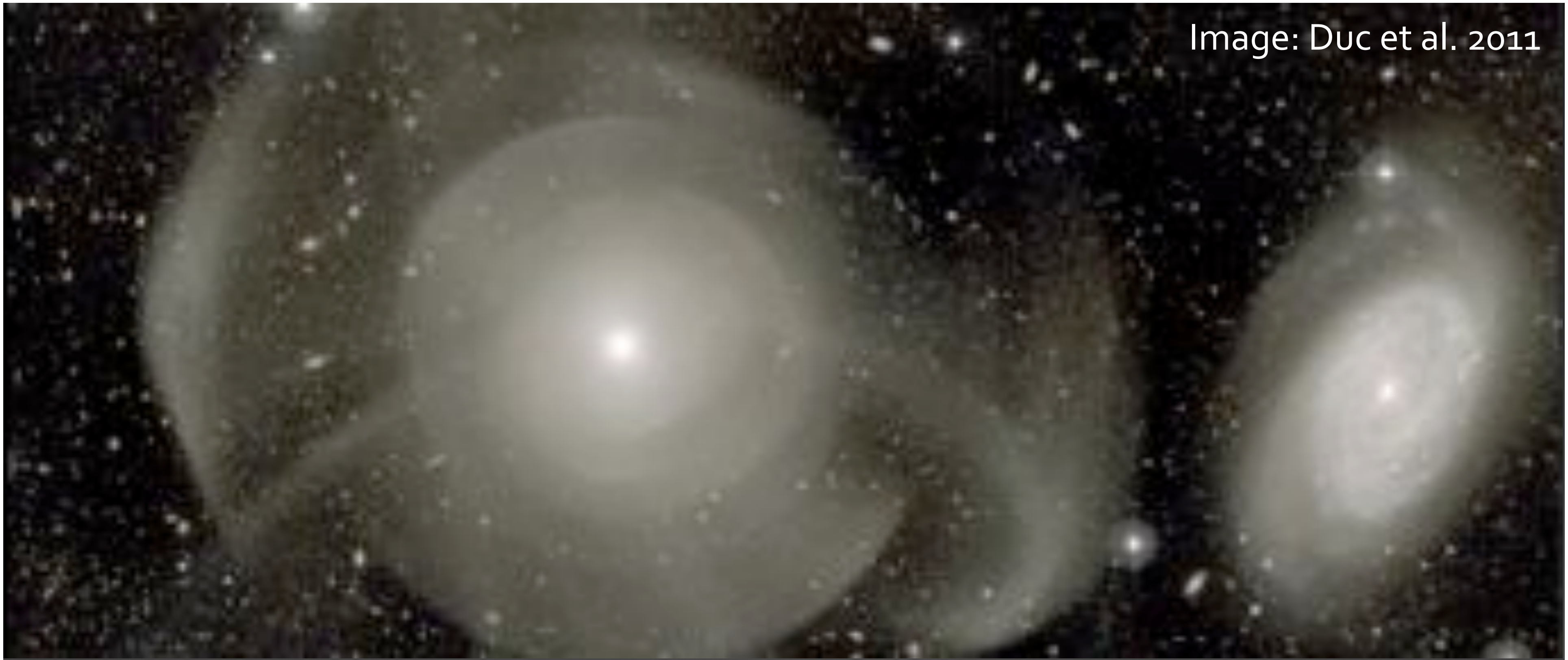


Mapping Star Formation Histories of Early-Type Galaxies with Atlas3D

Richard McDermid
Macquarie University / Australian Astronomical Observatory
+ Atlas3D Team

The Team

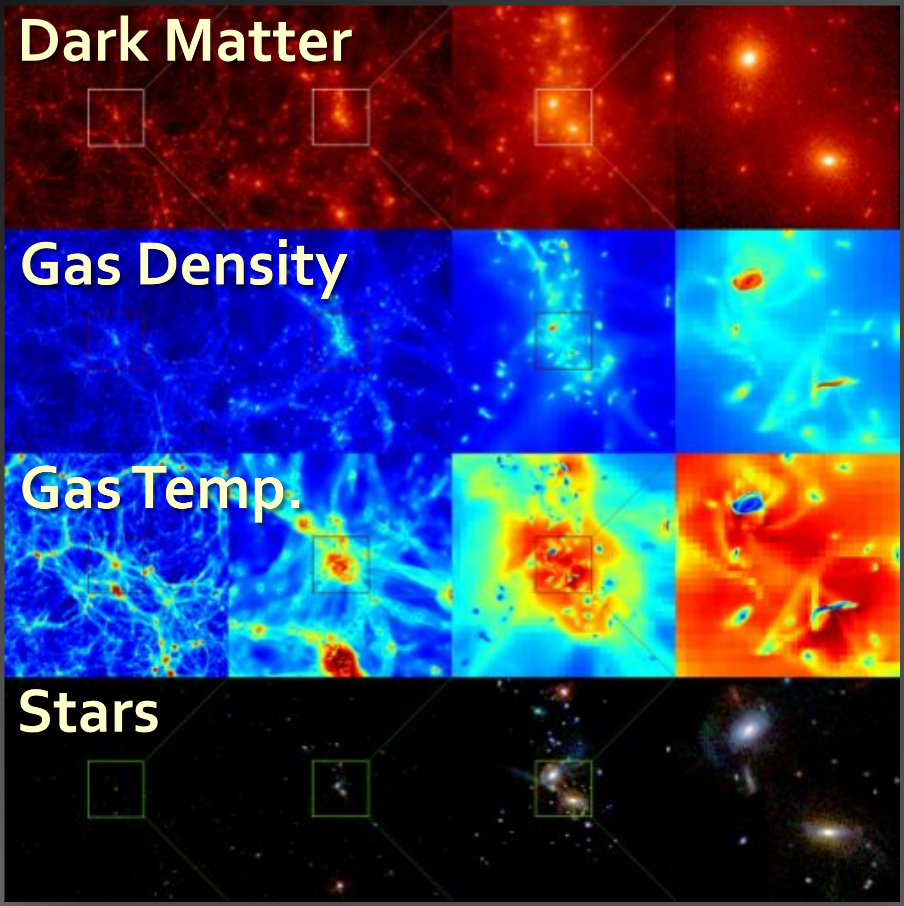
PIs: Michele Cappellari, Eric Emsellem, Davor Krajnović, Richard McDermid

CoIs :

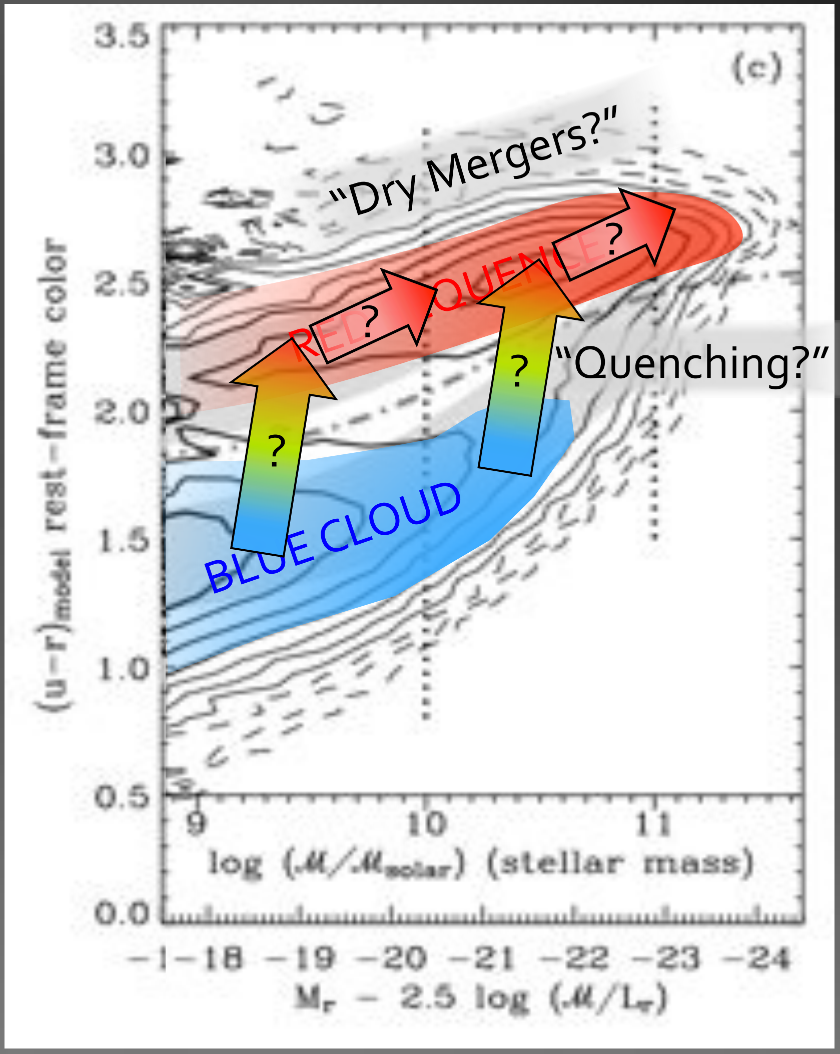
Katey Alatalo, Estelle Bayet, Leo Blitz, Maxime Bois, Frederic Bournaud, Martin Bureau, Alison Crocker, Roger Davies, Tim Davis, Tim de Zeeuw, Pierre-Alain Duc, Sadegh Khochfar, Harald Kuntschner, Pierre-Yves Lablanche, Raffaella Morganti, Thorsten Naab,Tom Oosterloo, Marc Sarzi, Nicholas Scott, Paolo Serra, Lisa Young, Anne-Marie Weijmans

Associates: Jesus Falcon-Barroso, Gijs Verdoes-Kleijn, Marie Martig, Remco van den Bosch, Glenn van de Ven

Hierarchical Growth



The Mare Nostrum Simulation = Teyssier et al.



Atlas3D Project

- Selection:

$M_K < -21.5$
$D < 42$ Mpc
$|\delta - 29| < 35°$
$|b| > 15°$
Early-type Morphology

- 260 galaxies
- Volume-limited
- Complete in M_K
- No colour cut
- Mass range: ~ 7×10^9 - 5×10^{11} M_{sun}

Cappellari +A3D 2011, Paper I

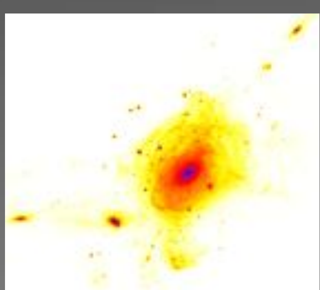
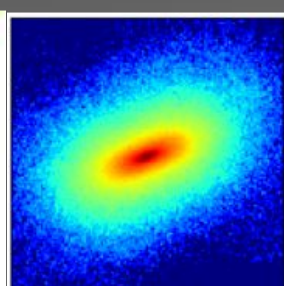
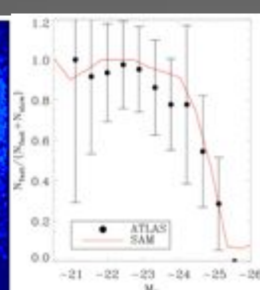
Multi-λ Approach

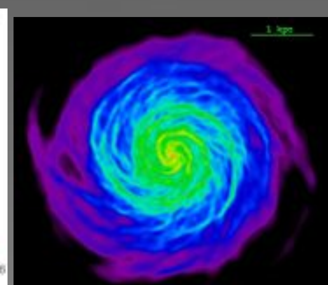
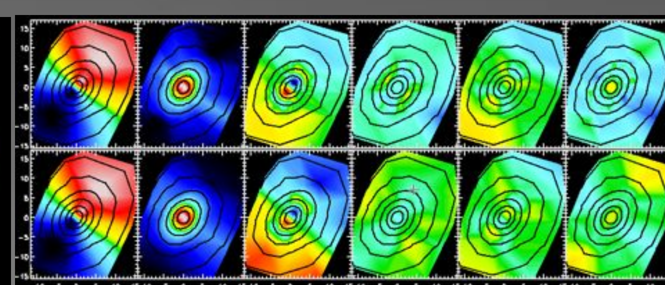
- ***SAURON*** **Large Program on WHT**
- ***Single-dish CO*** survey of full sample (**IRAM 30m**)
- ***HI maps*** of ~150 northern galaxies with **WSRT** (excl. Virgo)
- ***CO interferometry*** of detections with **CARMA**
- ***Photometry*** multi-bands (**INT**, **2MASS**, **SDSS**, deep=**MegaCam**)
- ***Archival*** data (2MASS, Chandra, XMM, GALEX, HST, Spitzer)

Lisa Young's talk

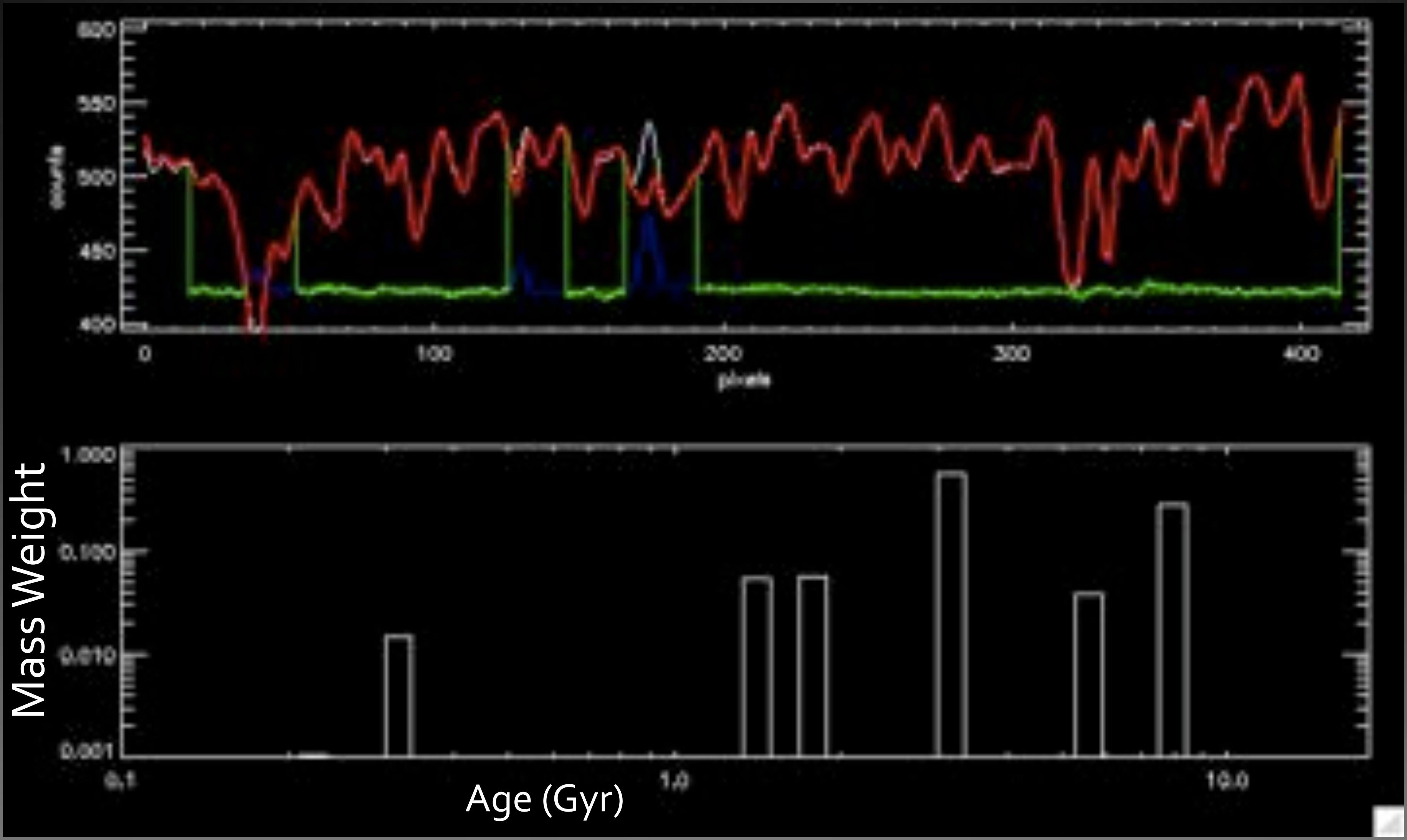
Multi-Discipline Approach

- ***Stellar Populations, Star Formation Histories***
- ***Dynamical modelling, Mass-to-Light ratios (JAM)***
- ***Gas in multiple phases***
- ***High-res numerical simulations of idealized mergers***
- ***High-res RE-simulations of massive galaxies with full cosmology***
- ***Semi Analytic Modelling***

Star Formation History



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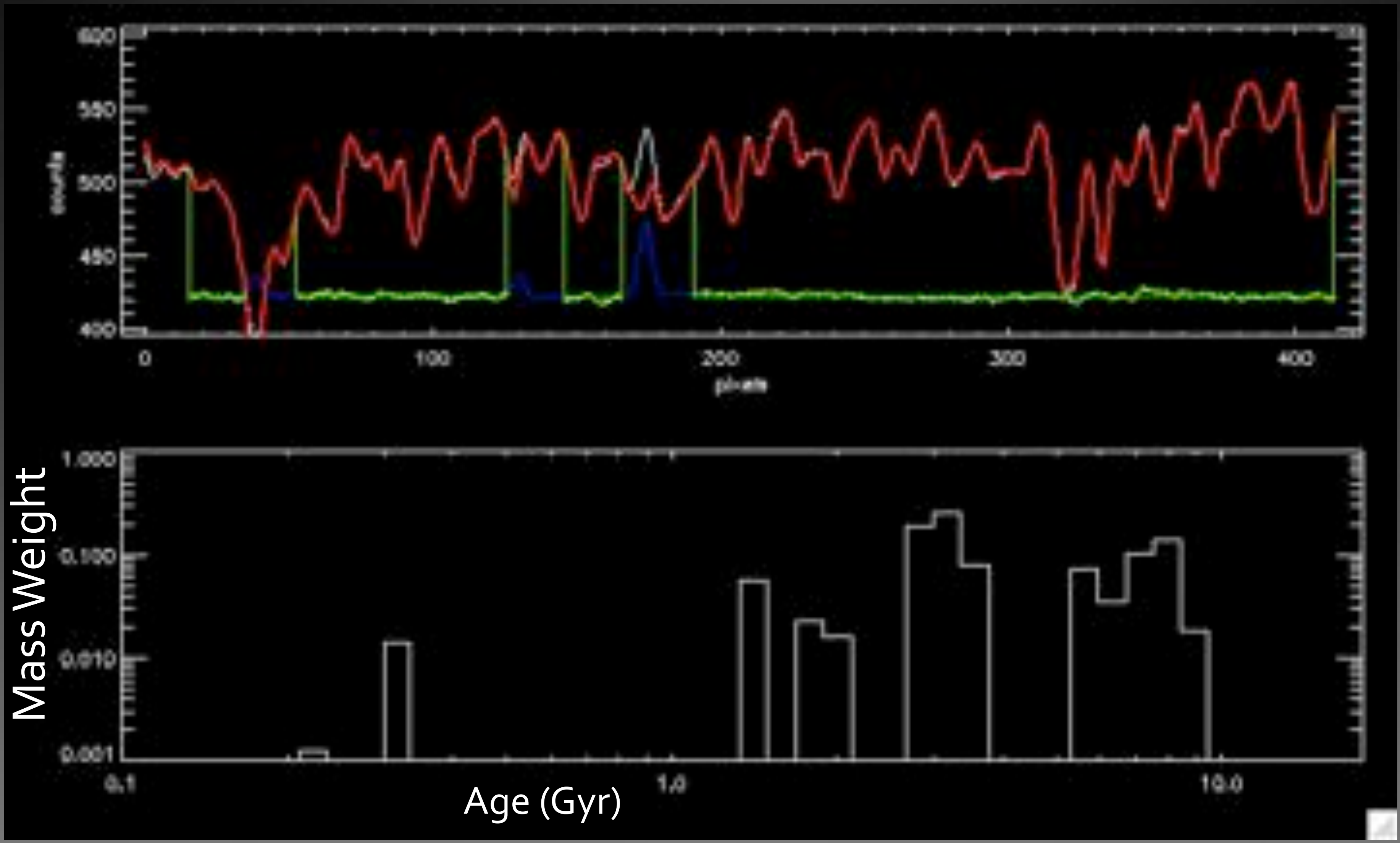
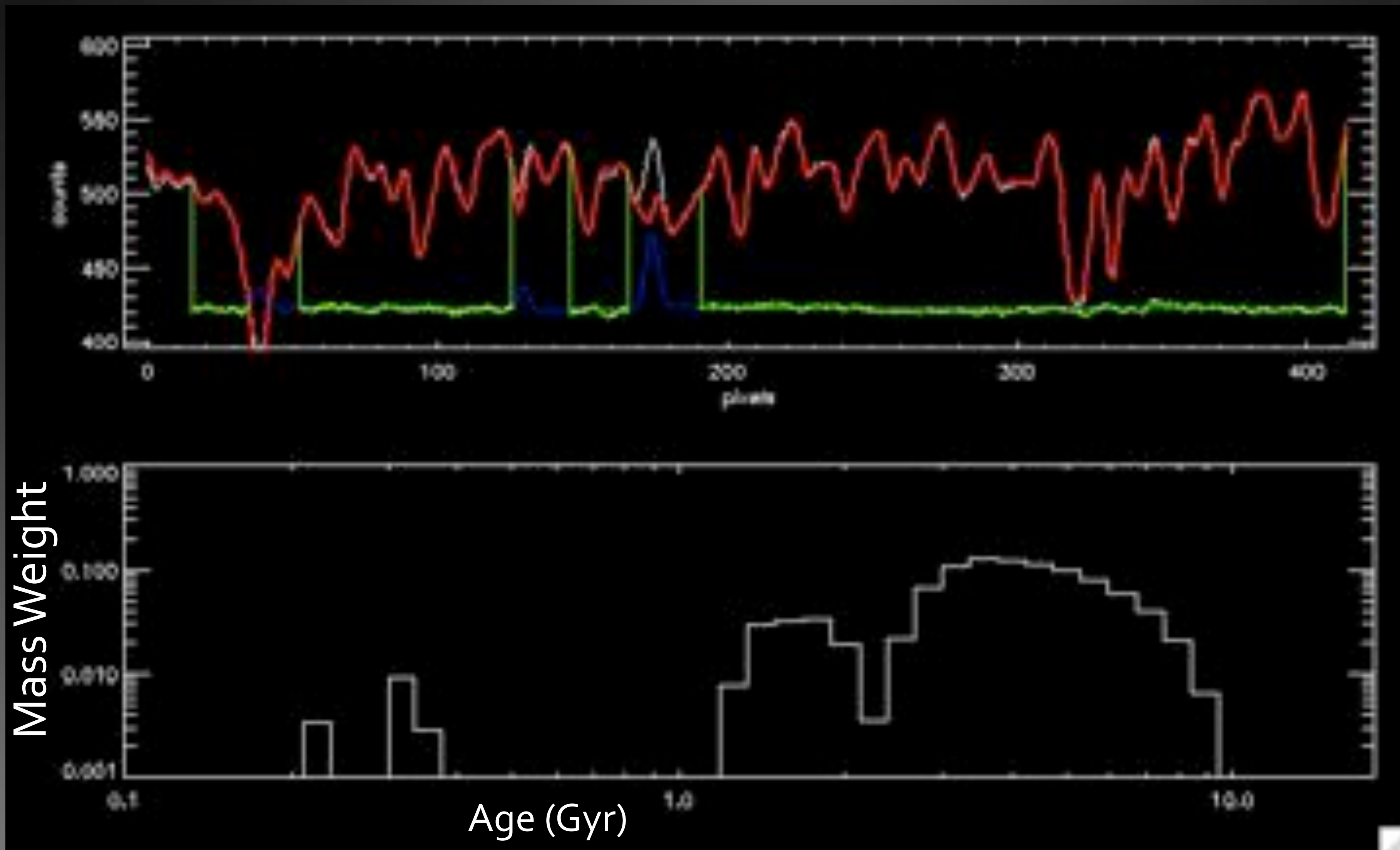
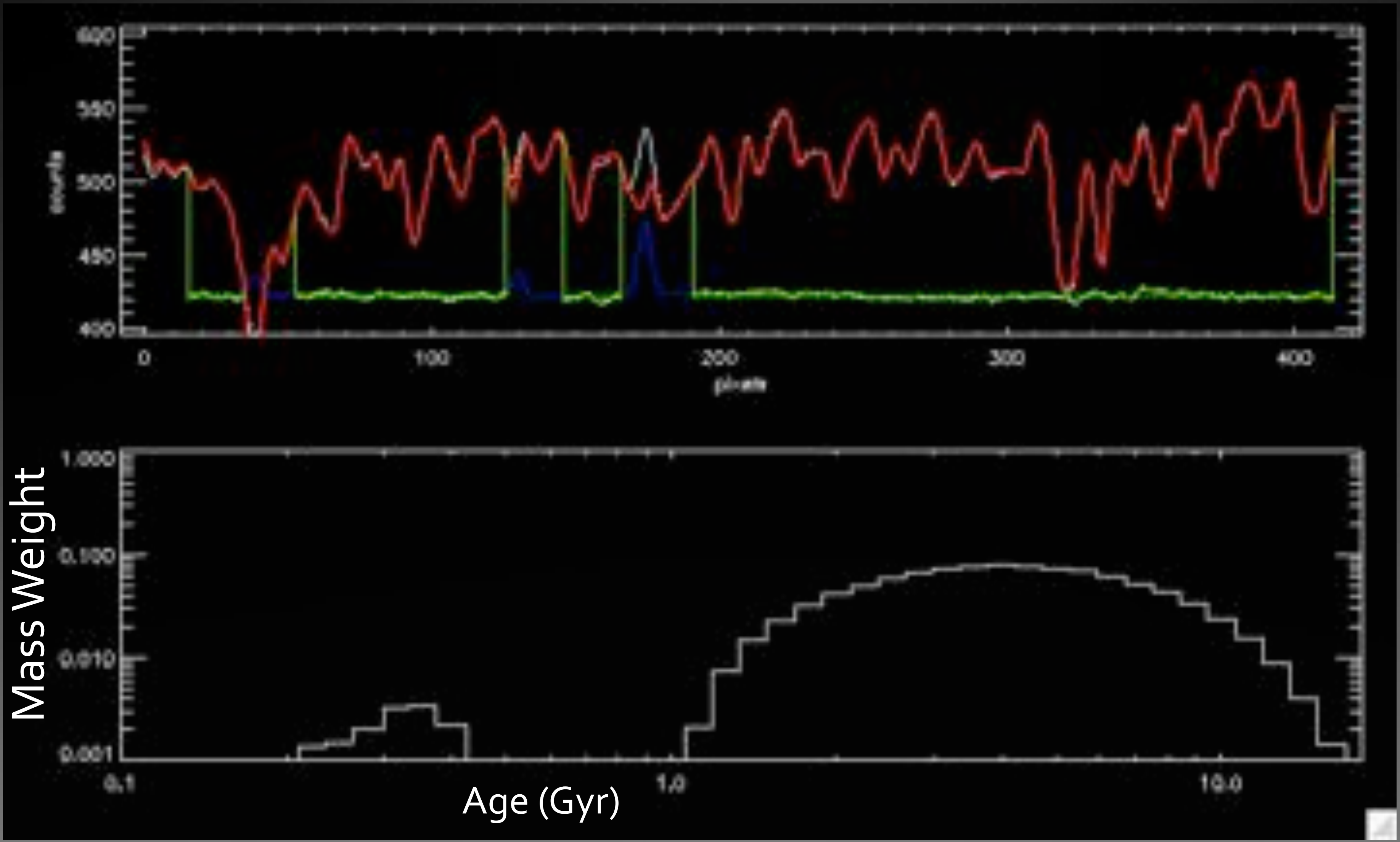


Star Formation History



Star Formation History



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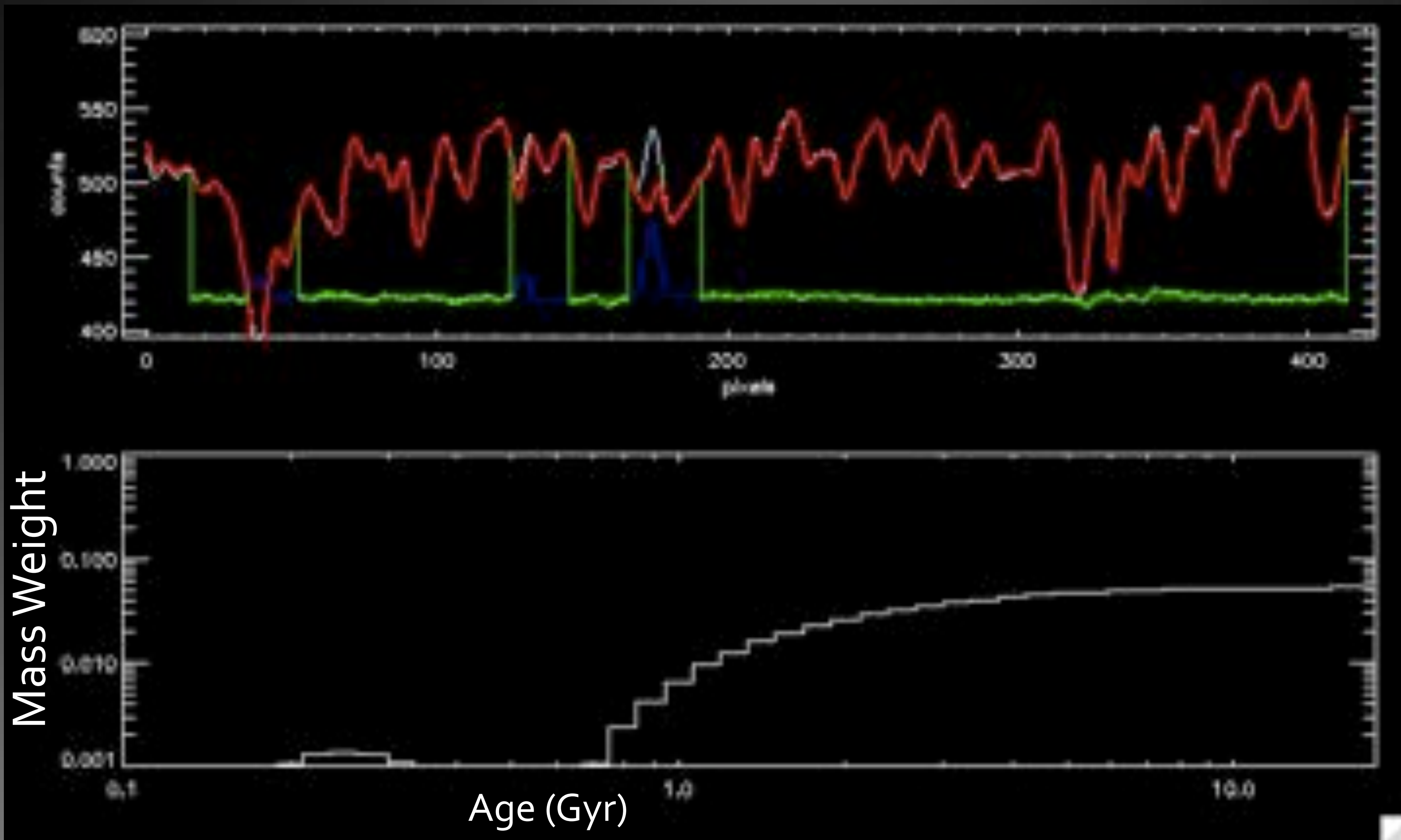

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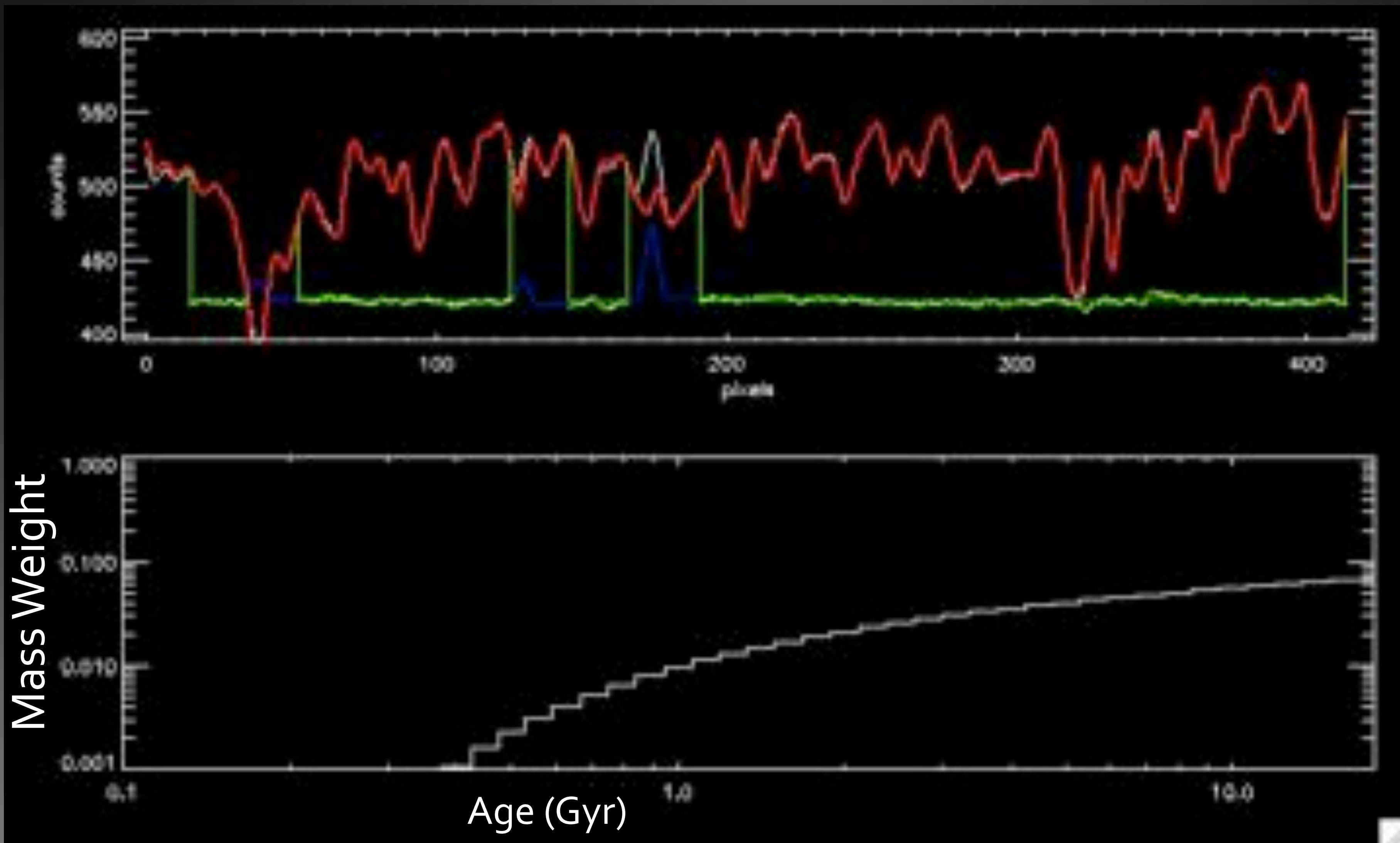

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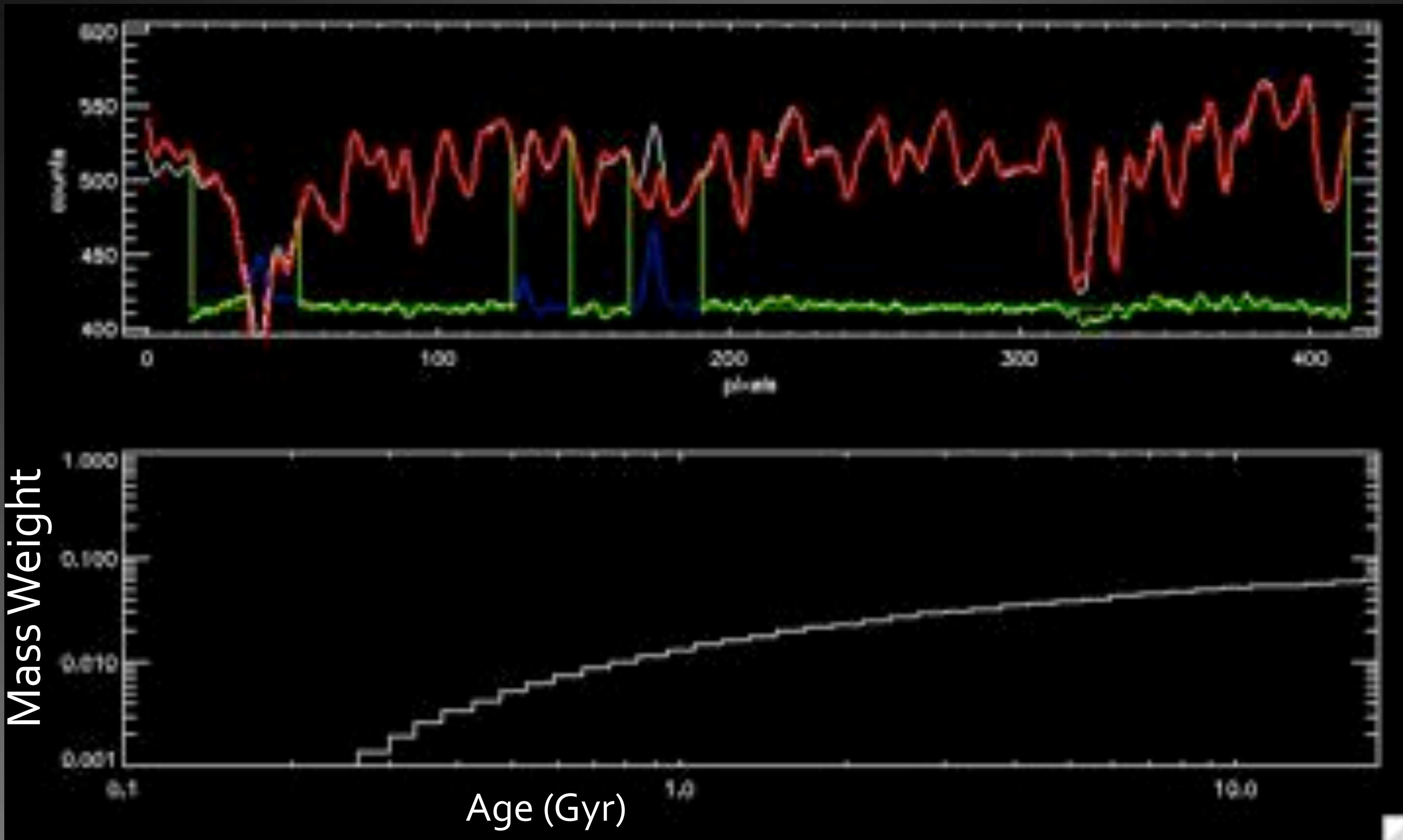
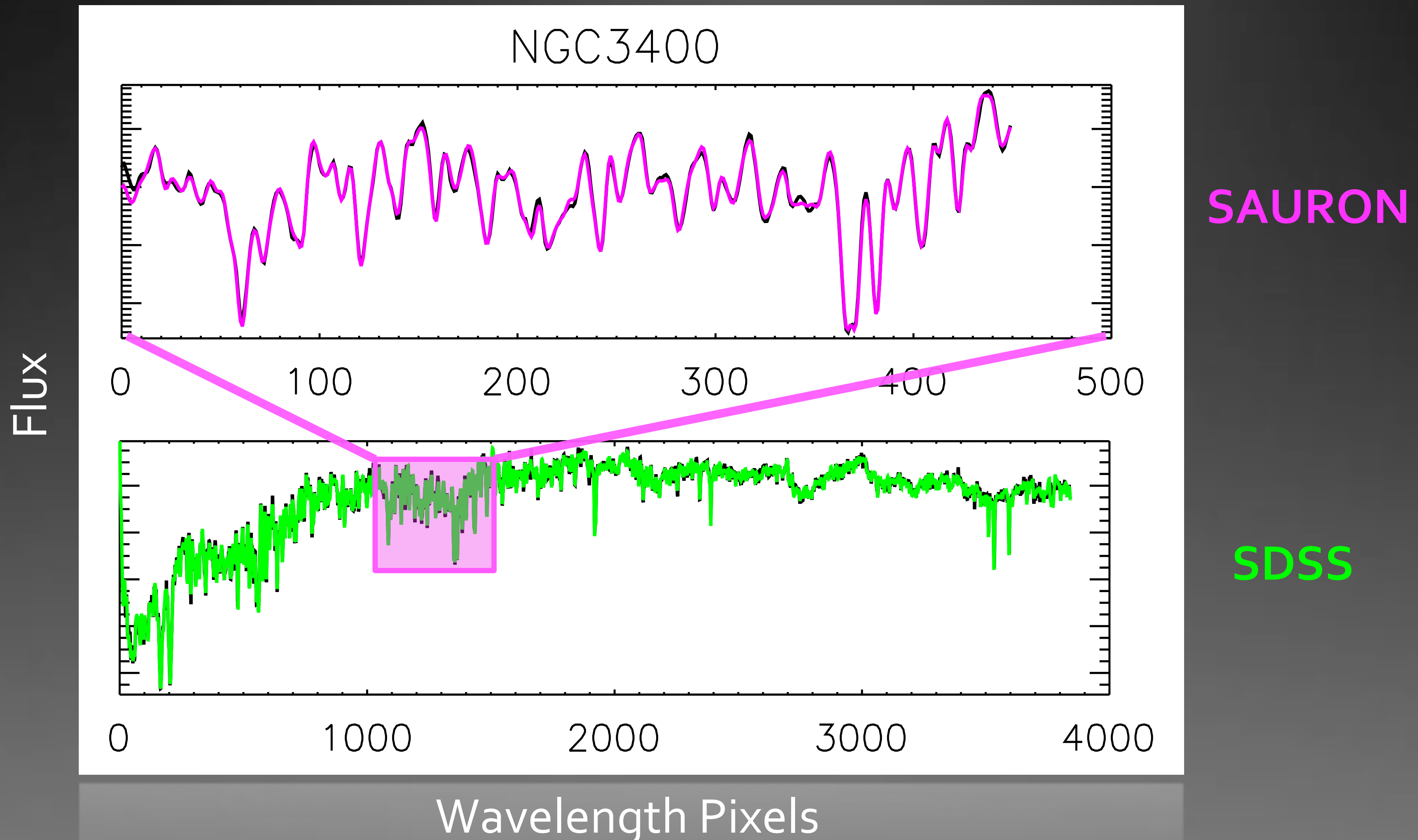


Comparison with SDSS



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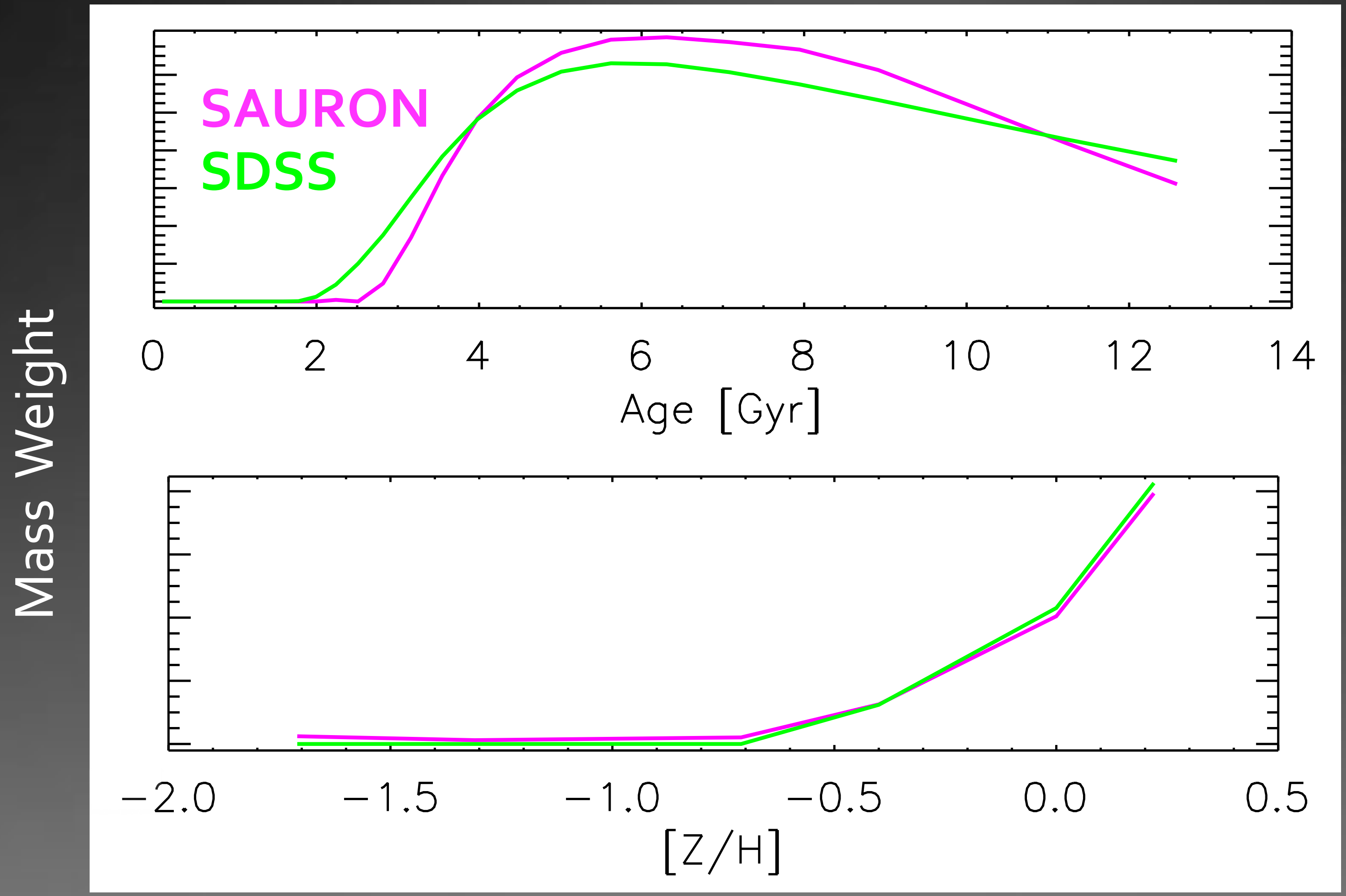

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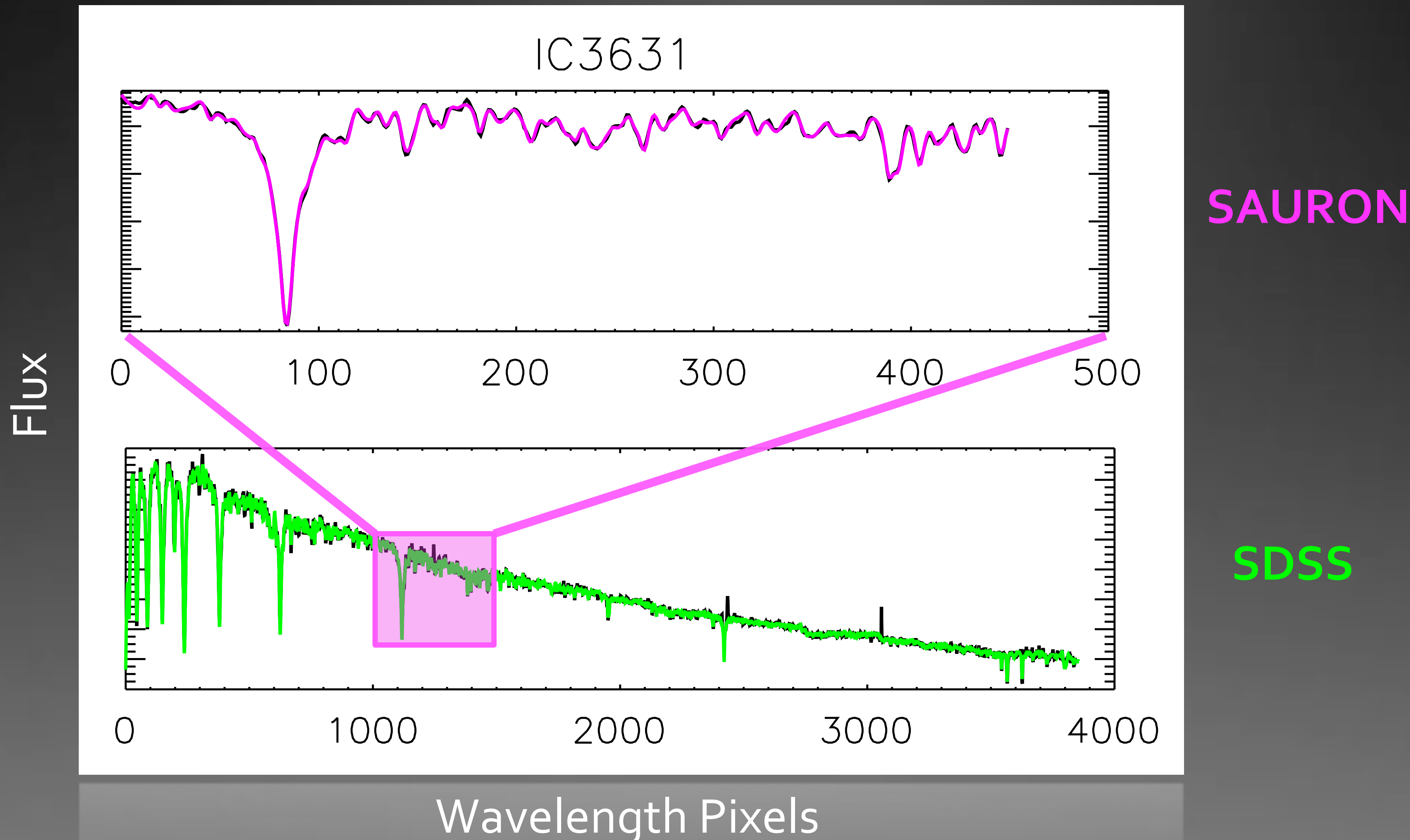

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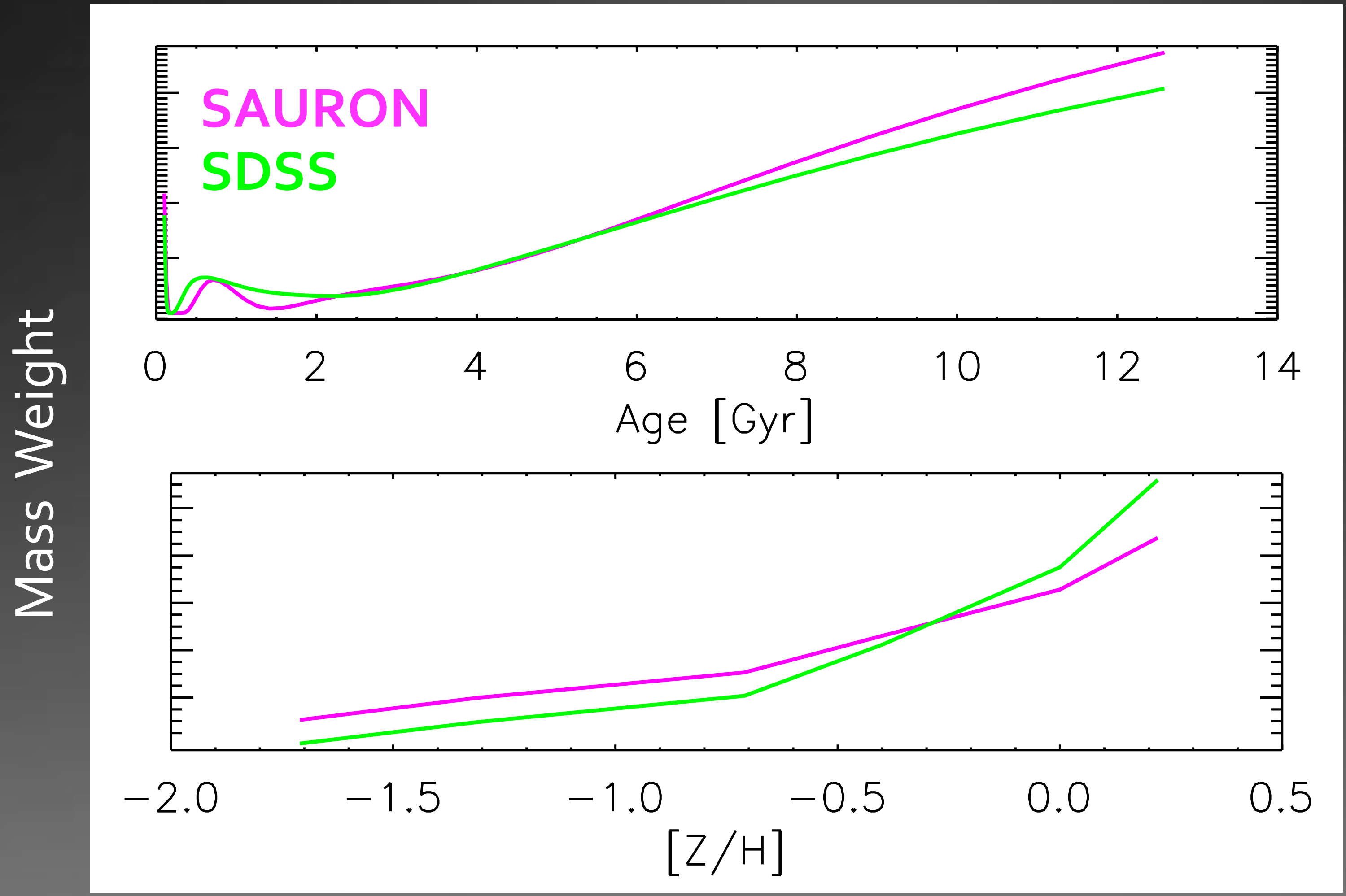
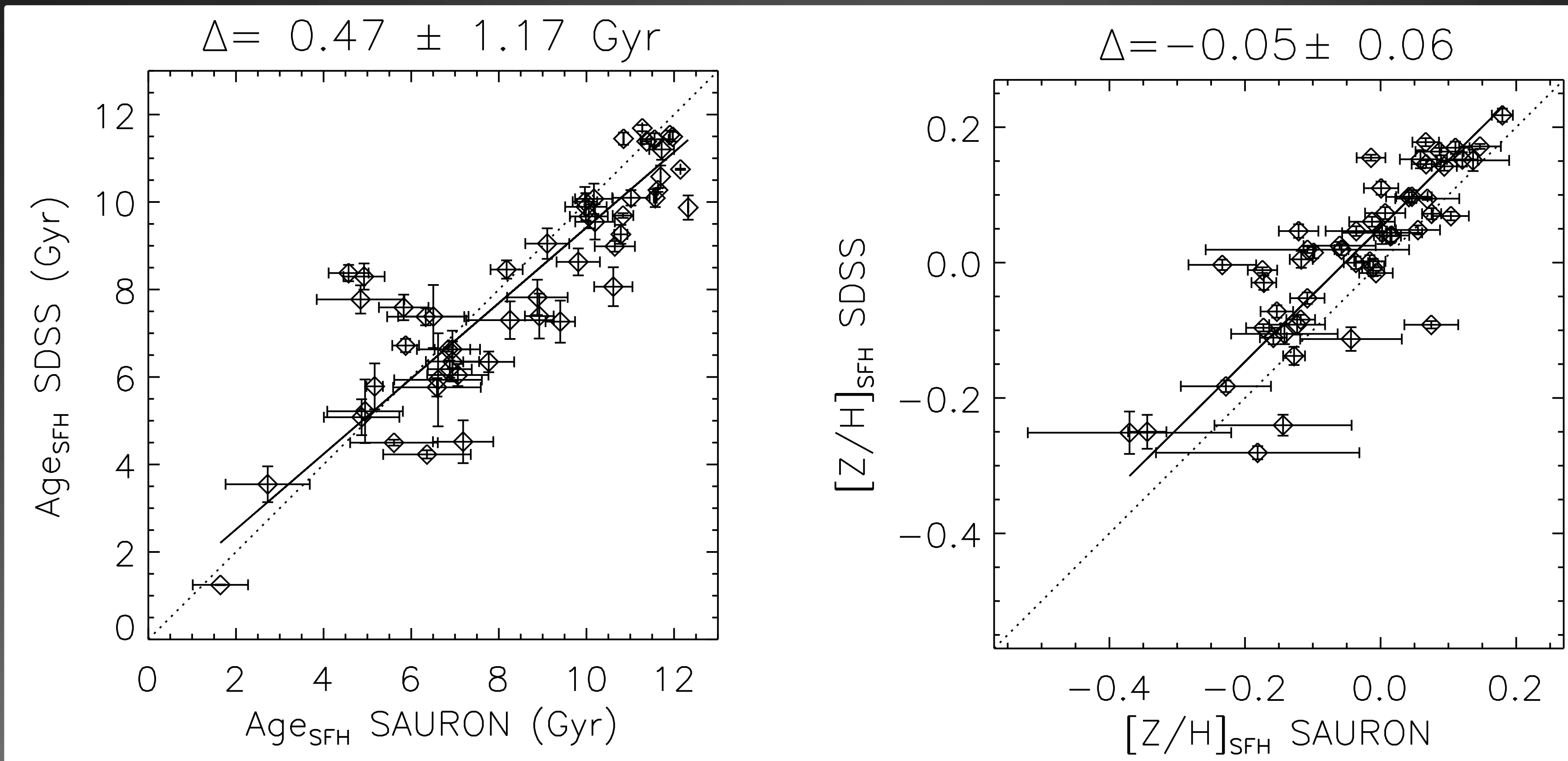
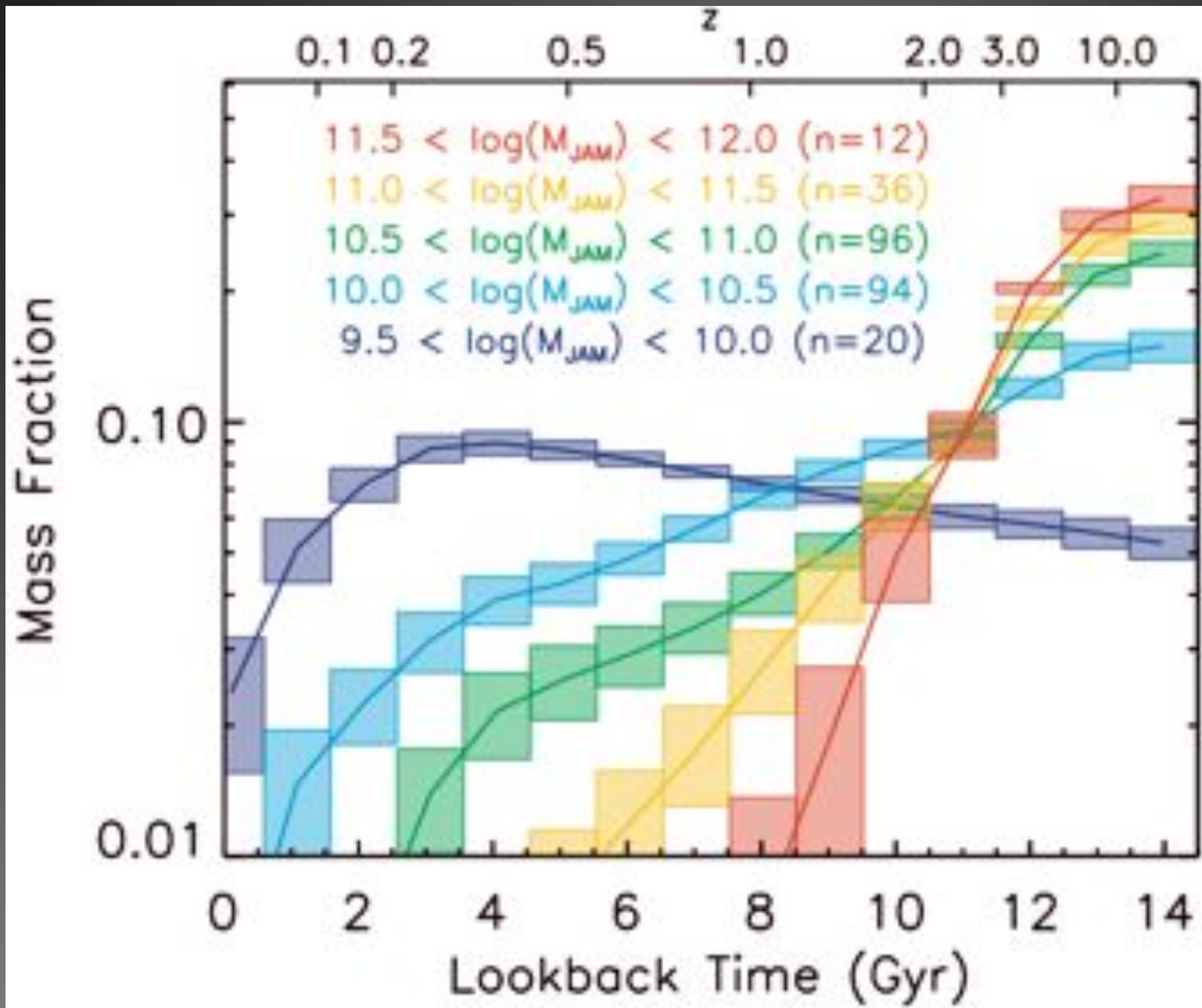


Comparison with SDSS

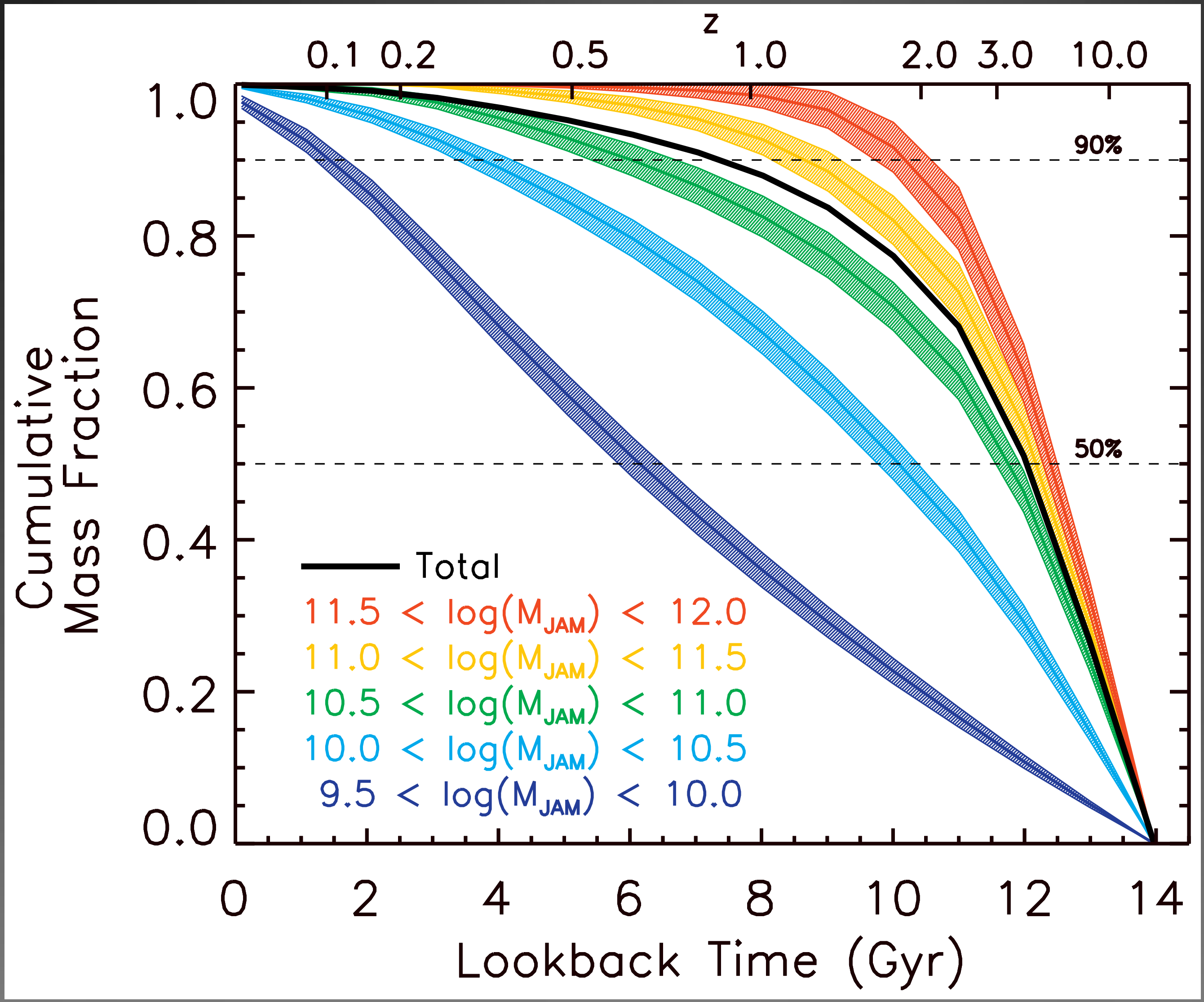
Mass-weighted average age and metallicity



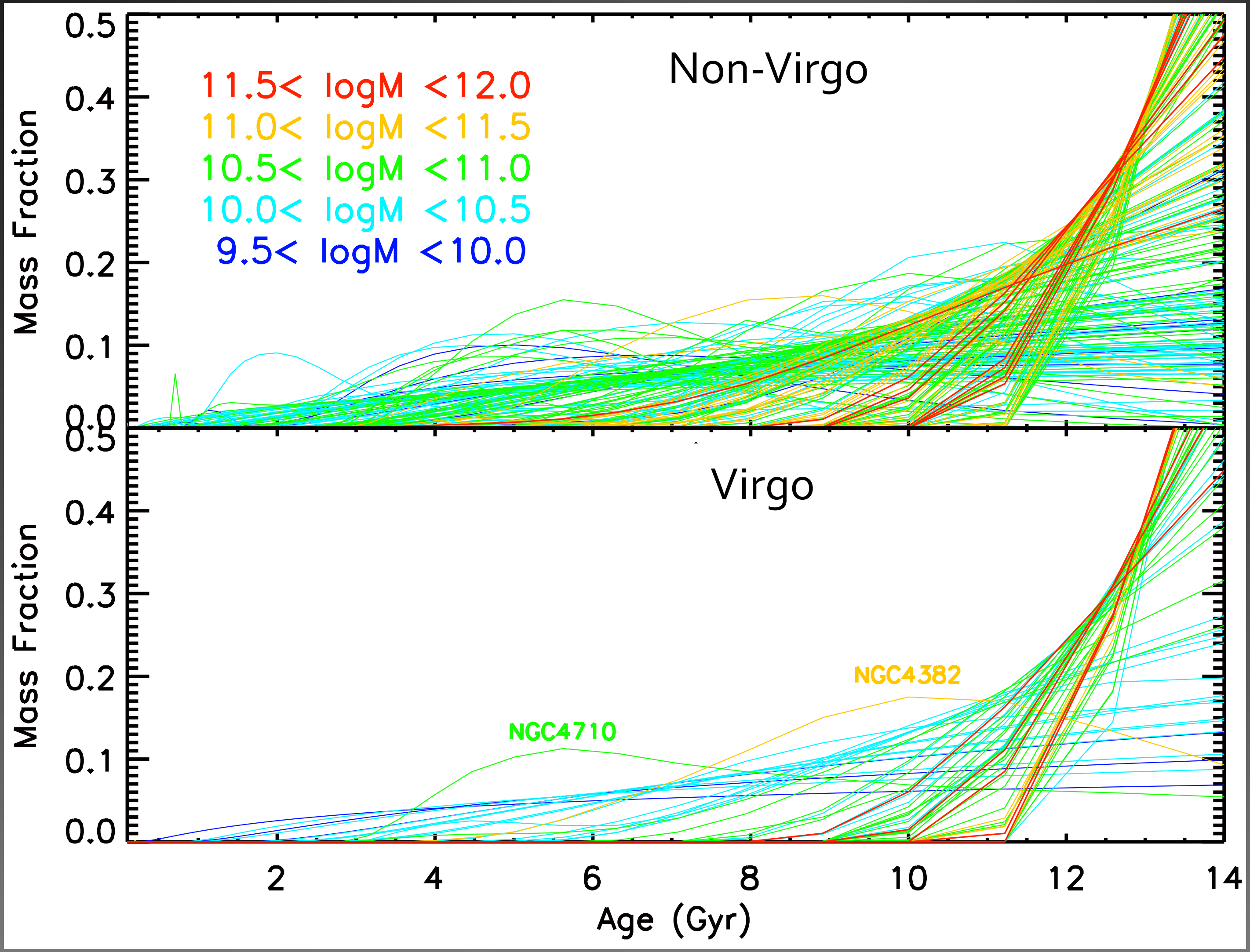
Mean Star Formation History with Galaxy Mass



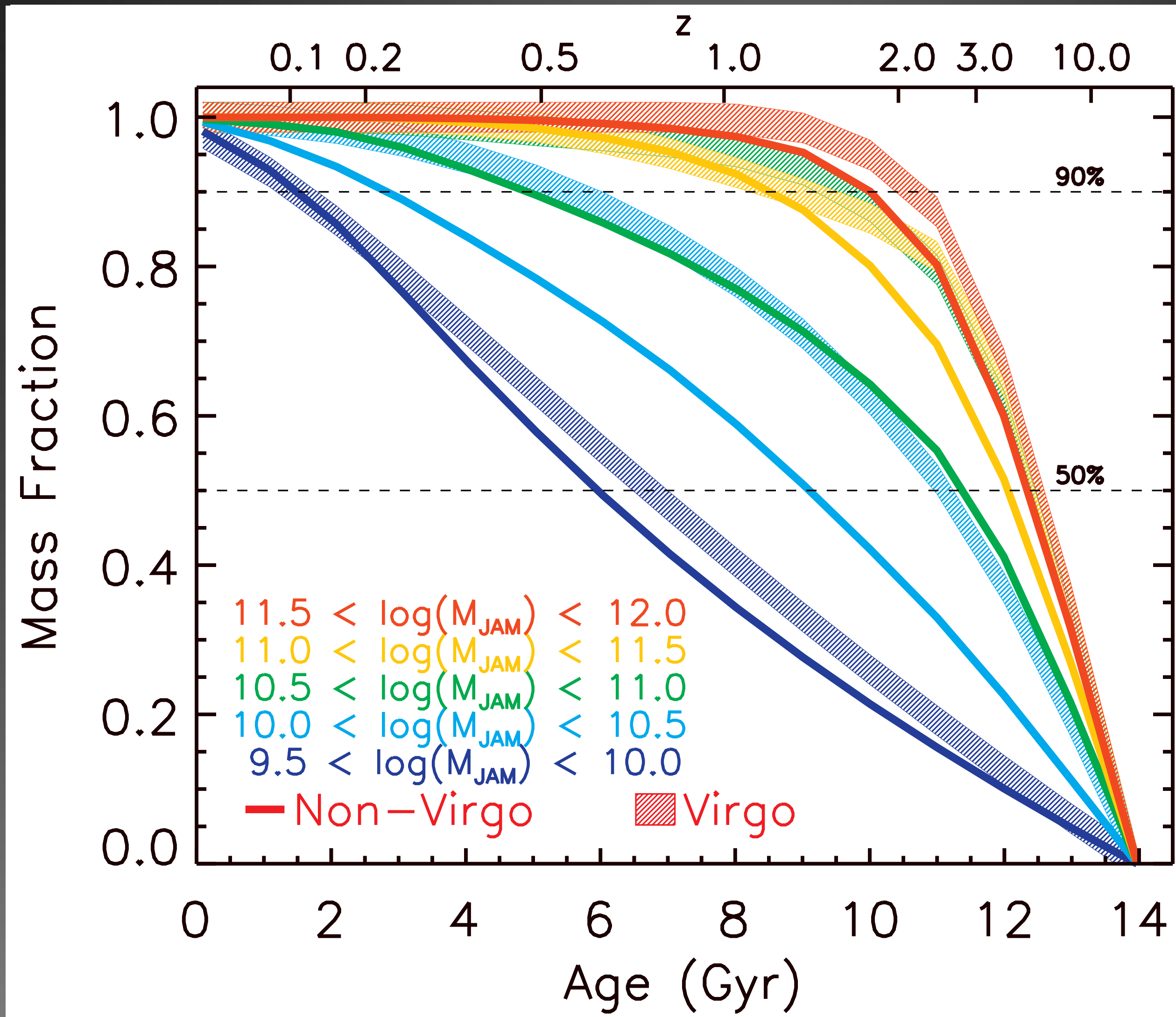
Mean Star Formation History with Galaxy Mass



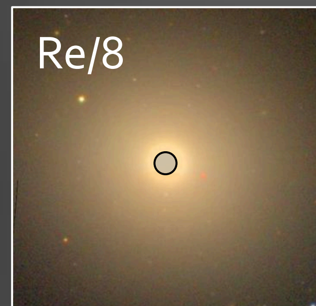
Star Formation History with Environment

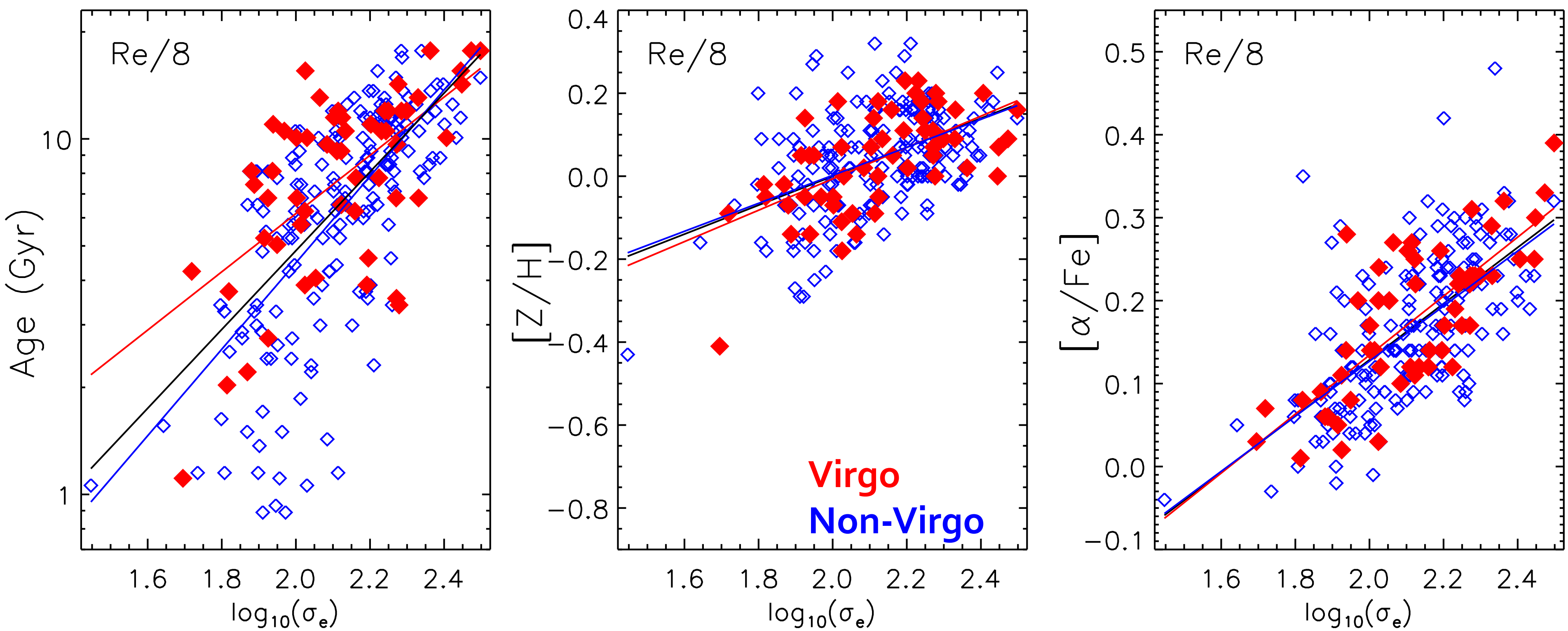


Star Formation History with Environment



Virgo versus Non-Virgo





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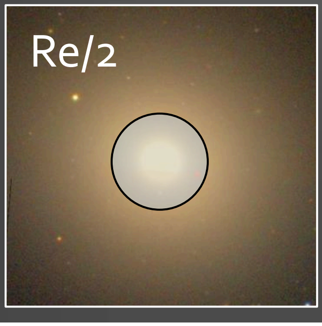
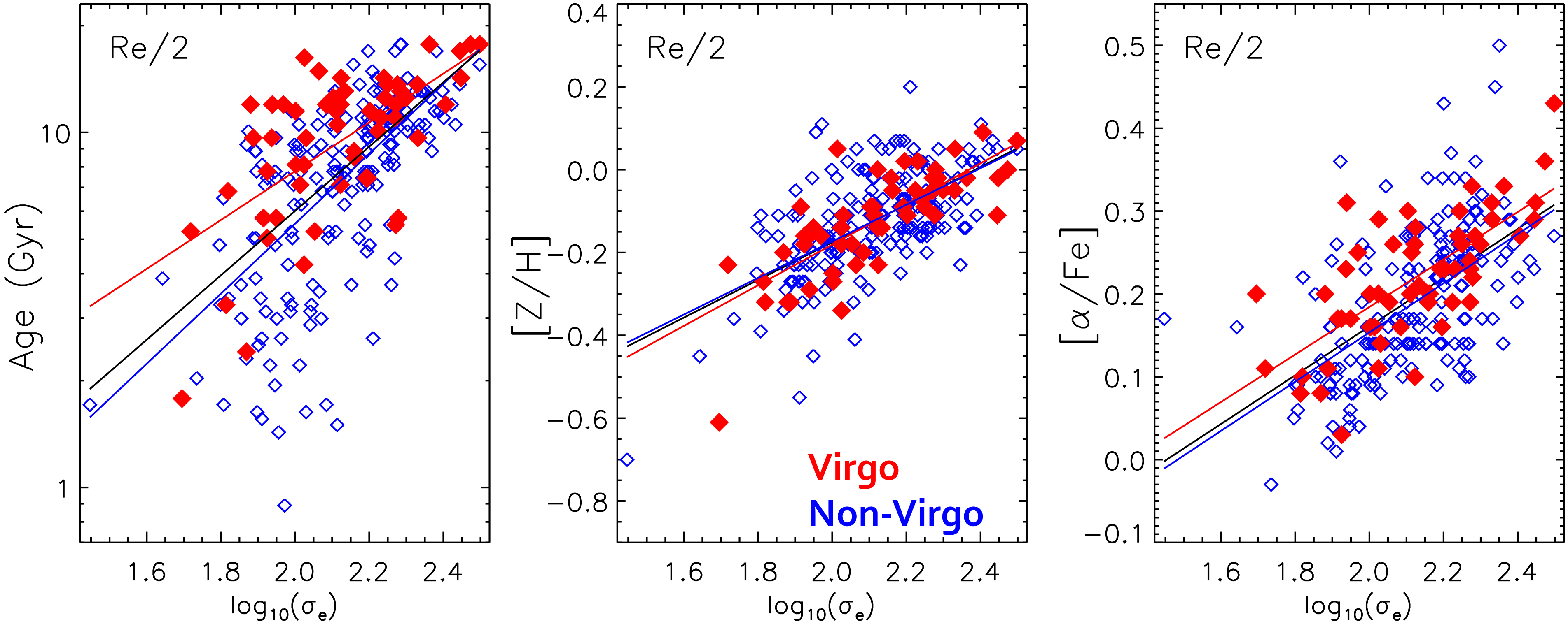
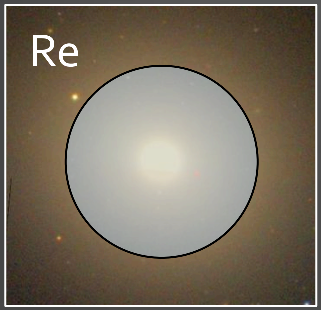
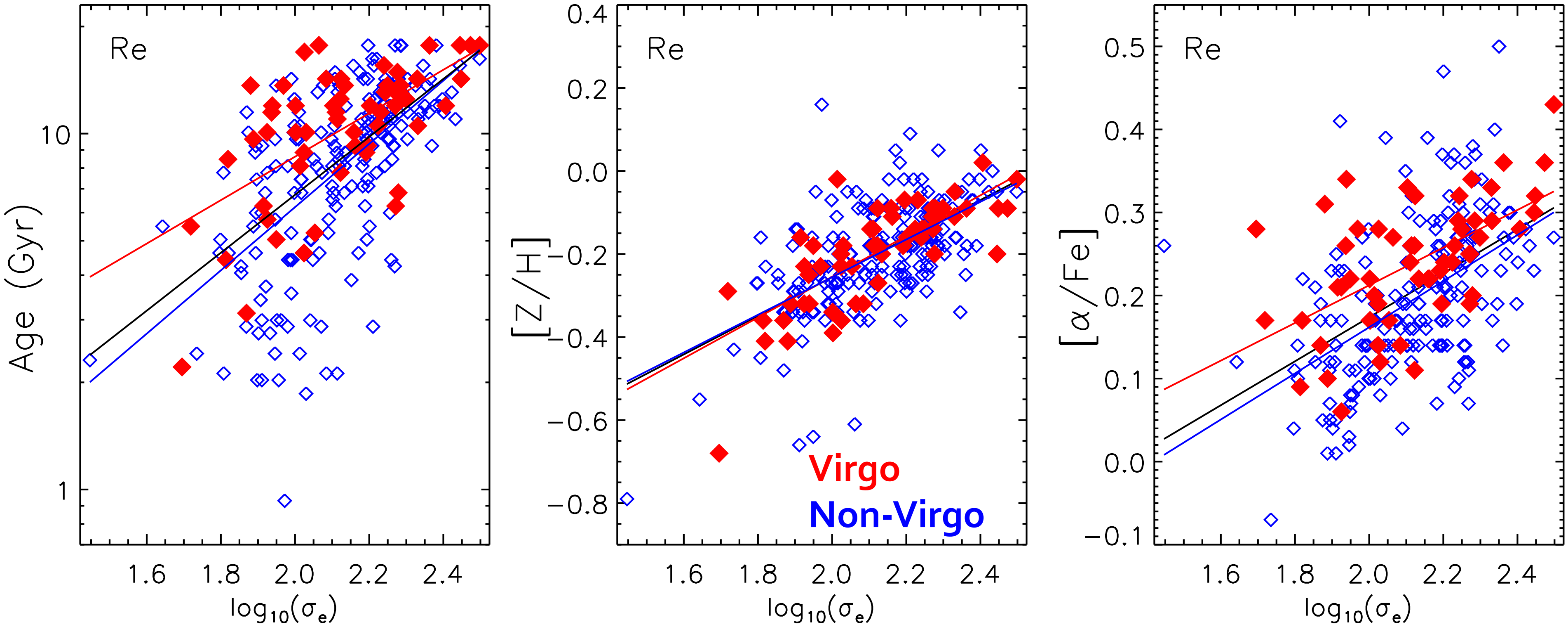




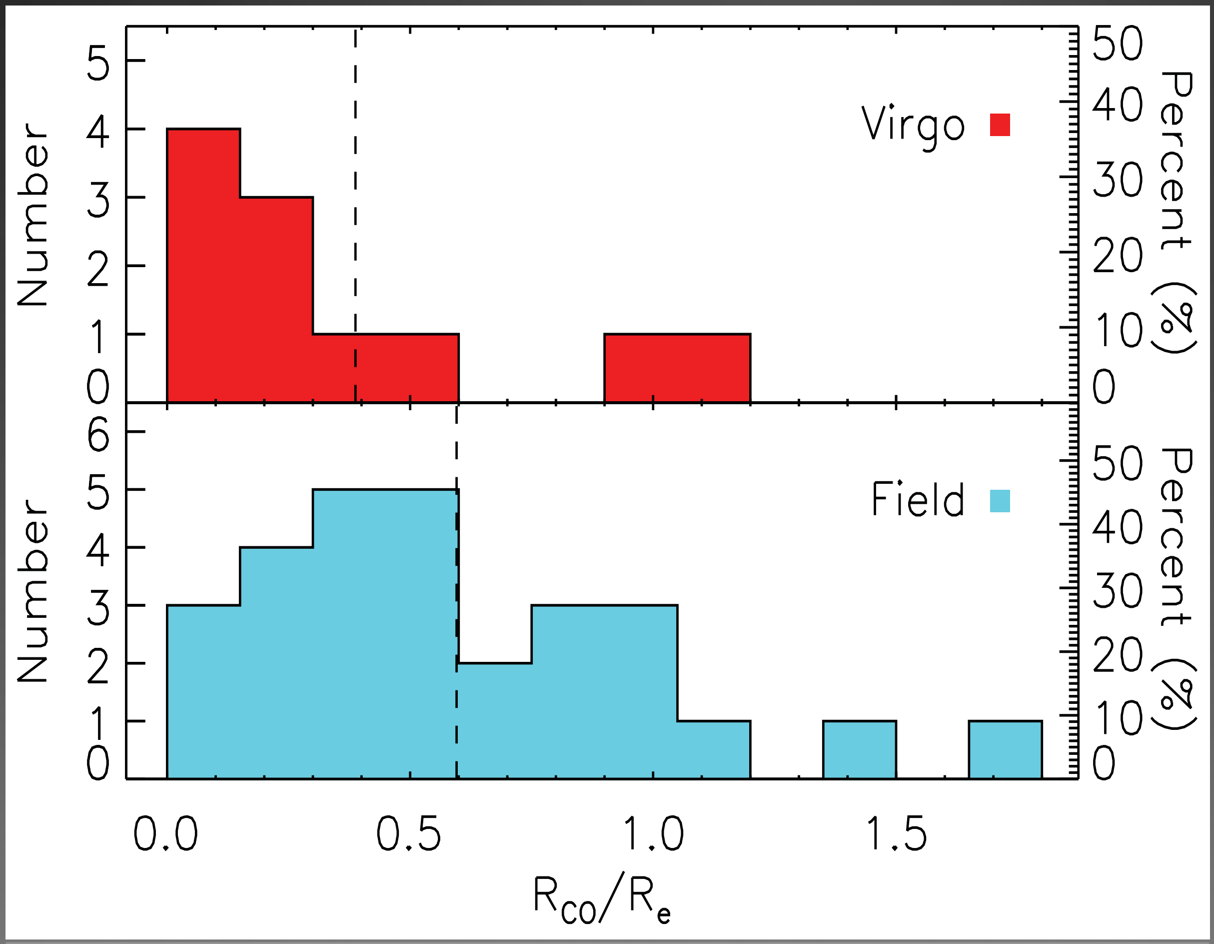
Virgo versus Non-Virgo



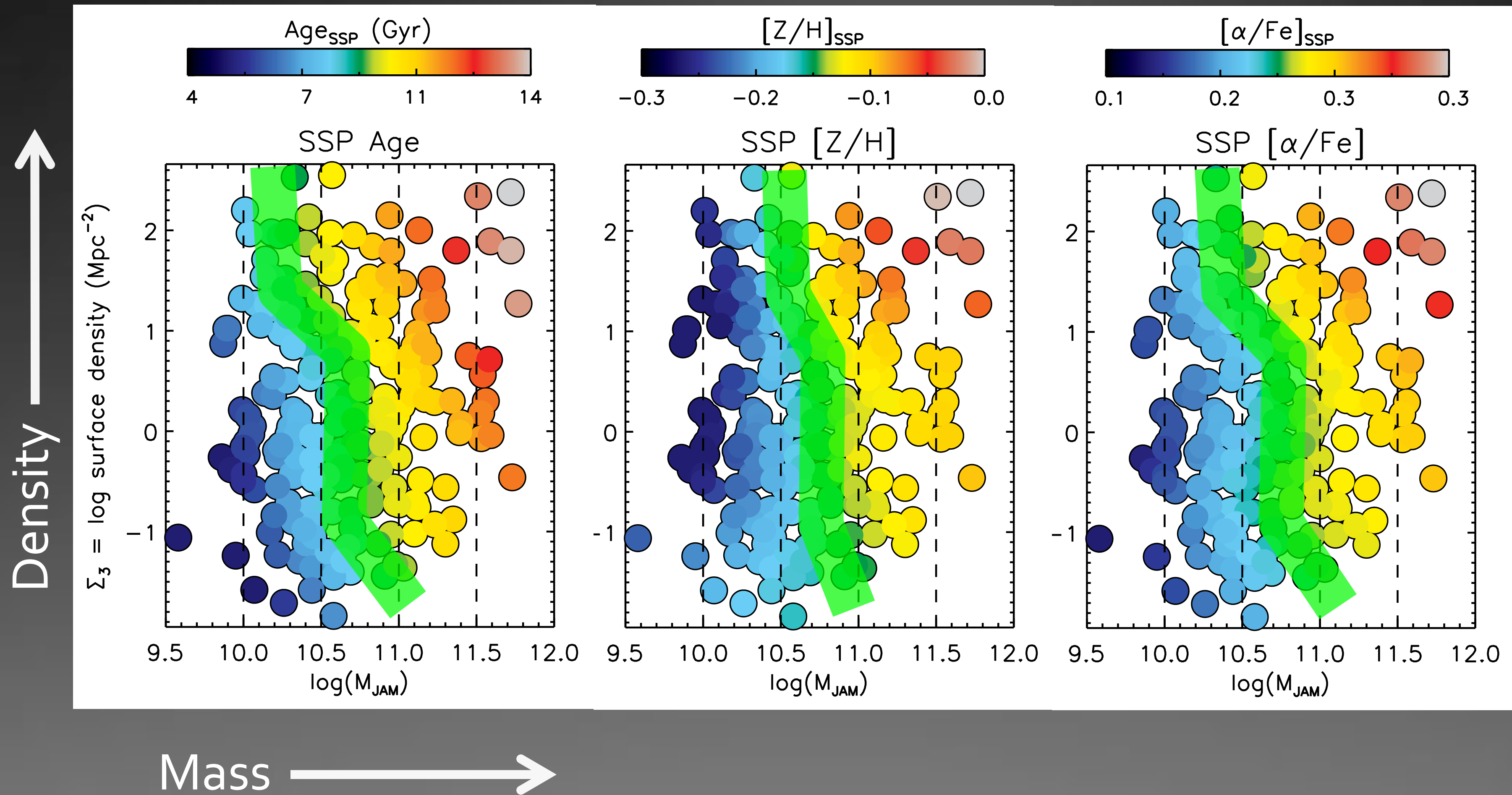


Truncation of CO in Virgo

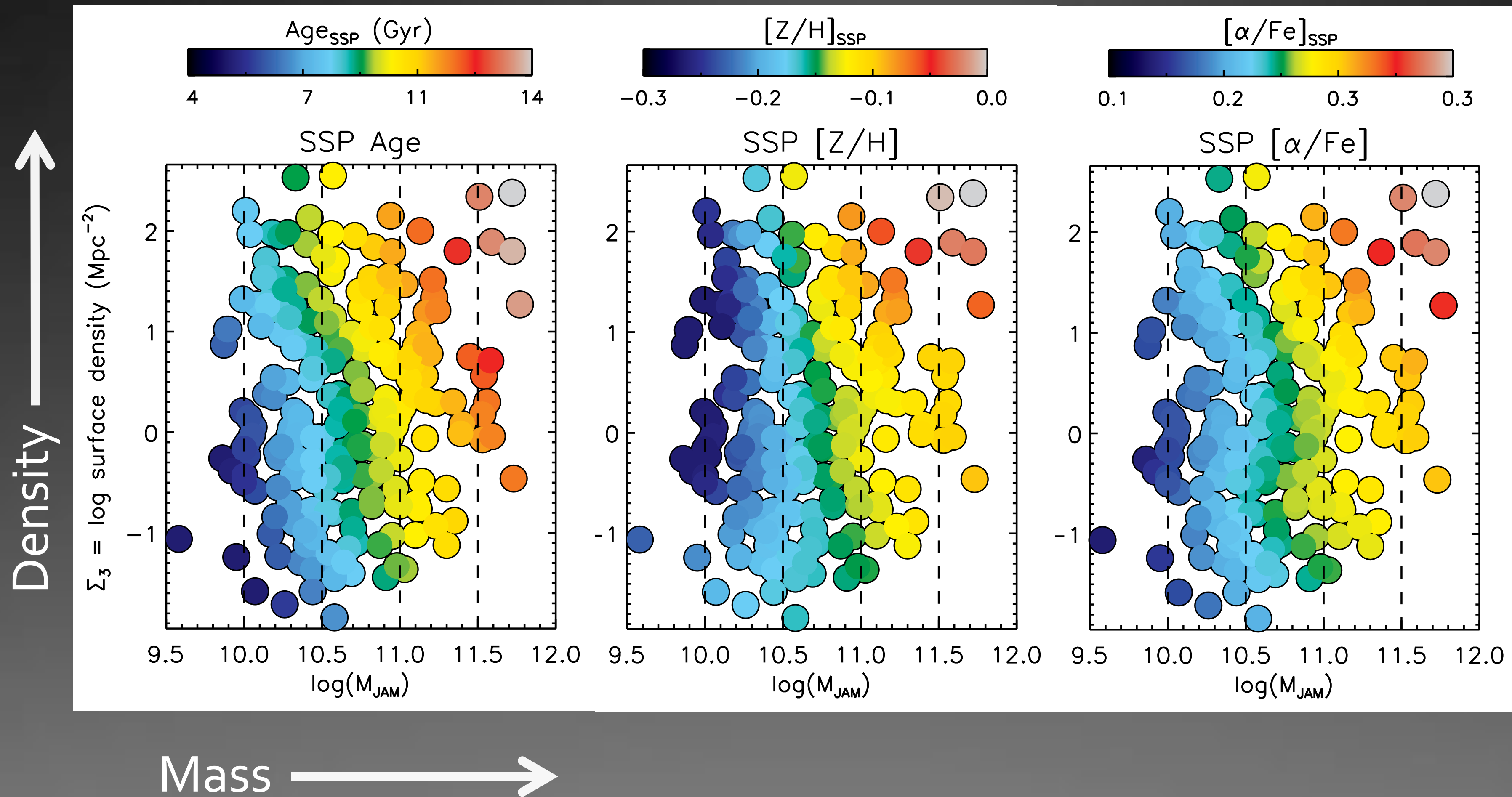
Davis et al. 2013a



Local galaxy surface density

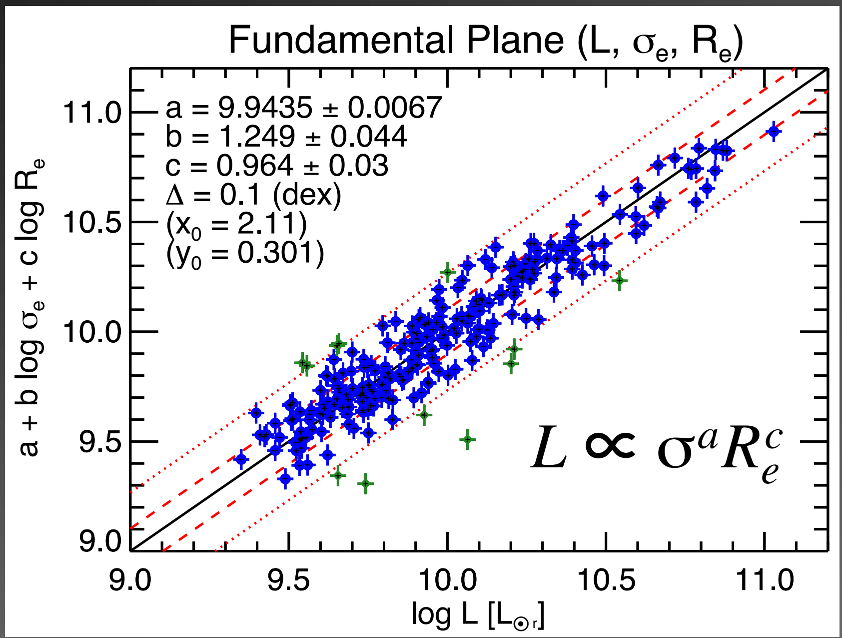


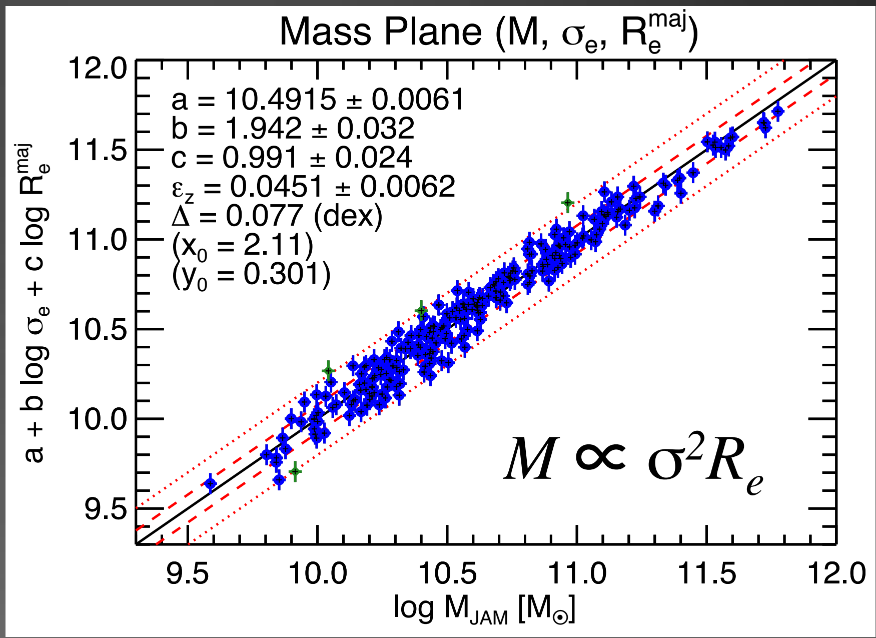
Local galaxy surface density



Fundamental Plane → Mass Plane

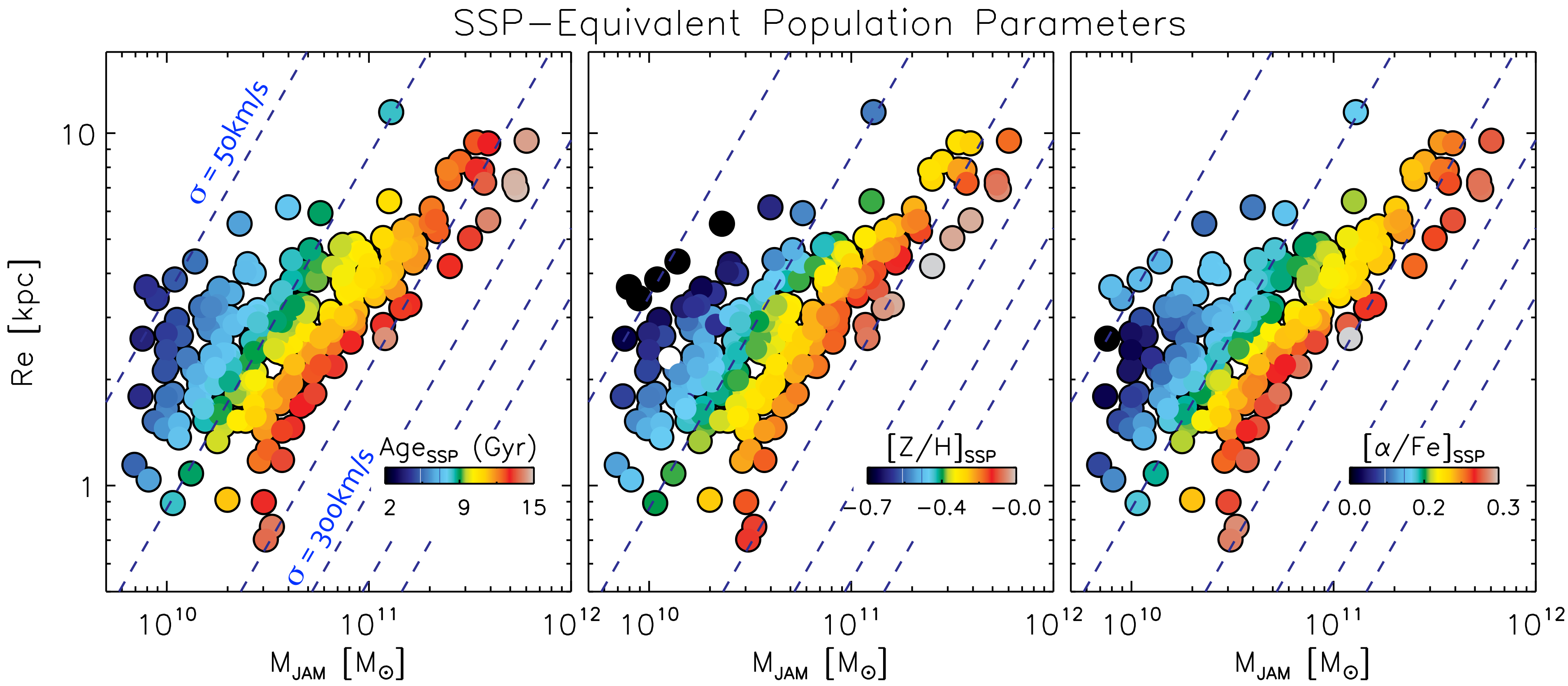
Cappellari et al. 2013a



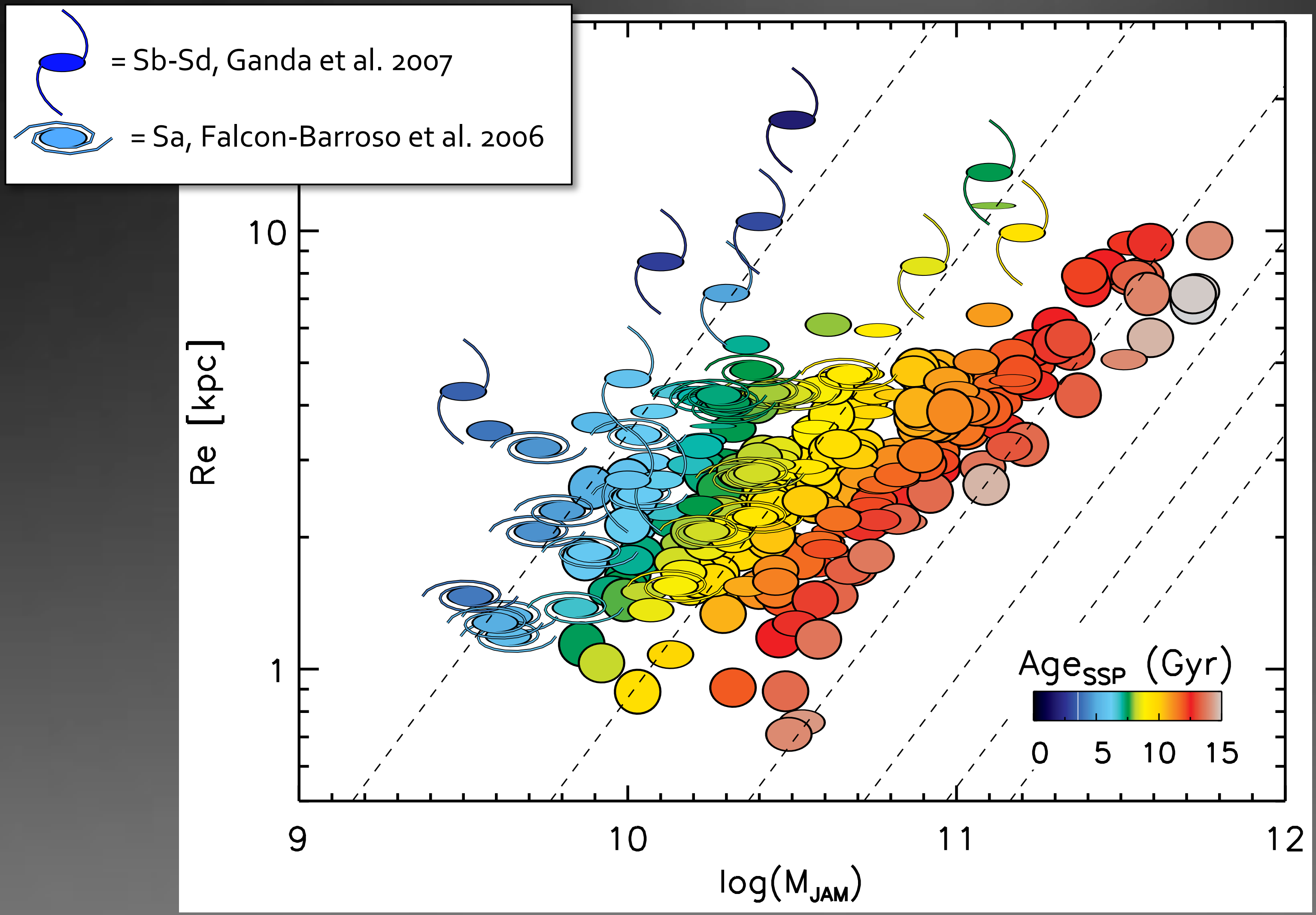


Mass-Size Plane

Age [Z/H] [α/Fe]

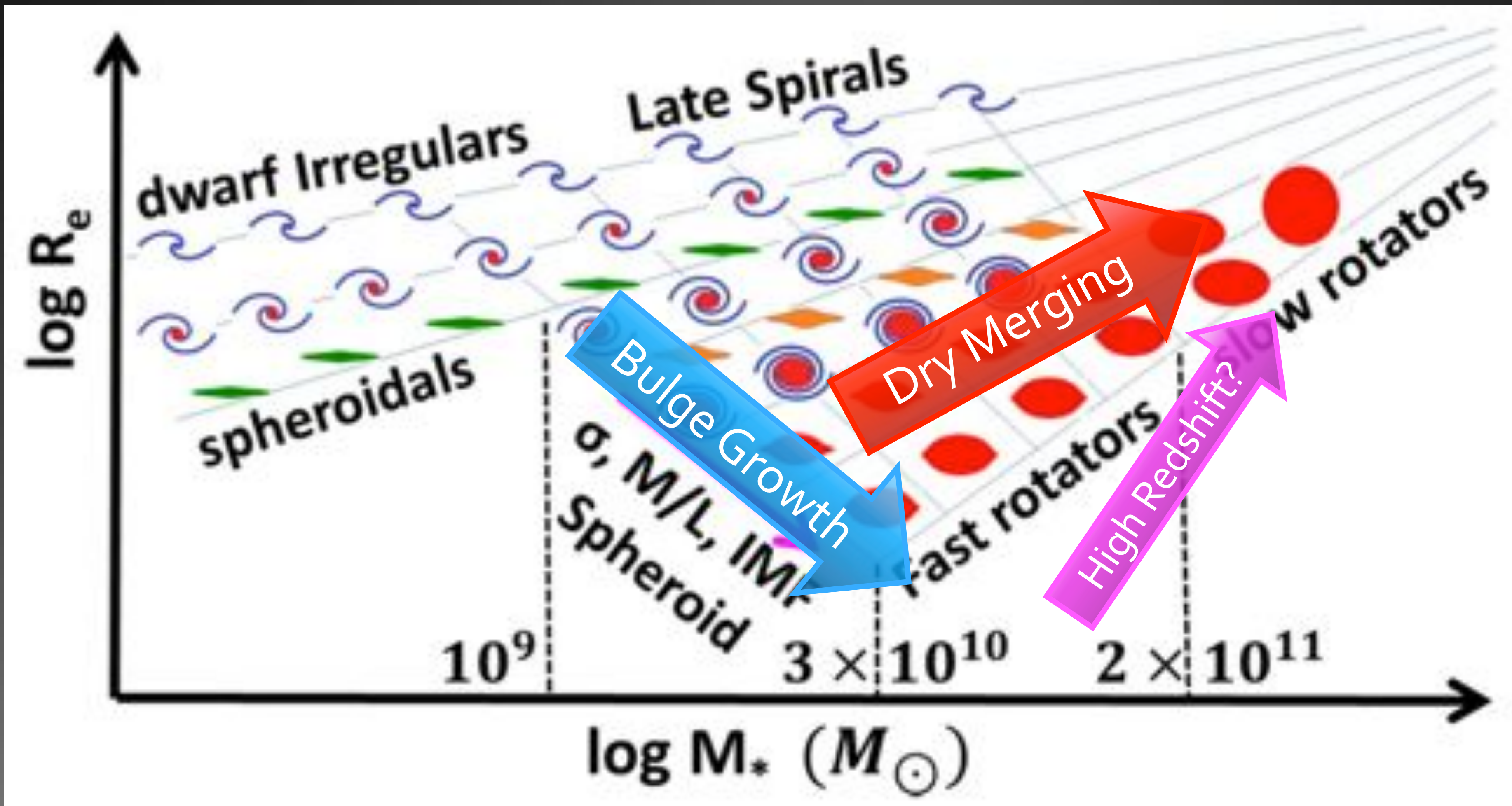


Mass-Size Plane



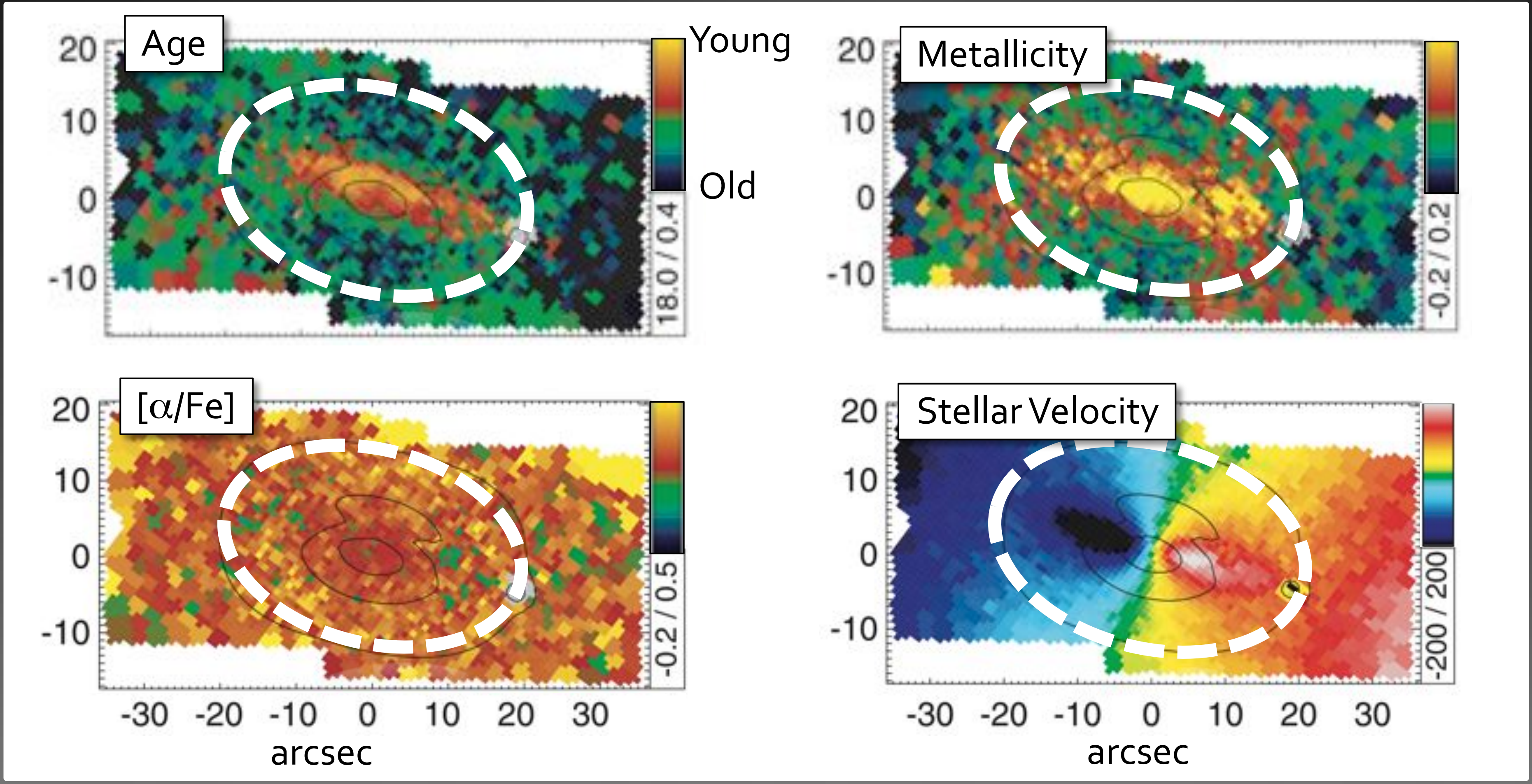
General Picture

Cappellari et al. 2013b

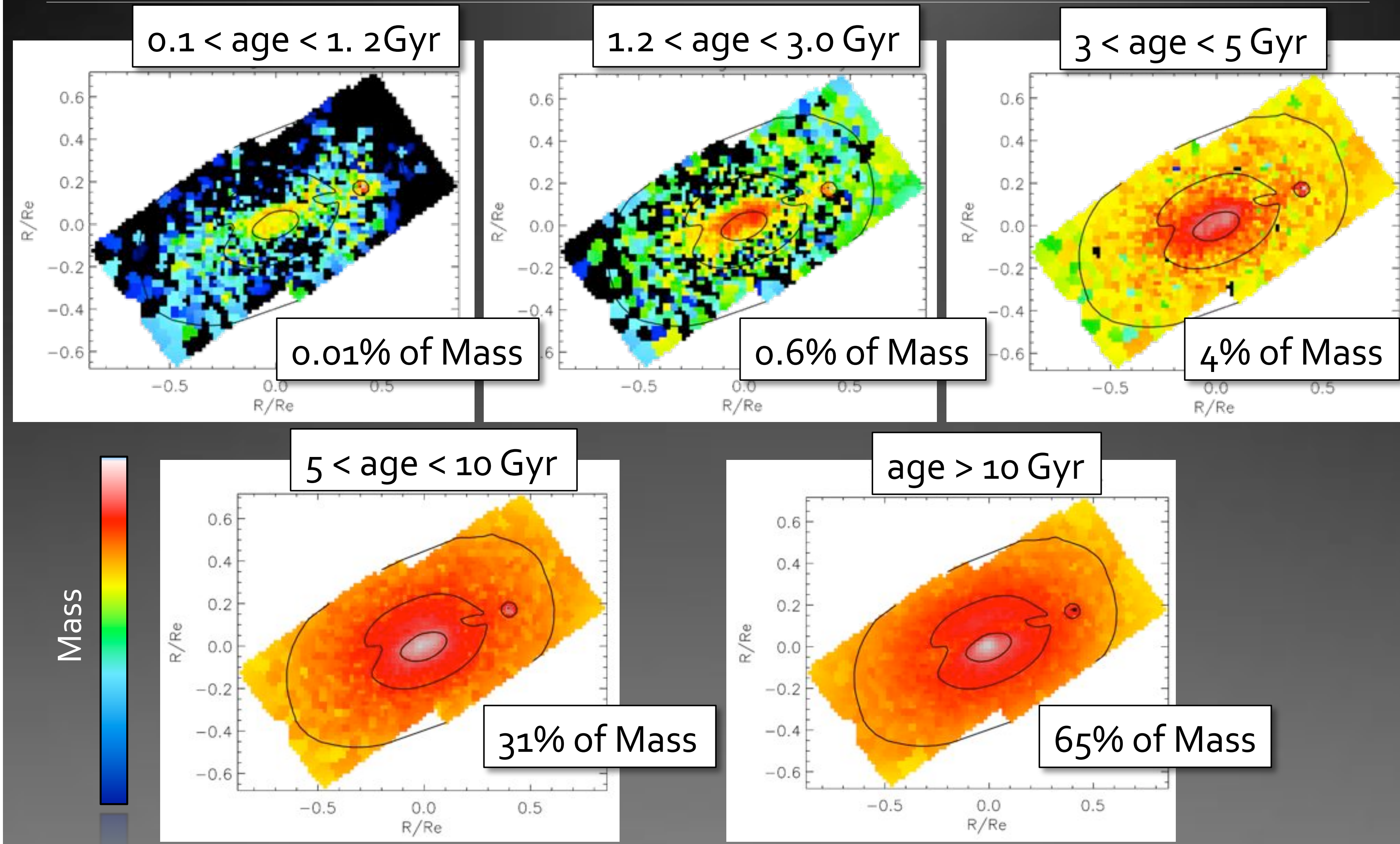


Spatially-resolved picture

Kuntschner et al. 2010



Spatially-resolved picture




30"
15"
42'00"
45"
7°41'30
Davis et al. 2013

Conclusions

- Most massive ETGs form 90% of stars by z = 2
- Least massive ETGs form 90% of stars by z = 0.1
- Stars form quickest in denser environments
- At fixed mass:
  - Smaller galaxies are older, richer in metals and more alpha-enhanced
  - Larger galaxies form smooth sequence with spirals