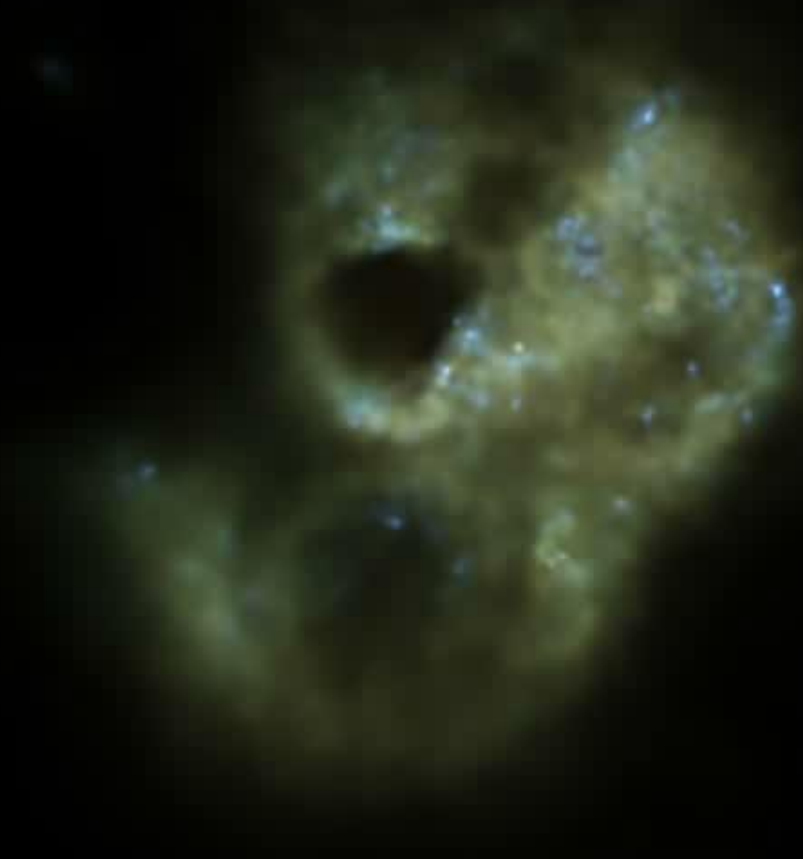
How primordial star formation shaped the present day dwarf galaxies

Robbert Verbeke

Bert Vandenbroucke

Sven De Rijcke



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Star Formation in Different Environments – August 10th 2017

Why dwarf galaxies

Large number of them

Shallow gravitational potential

Extreme end of galaxy formation

Challenges for cosmological and galaxy evolution models

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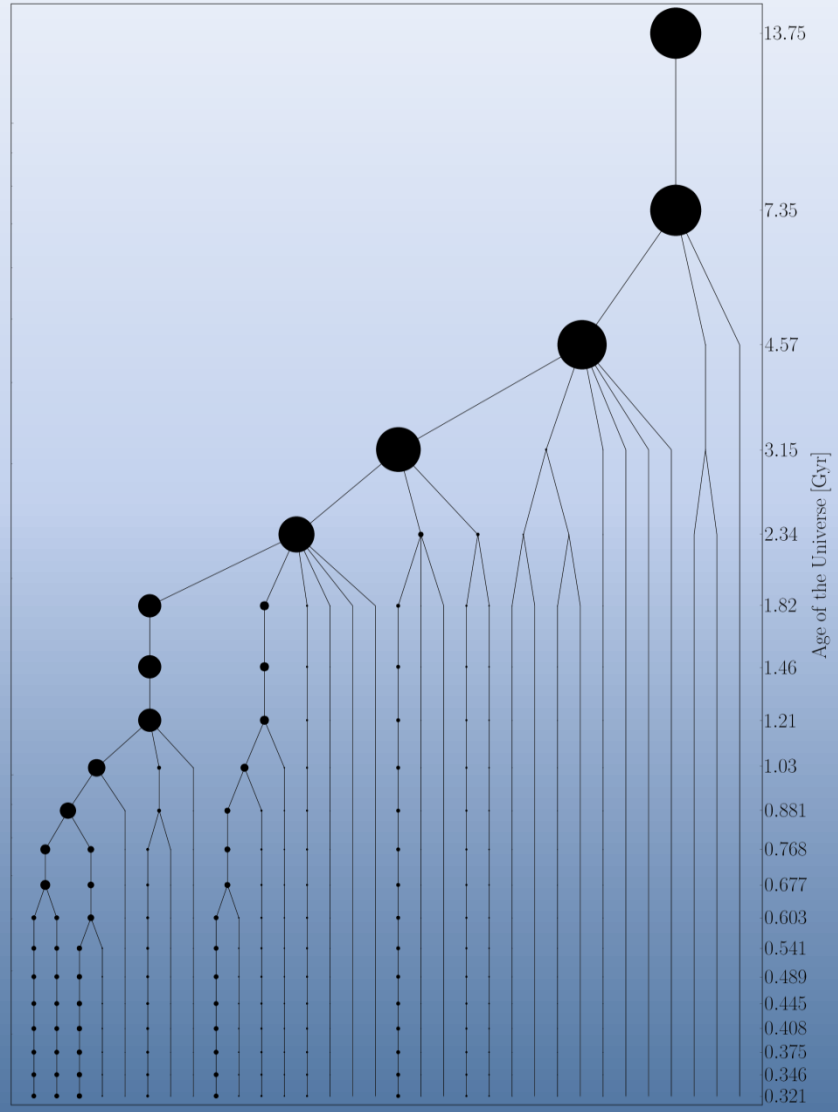
Models Of Realistic dwarfs In Action

- MoRIA
- Gadget-2 (N-body/SPH) (Springel et al. 2005)
- Dwarf galaxy scale
- High resolution (m_{bar} = $10^{3\text{-}4}$ $M_{\odot}$, e_f=5-10 pc)
- Cosmologically motivated merger tree (Cloet-Osselaer et al. 2014)
- Star formation
- Gas cooling and heating (De Rijcke et al. 2013)
- Feedback from supernovae and UV radiation from massive stars
- Chemical enrichment
- Heating by cosmic UV background
- Advanced treatment of the multi-component, multi-phase ISM (Vandenbroucke et al. 2013)



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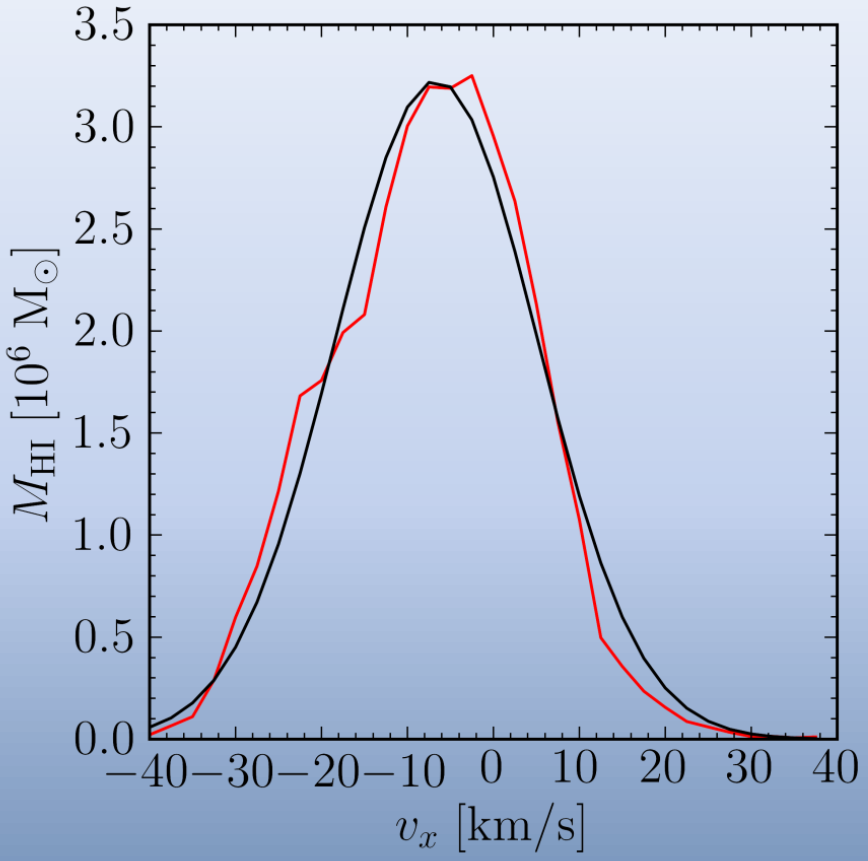
Mock observations



Mock HI spectrum: $v_c = W_{20}/2$

Also see Verbeke et al. 2017

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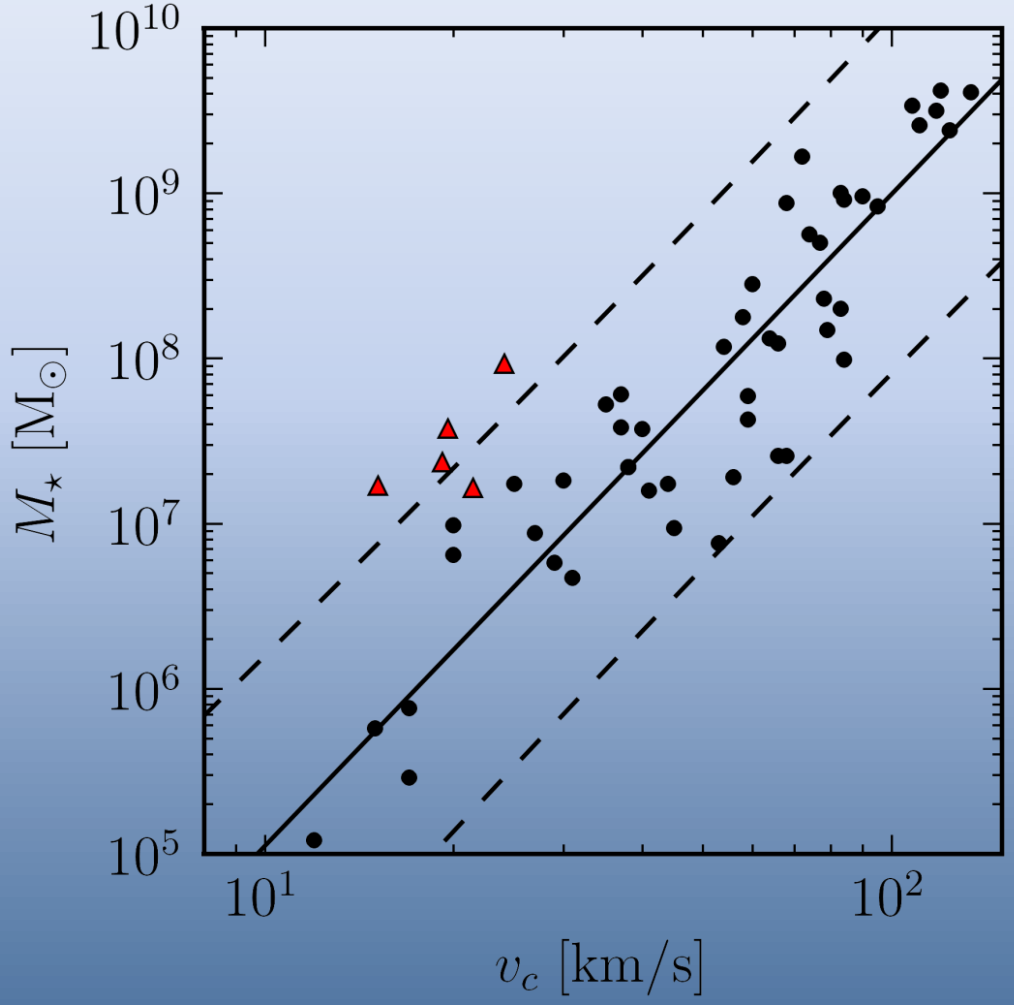
Baryonic Tully-Fisher Relation



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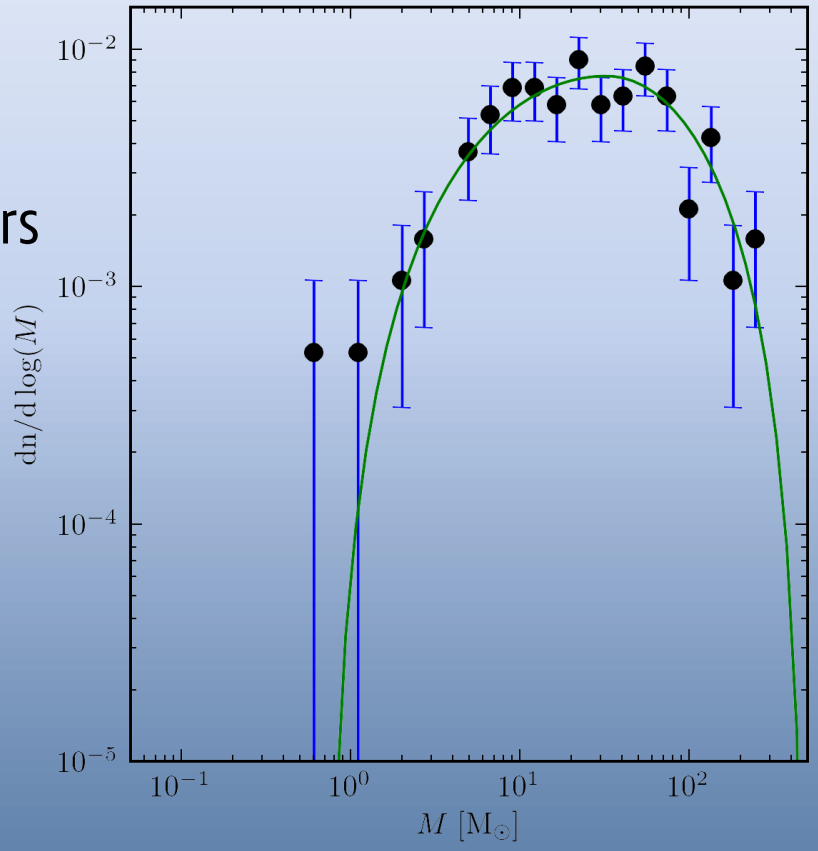
First stars

- Out of pristine, unenriched gas ([Fe/H] < -5)
- Top-heavy IMF (Susa et al. 2014)
- 4 x more SNII energy
- 40 x more UV radiation from massive stars
- Faster SN feedback
- Lower star formation at early times



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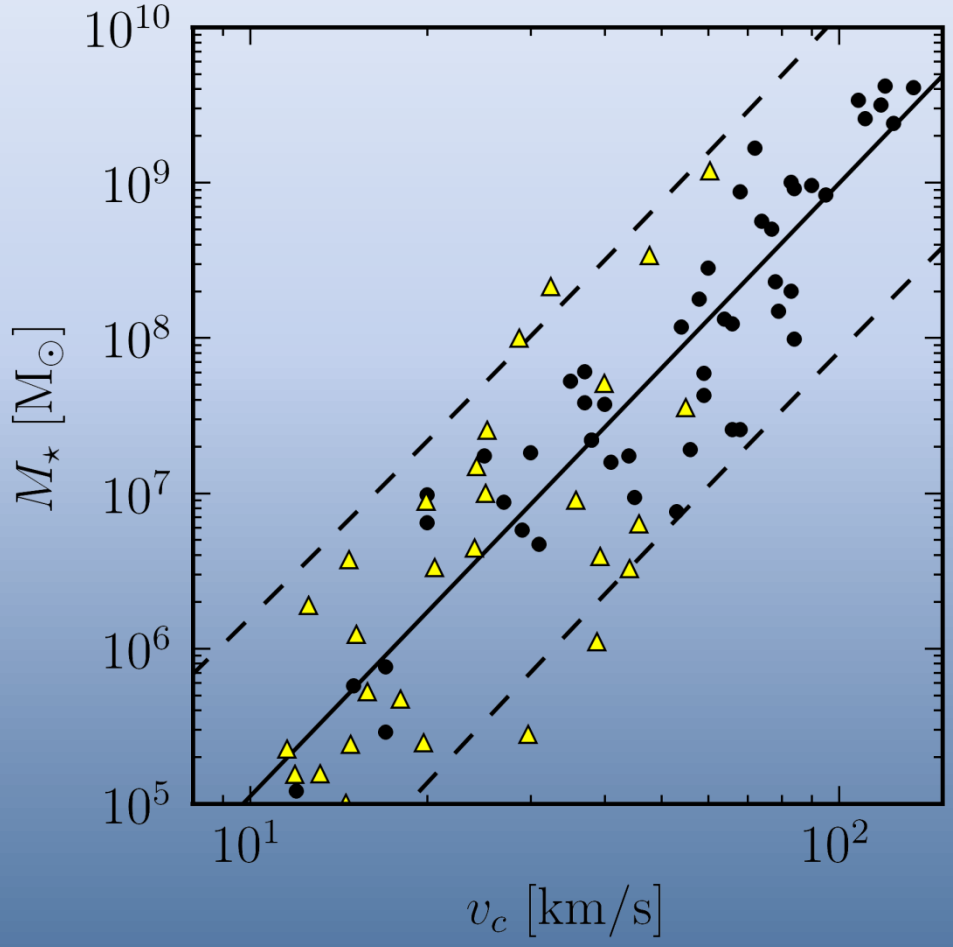
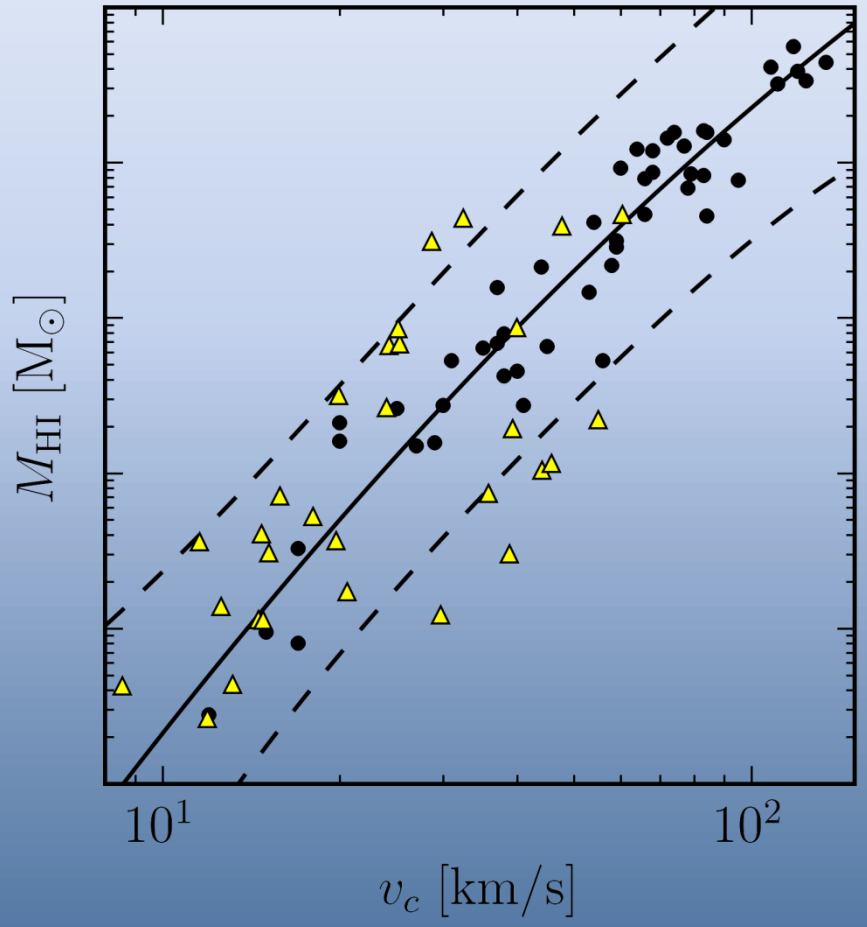
Baryonic Tully-Fisher relation II





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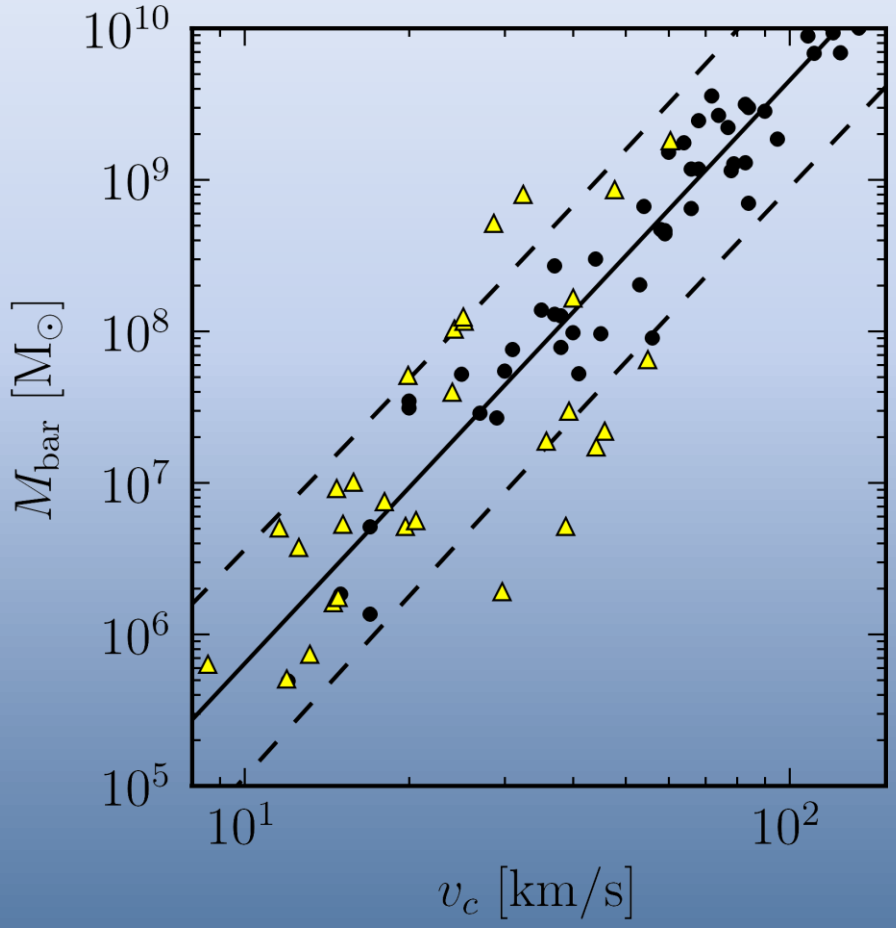
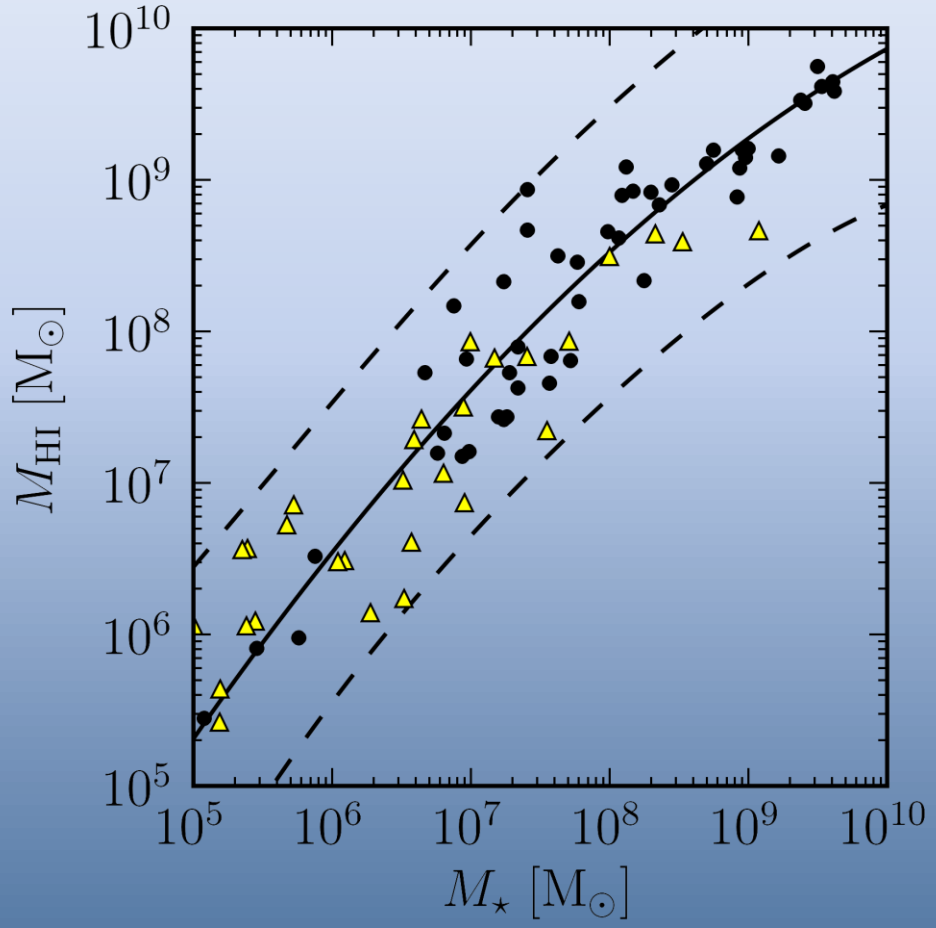
Baryonic Tully-Fisher relation II





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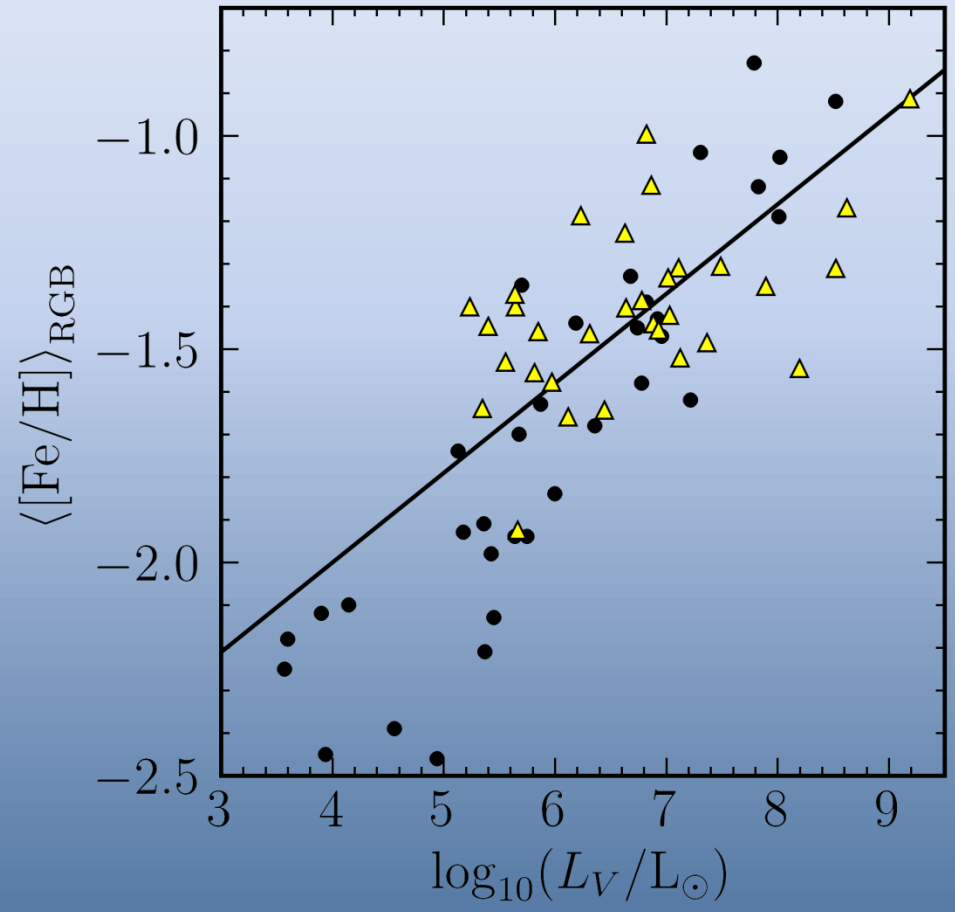
Stellar metallicity

From RGB stars



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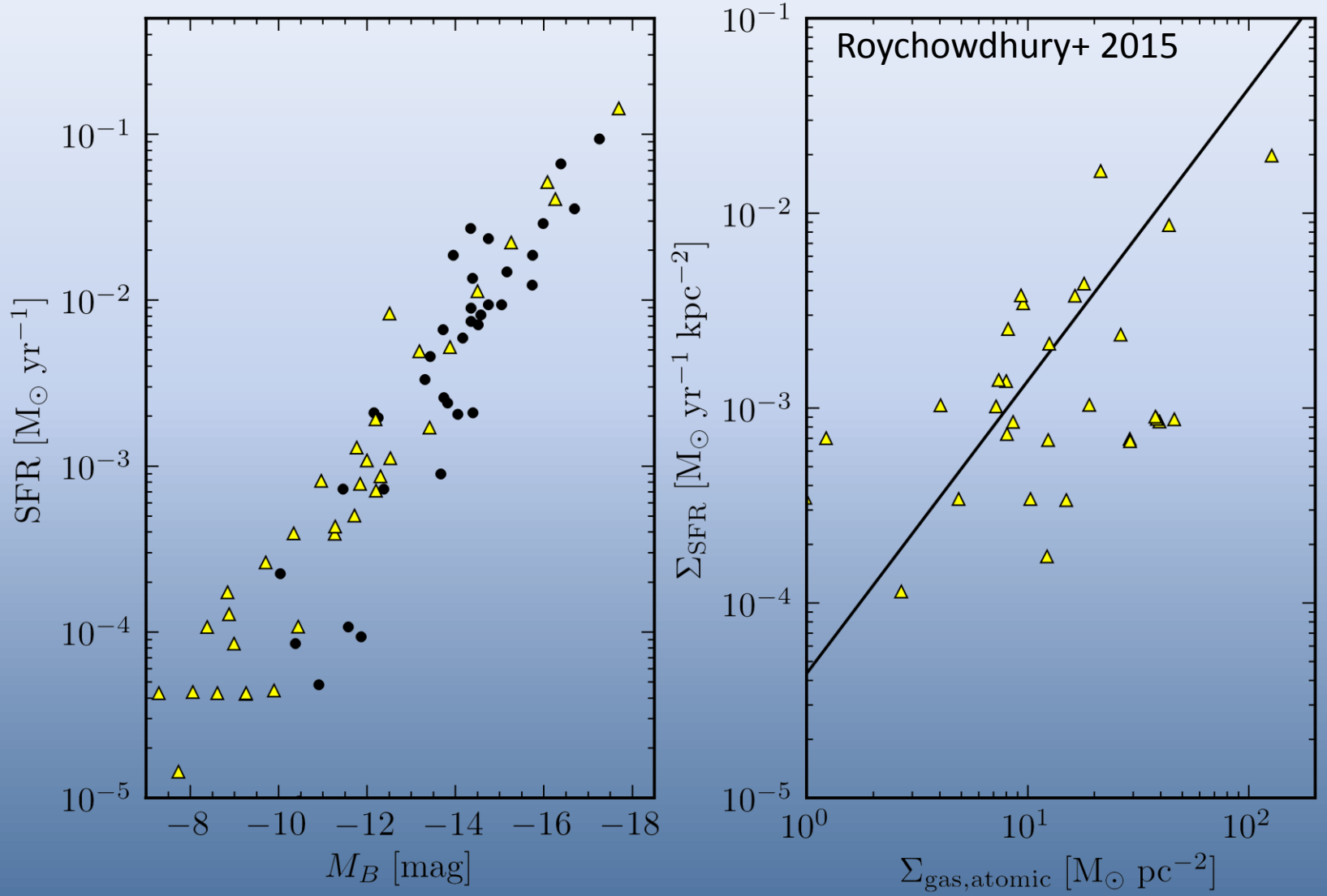
Star formation rates at z=0



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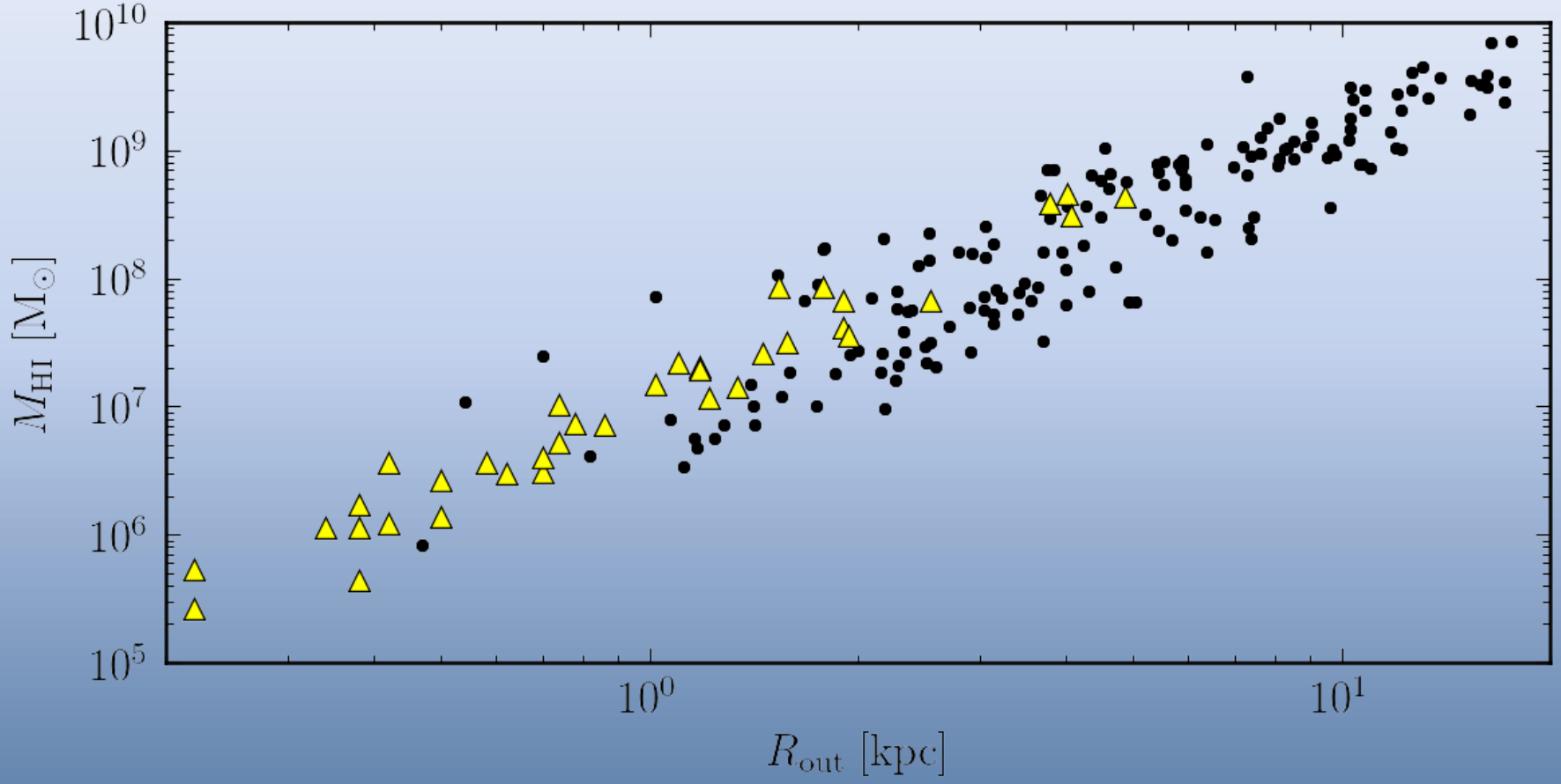
HI sizes



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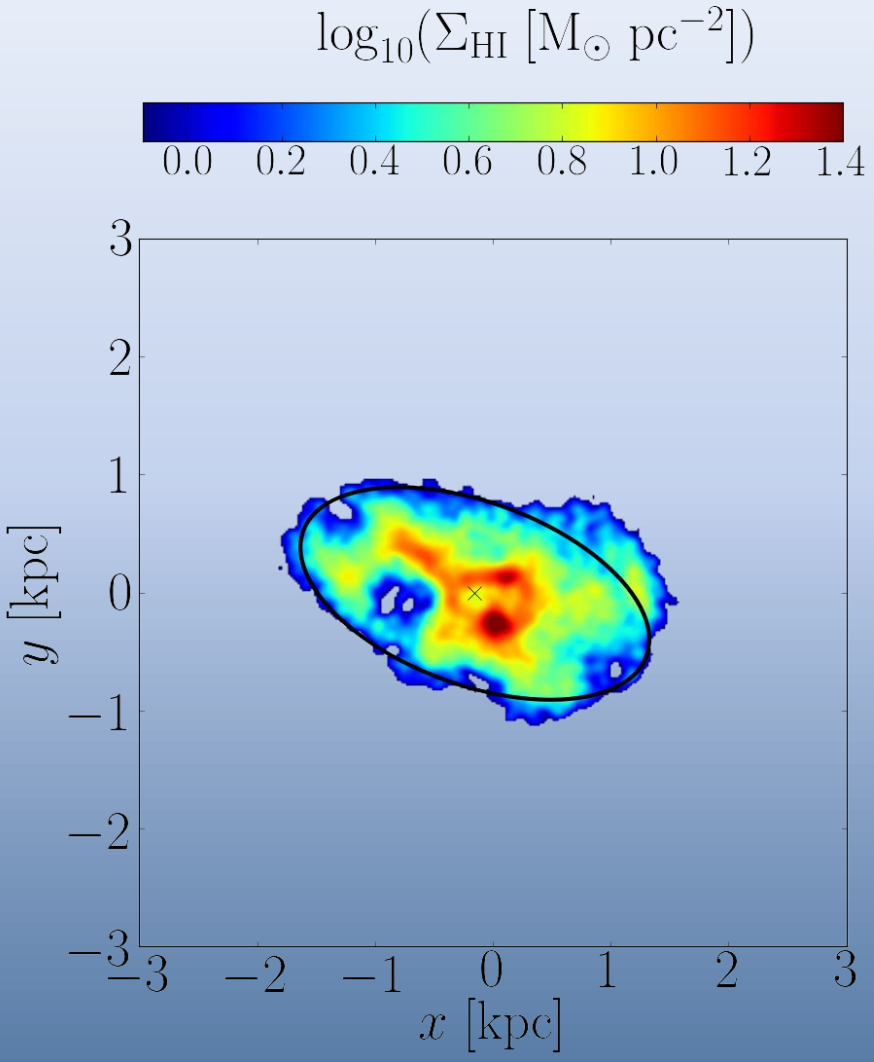
HI substructure



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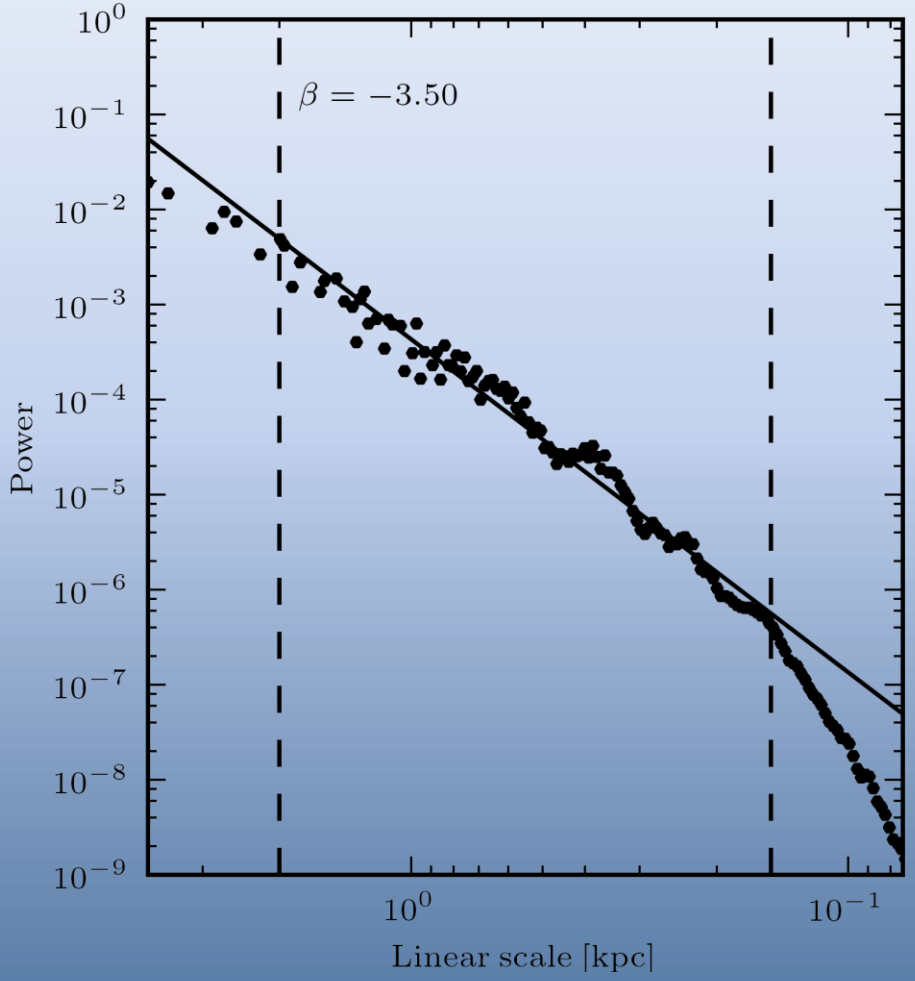
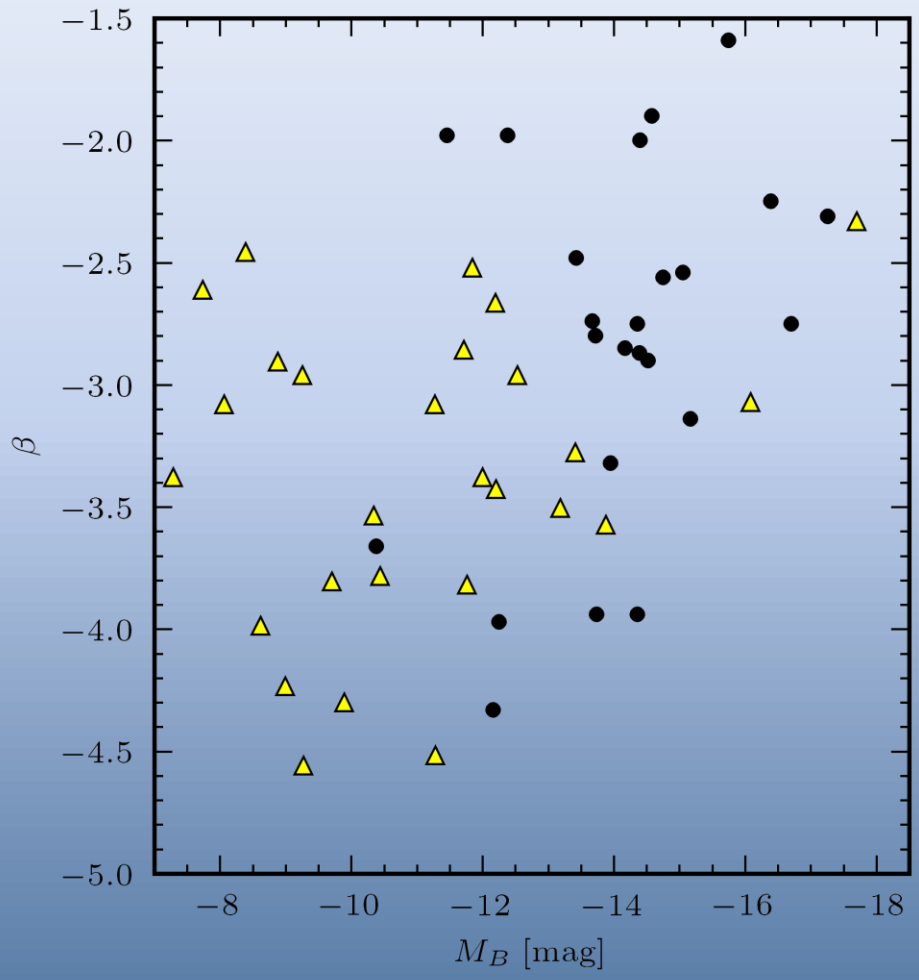
HI substructure





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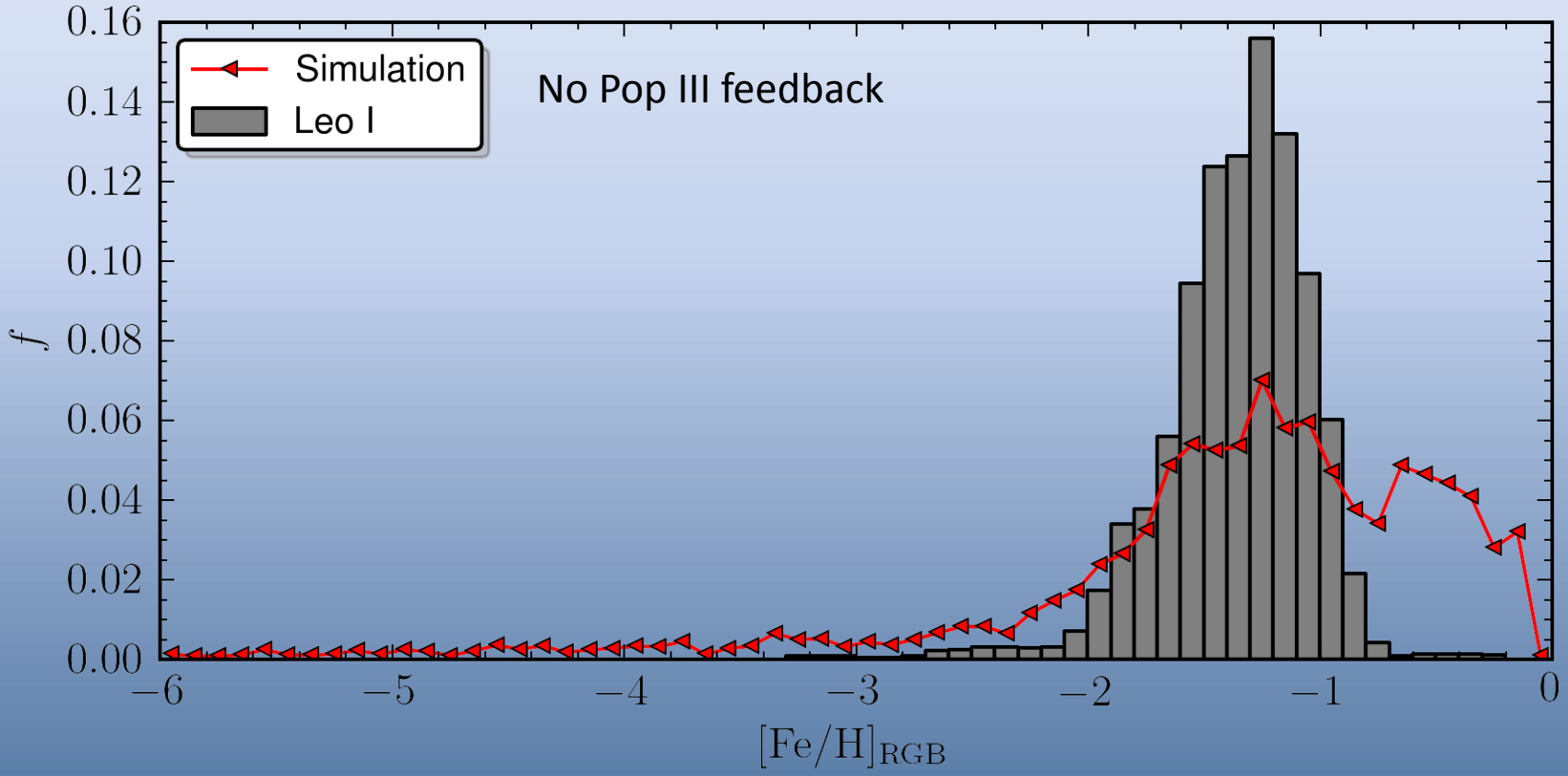
Metallicity distribution function



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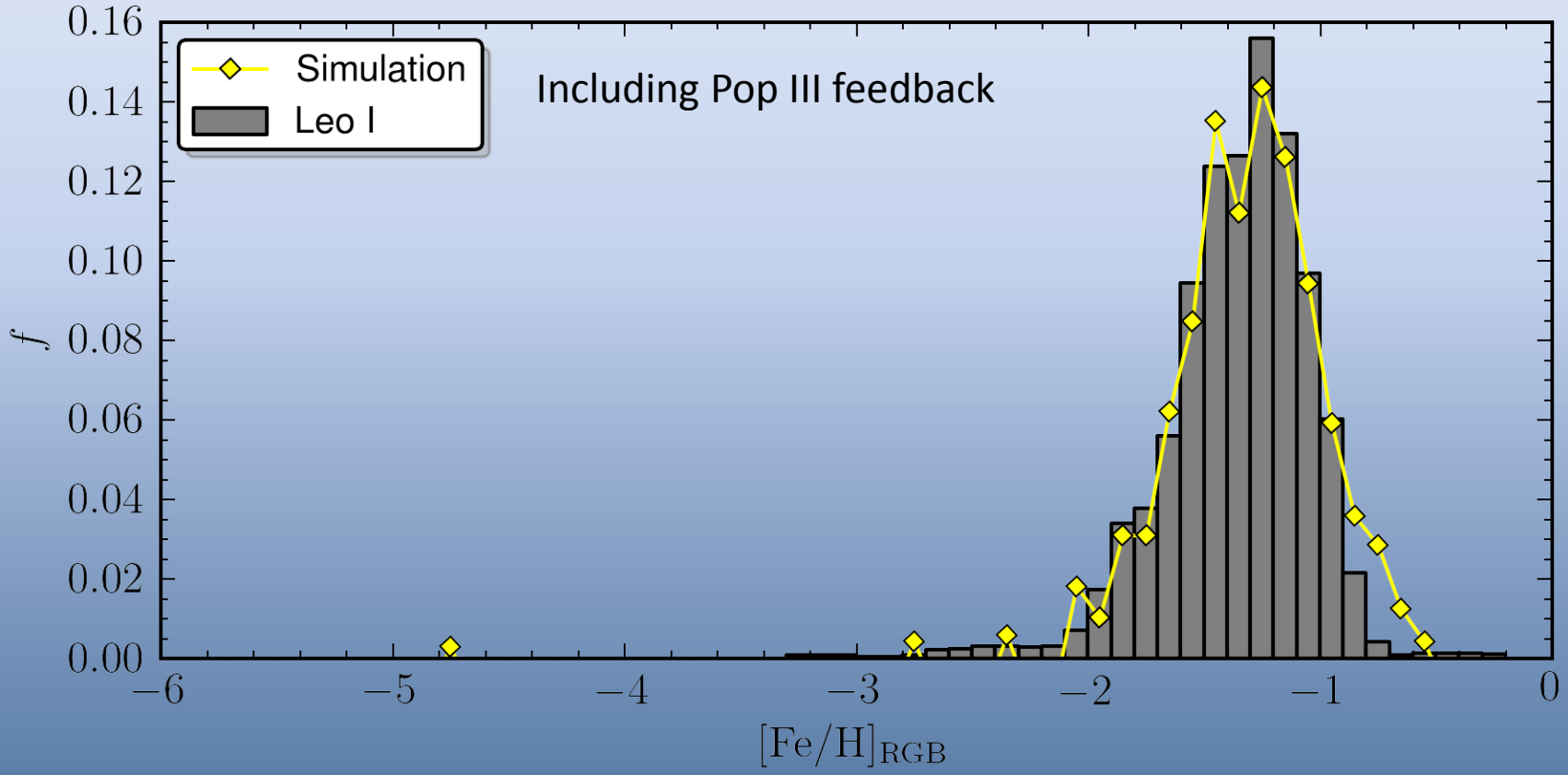
Metallicity distribution function



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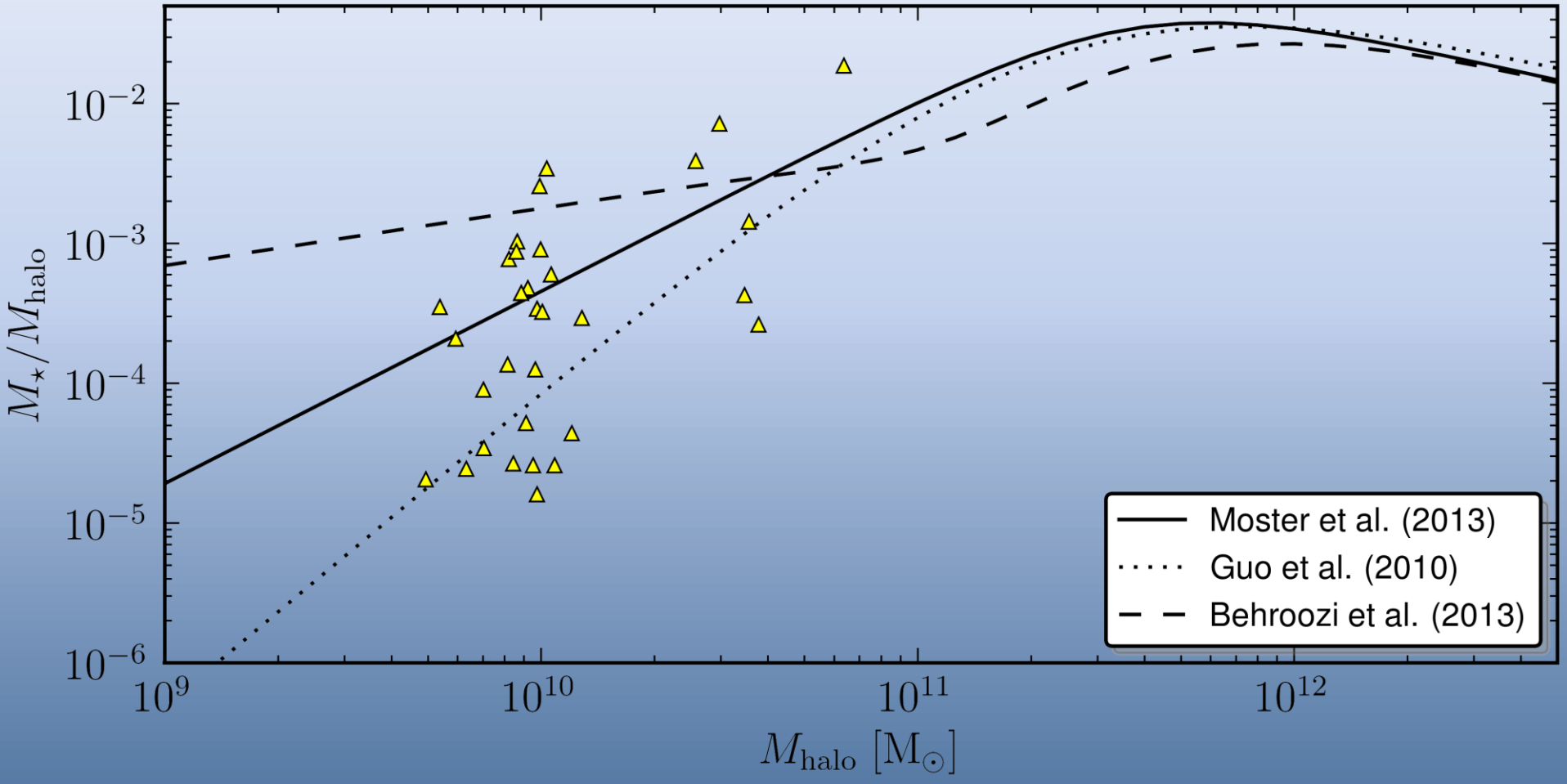
Stellar mass – Halo mass relation



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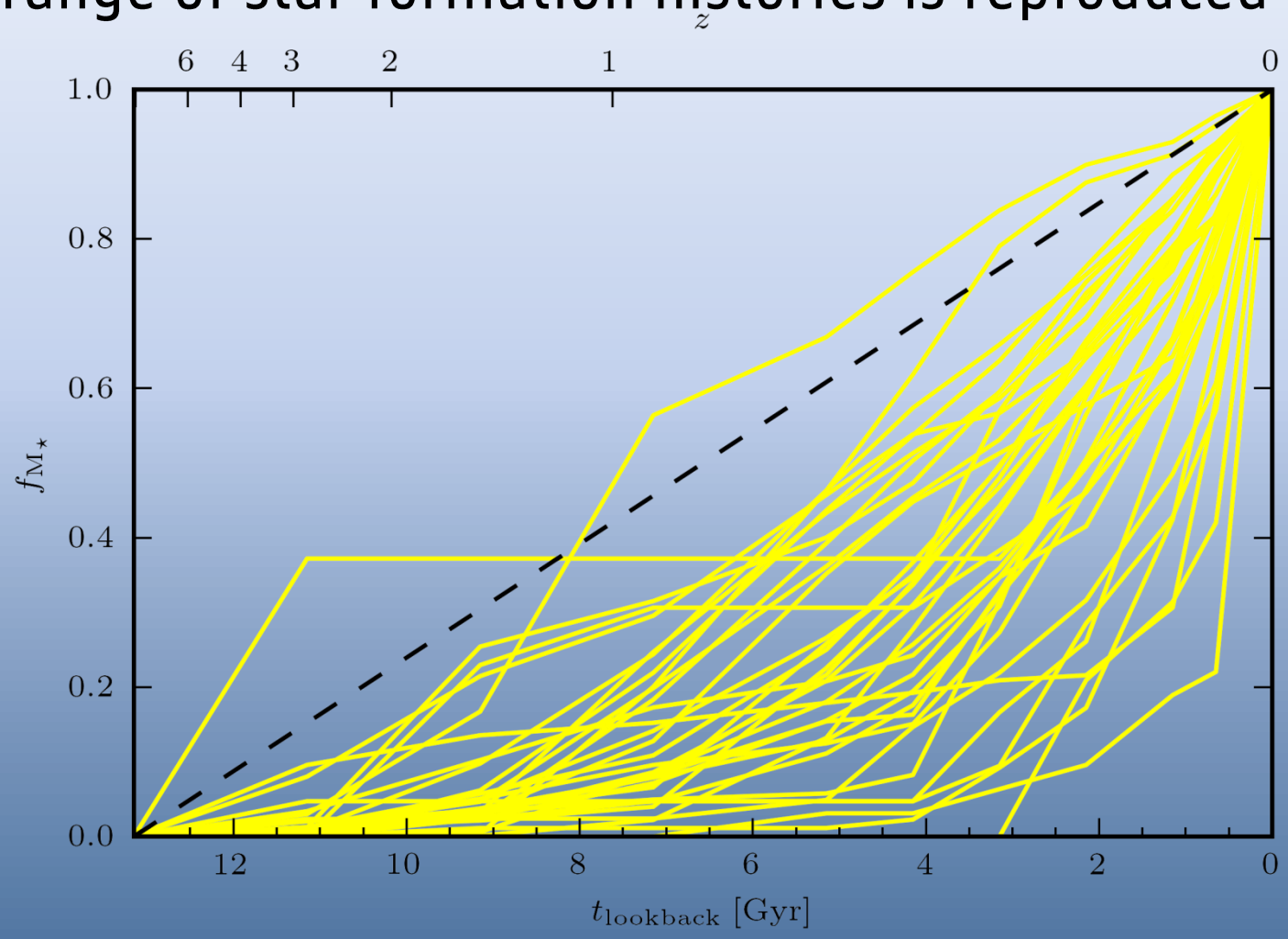
Star formation histories

Broad range of star formation histories is reproduced



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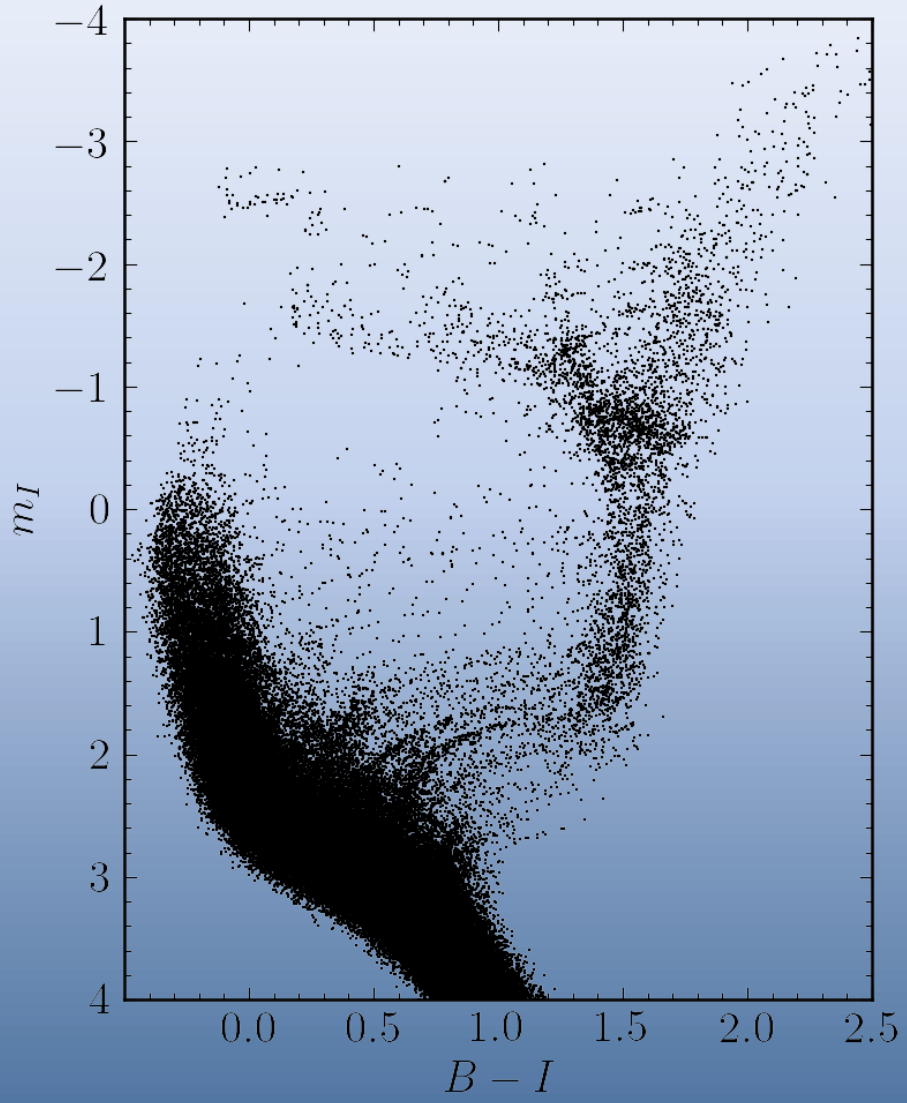
Color-Magnitude Diagrams



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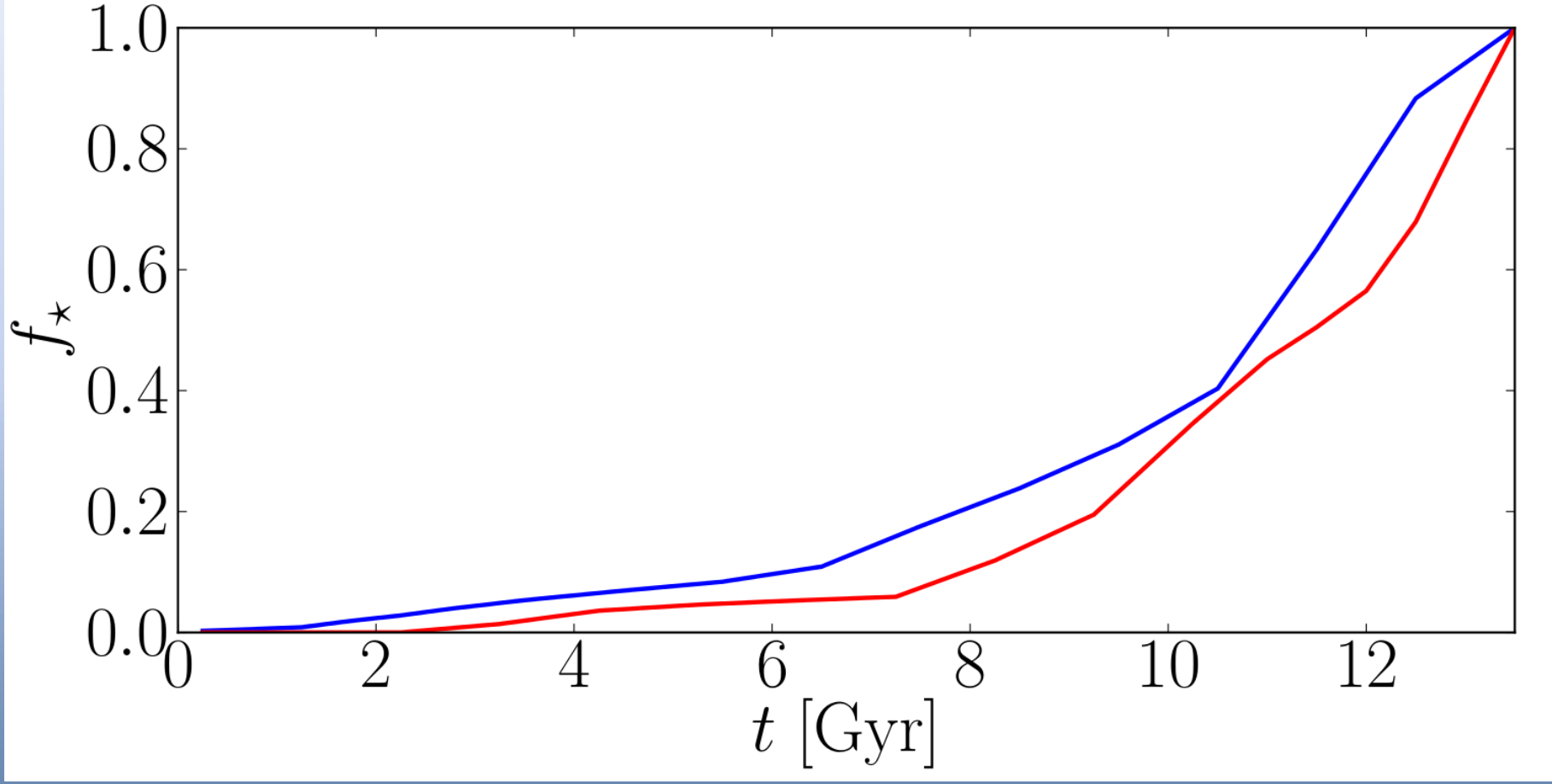

Summary

- Dwarf galaxies are a challenge for theoretical models
- Advanced models and analysis techniques are necessary
- First generation of stars had a great influence
- Realistic dwarfs can be simulated → MoRIA

Verbeke, Vandenbroucke & De Rijcke (2015)

Vandenbroucke, Verbeke & De Rijcke (2016)