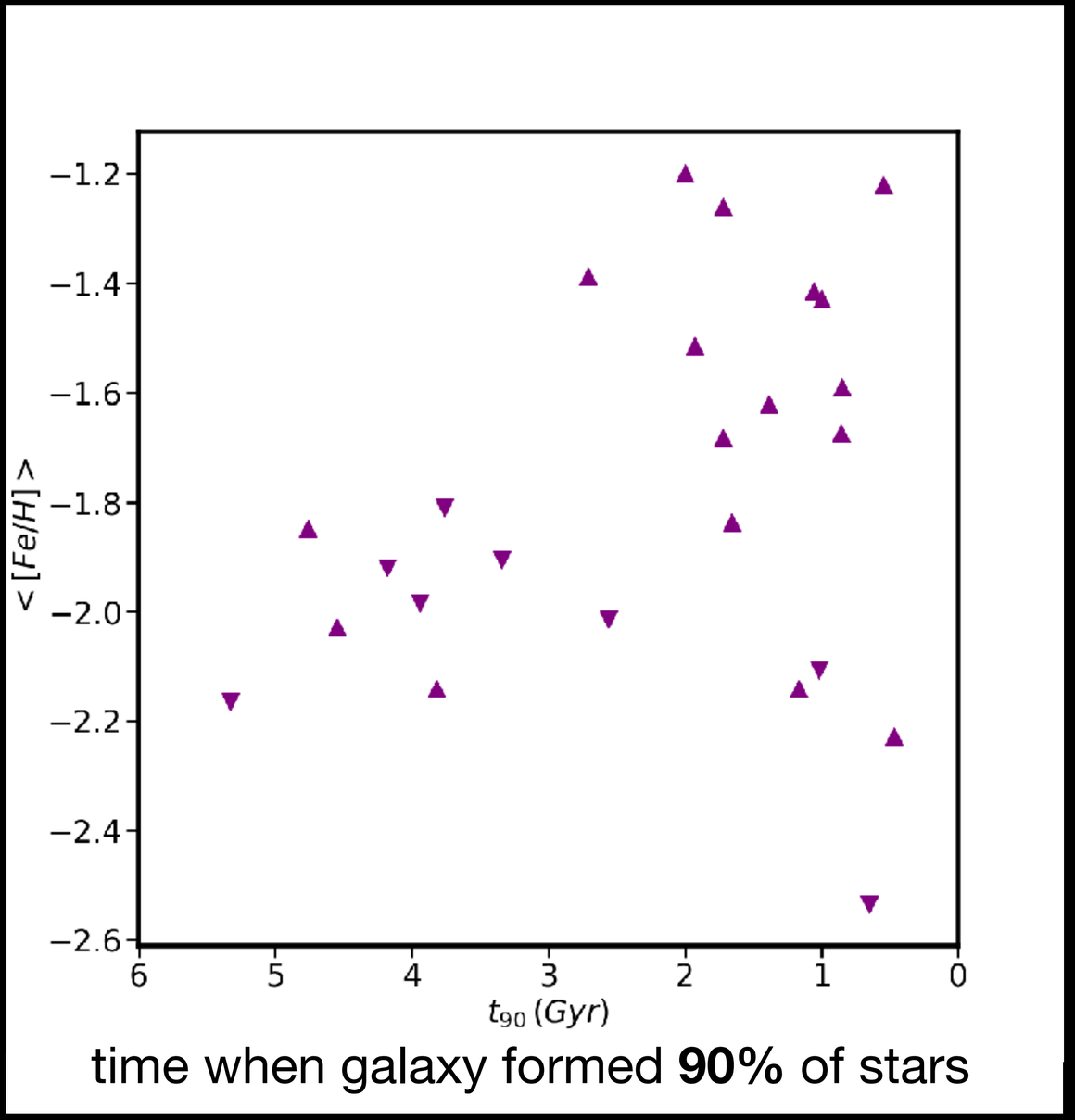
Explored a Few Relationships

- Probed relationships between z gradient and…
  - Age
  - Median metallicity
  - M_{star}
  - M_{halo}
  - V_{max}

Metallicity: weak correlation with age

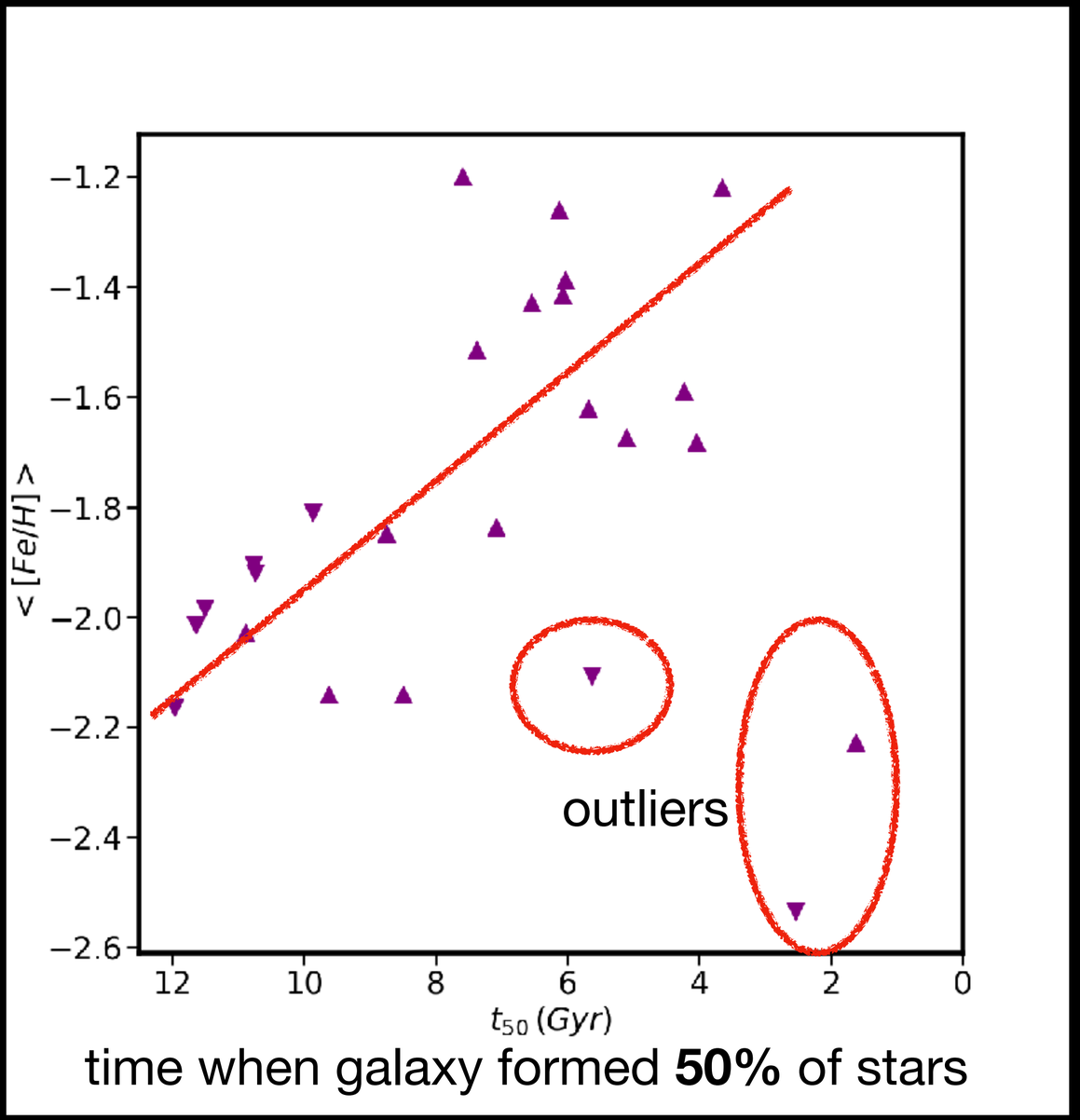


time when galaxy formed **50%** of stars

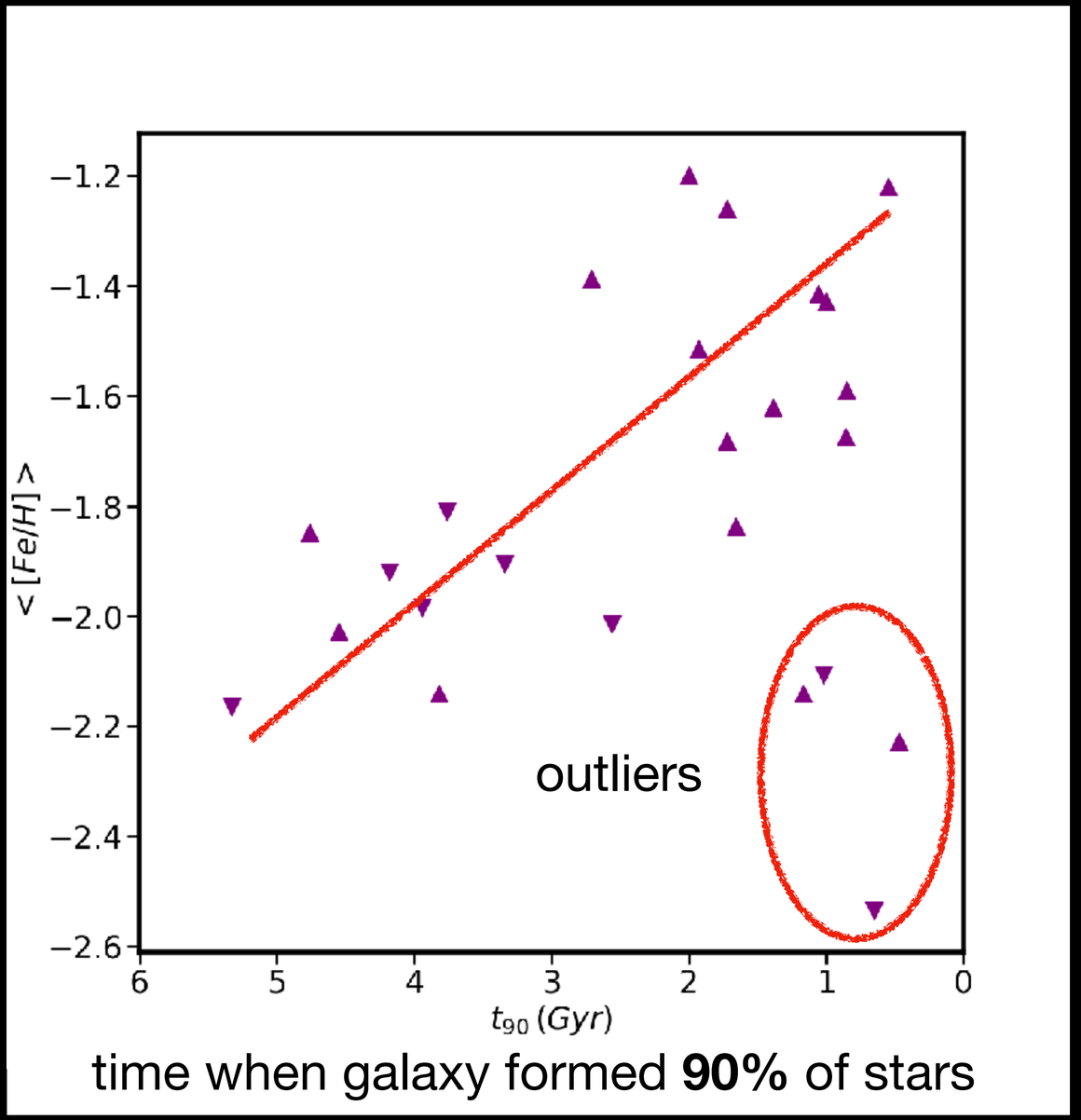


time when galaxy formed **90%** of stars

Metallicity: weak correlation with age

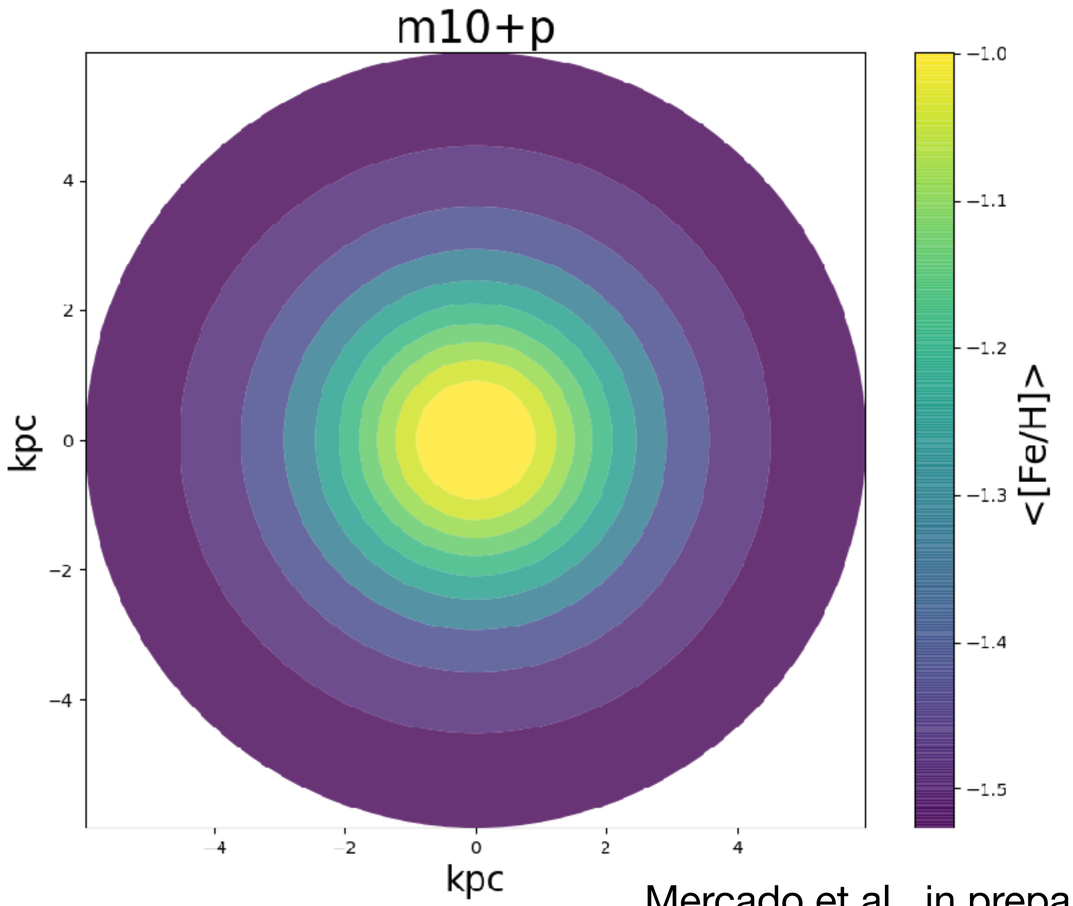


time when galaxy formed **50%** of stars

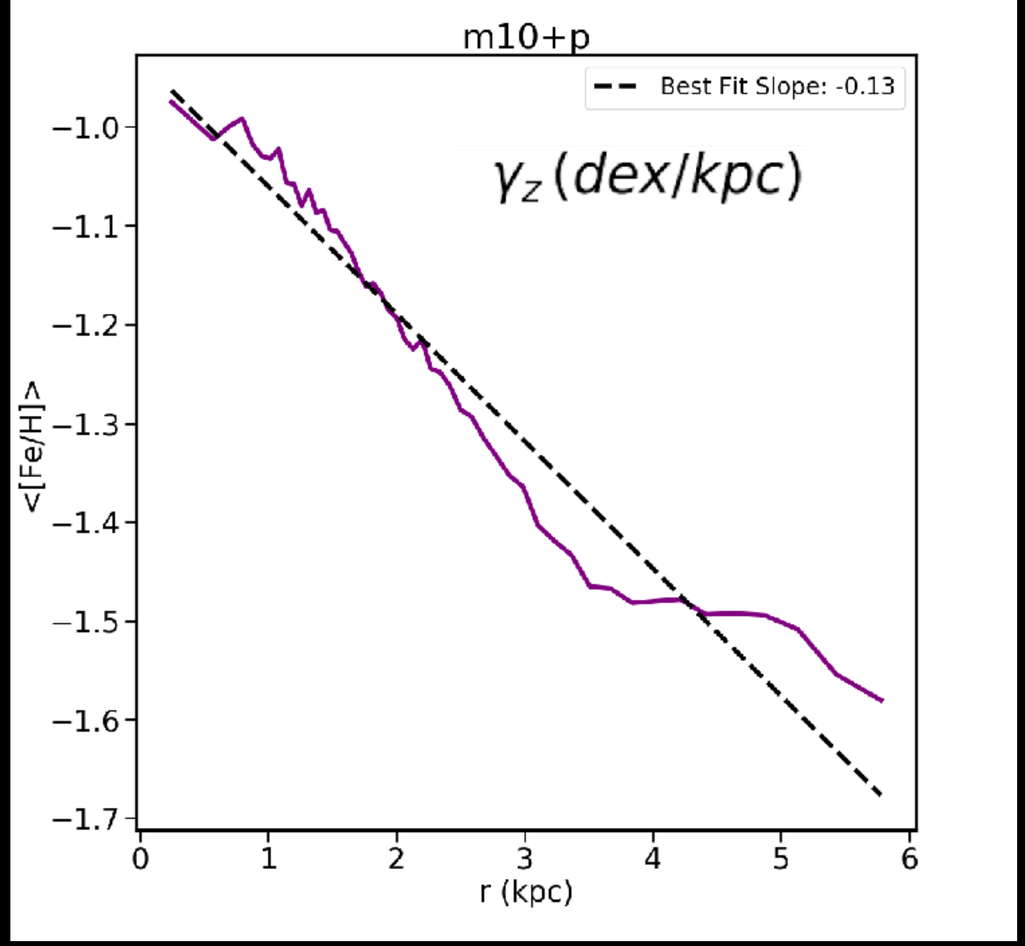


time when galaxy formed **90%** of stars

Z Gradients

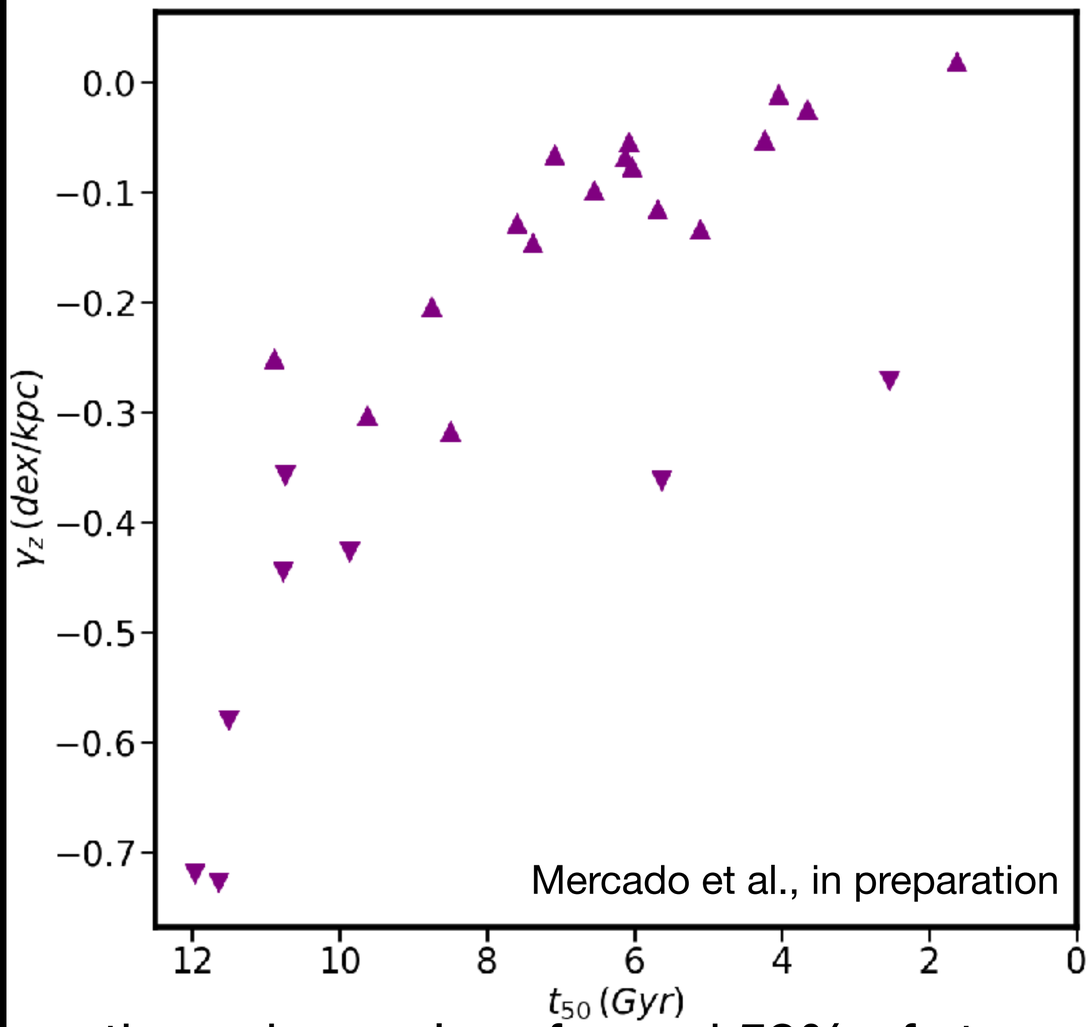


Mercado et al., in preparation

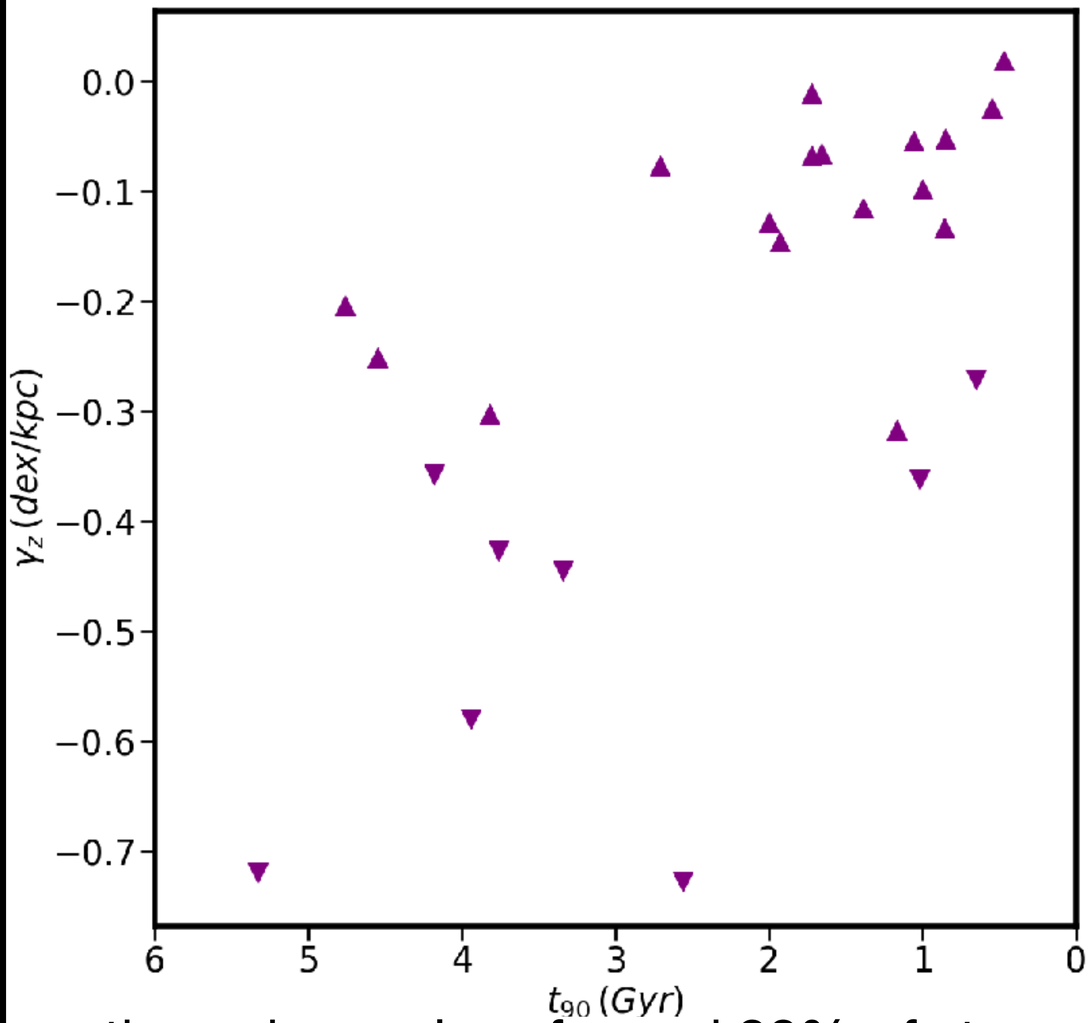


Metallicity gradients correlate with age

Older galaxies => Steeper Gradients

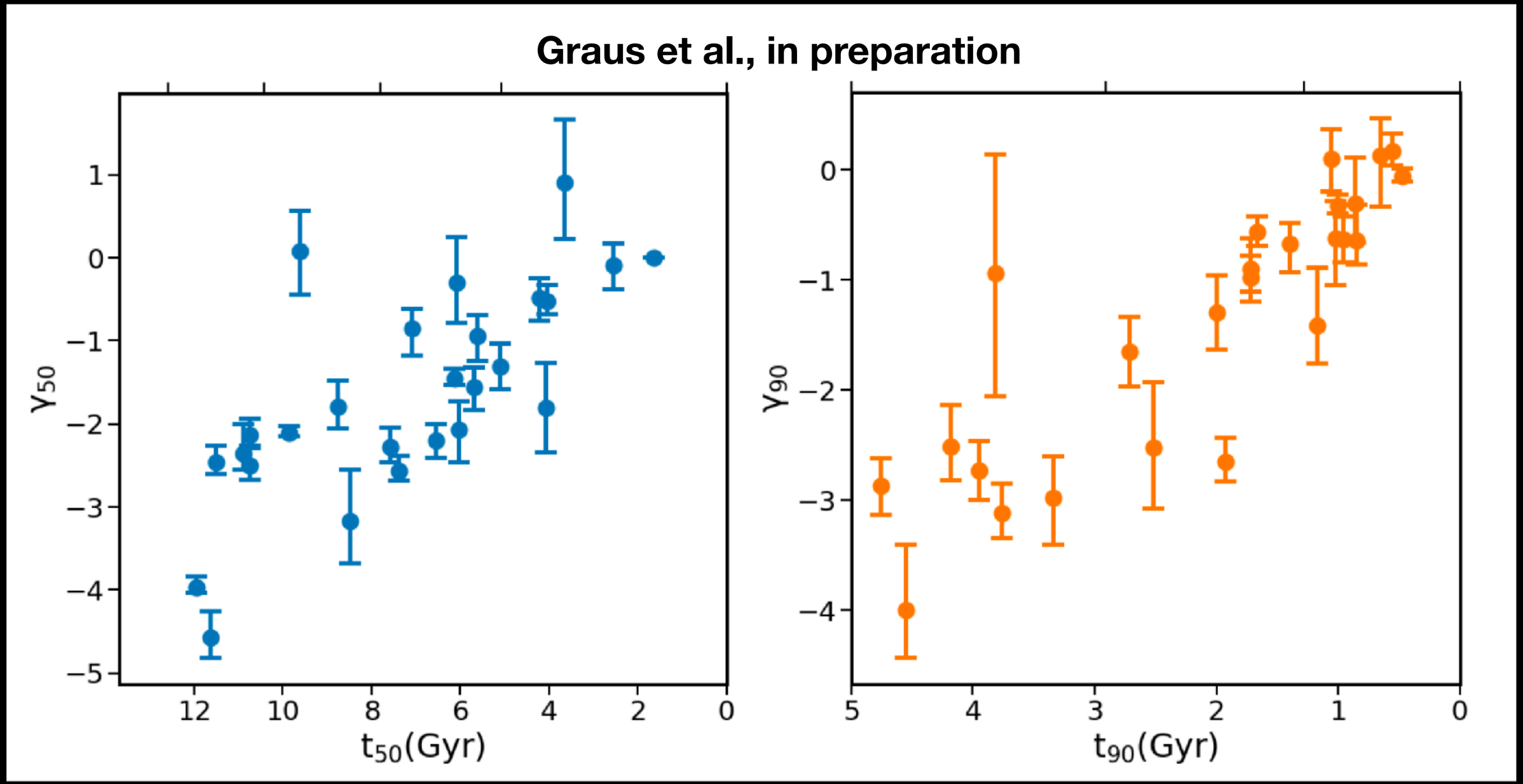


time when galaxy formed **50%** of stars

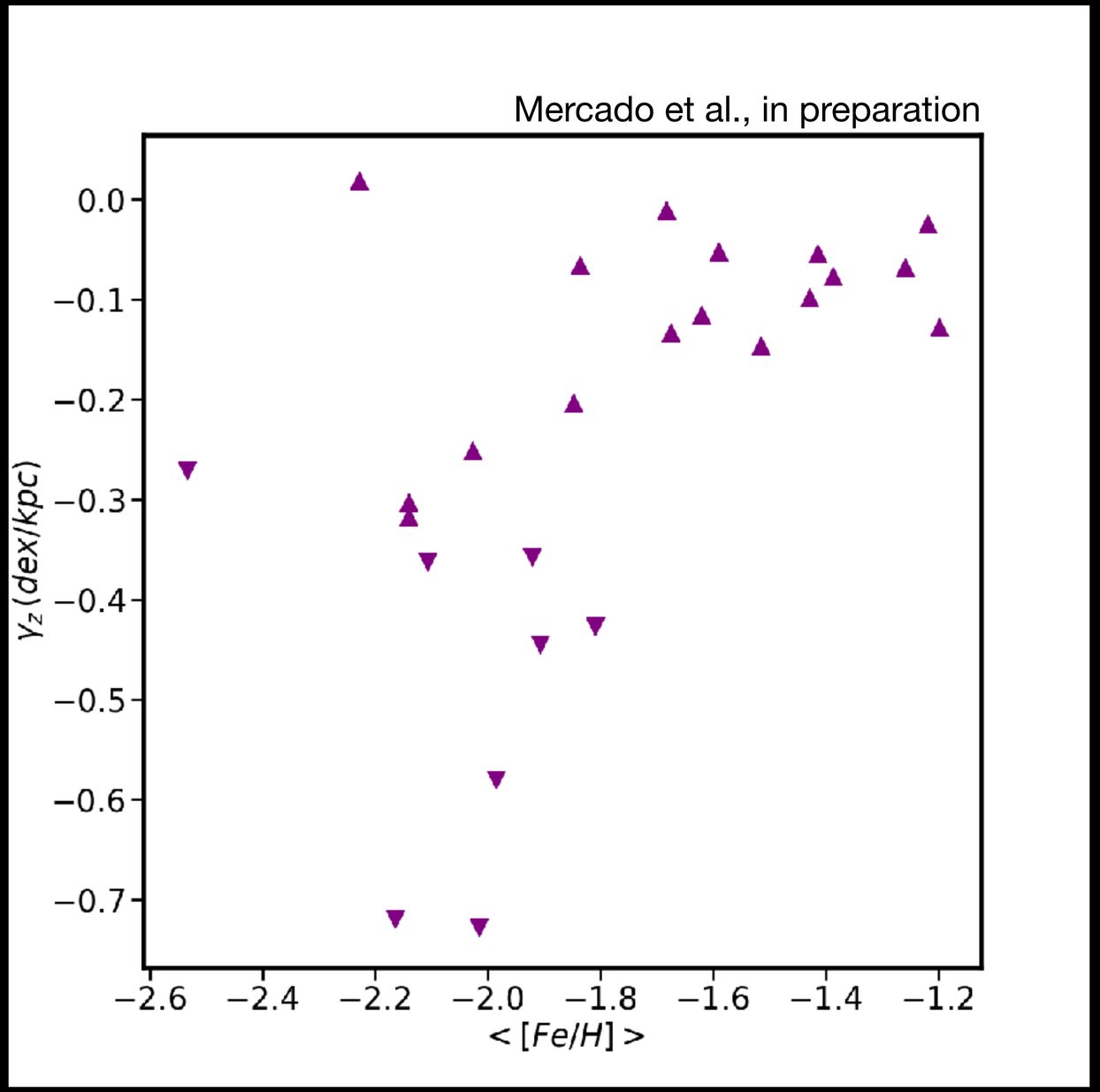


time when galaxy formed **90%** of stars

Age gradients correlate with age

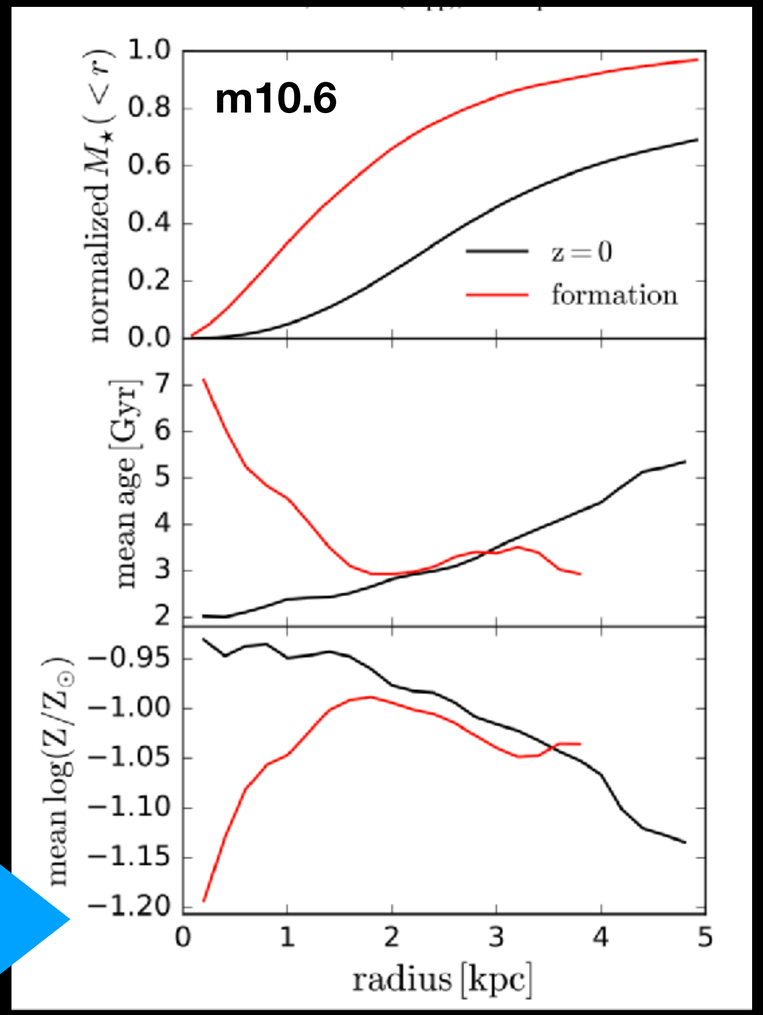


Metallicity gradients: some correlation with Z



Summary and Future Questions

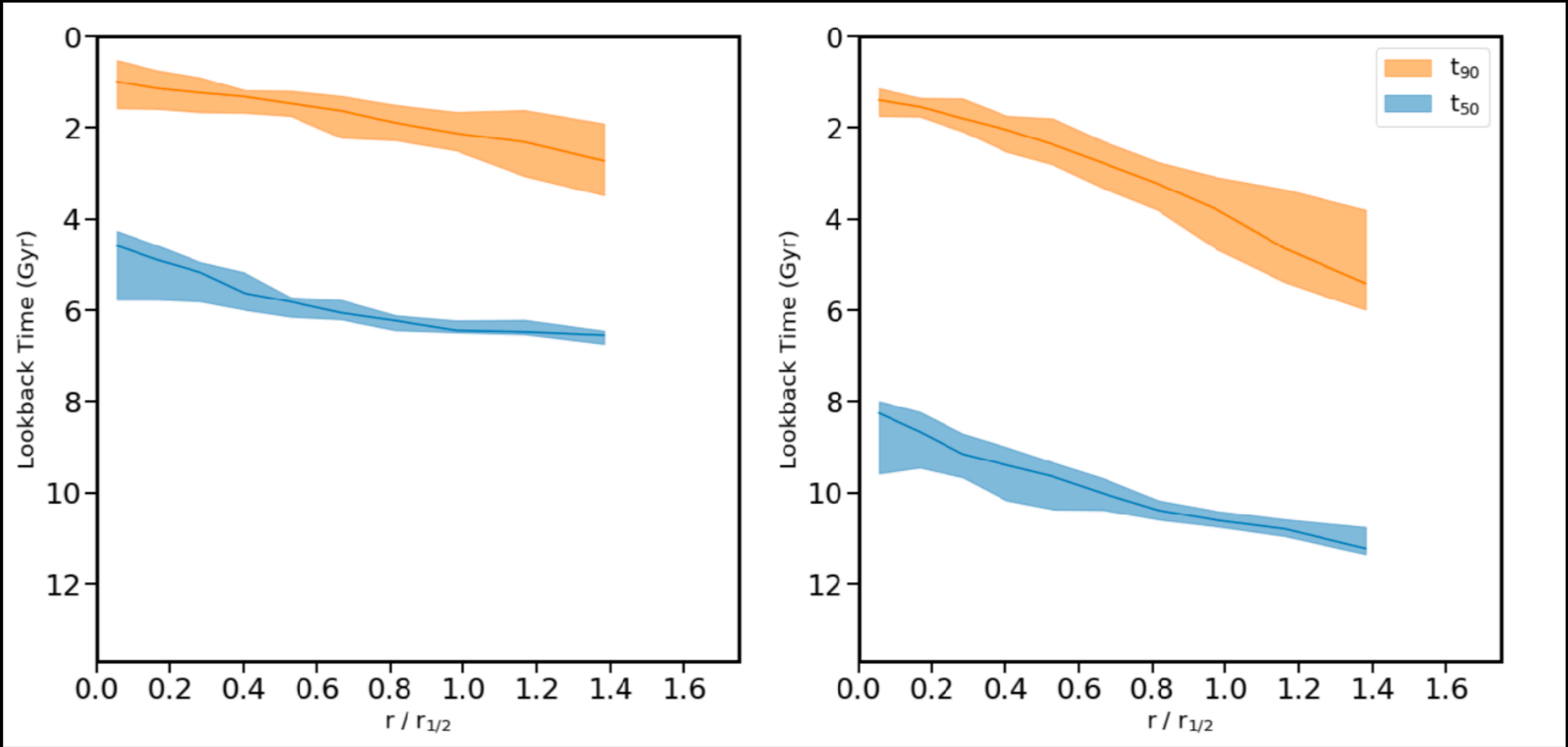
- ★ Metallicity gradients (& age gradients) correlate with age:
  - ★ Older galaxies have stronger gradients.
  - ★ To do: Evidence for this in data?
- ★ Galaxies with stronger age gradients should also have stronger metallicity gradients
- ★ Z gradients mostly correlate with Z (some outliers)
- • Questions:
  - • What mechanisms bring about these gradients & correlations?
    - • Outer, low-Z stars from mergers/accretions?
    - • Outer, low-Z stars kicked out? (El-Badry el al. 2016; Yu et al. in prep)



El-Badry el al. 2016

Thank you!

Graus et al.


Lookback Time (Gyr)
0
2
4
6
8
10
12
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
r / r1/2
t90
t50