Halo Mass, Residual Halo Mass, and Age on the Red Sequence

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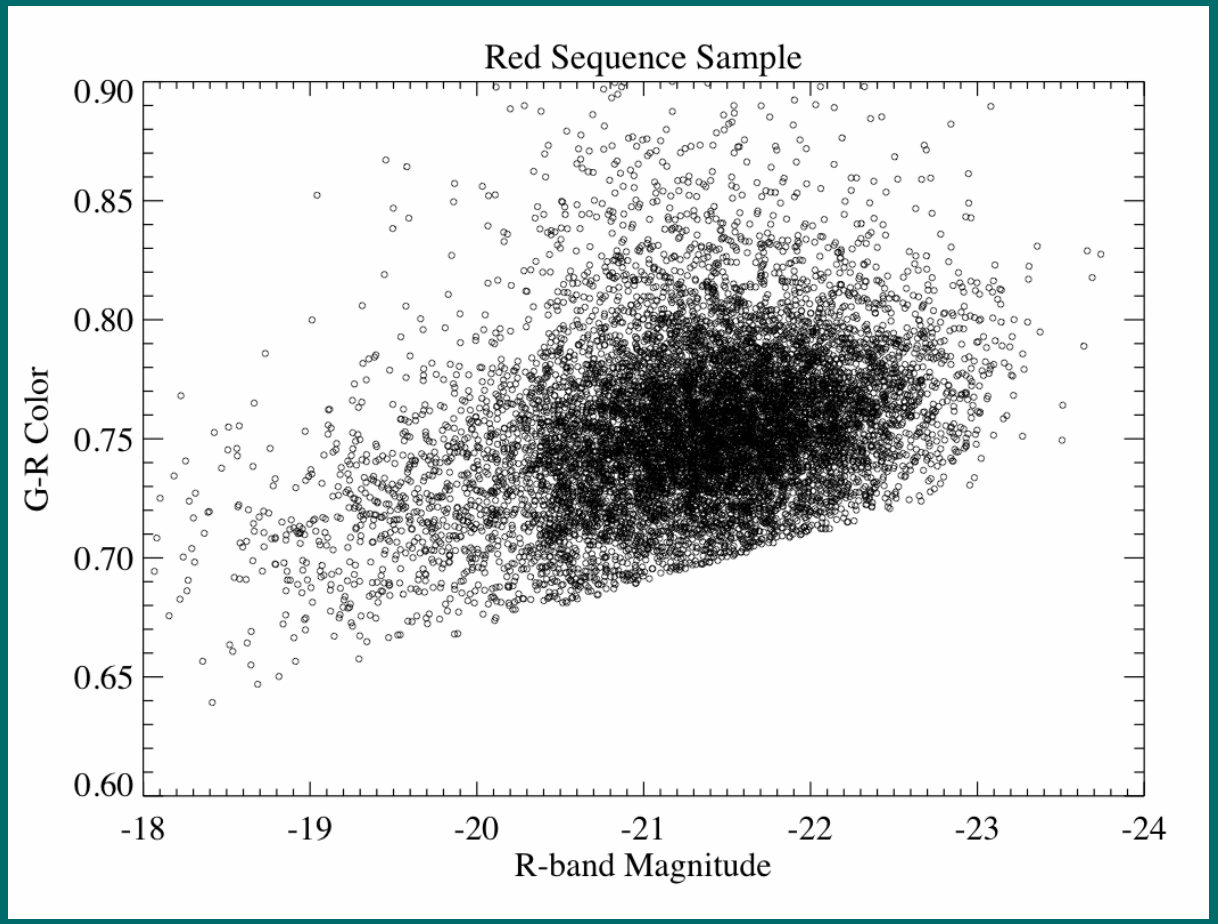
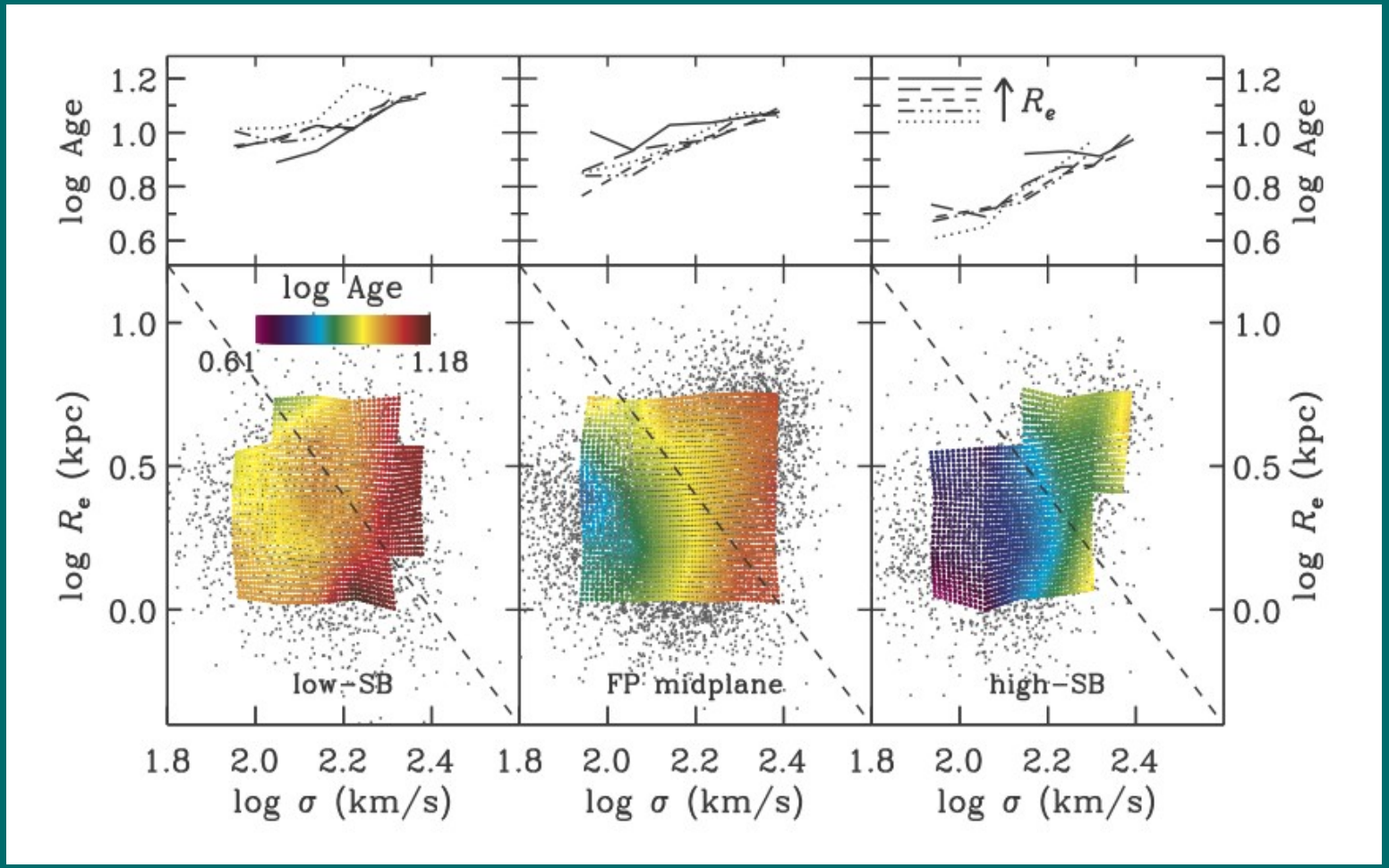
Sample Selection

- 18119 galaxies, 10619 centrals, 7500 satellites
- .024 < z < .08
- Quiescent, no Halpha or OII
- b/a > .4 to control dust
- Color cut

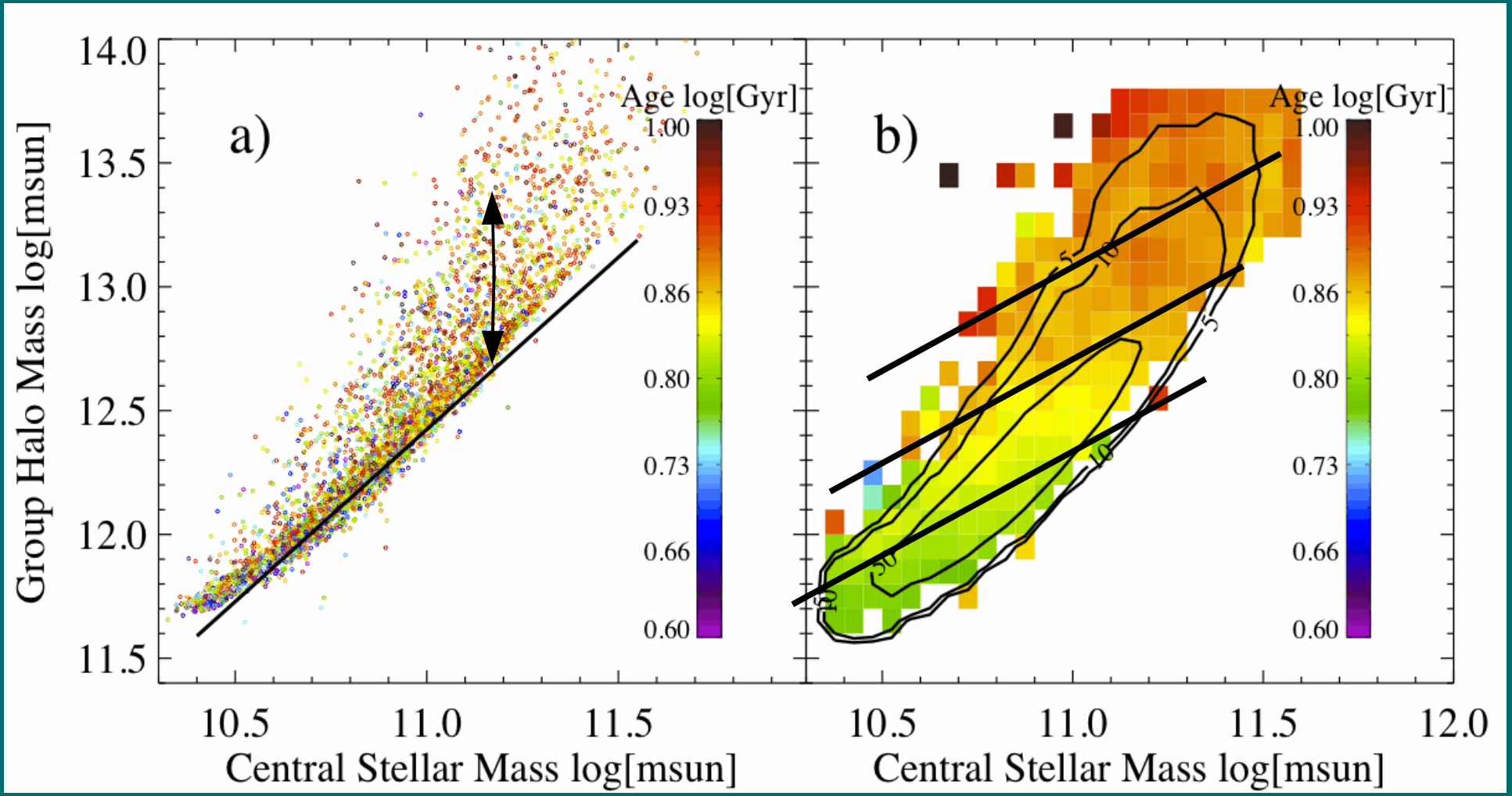


Structural Age: Not a Direct Age but Correct Statistically



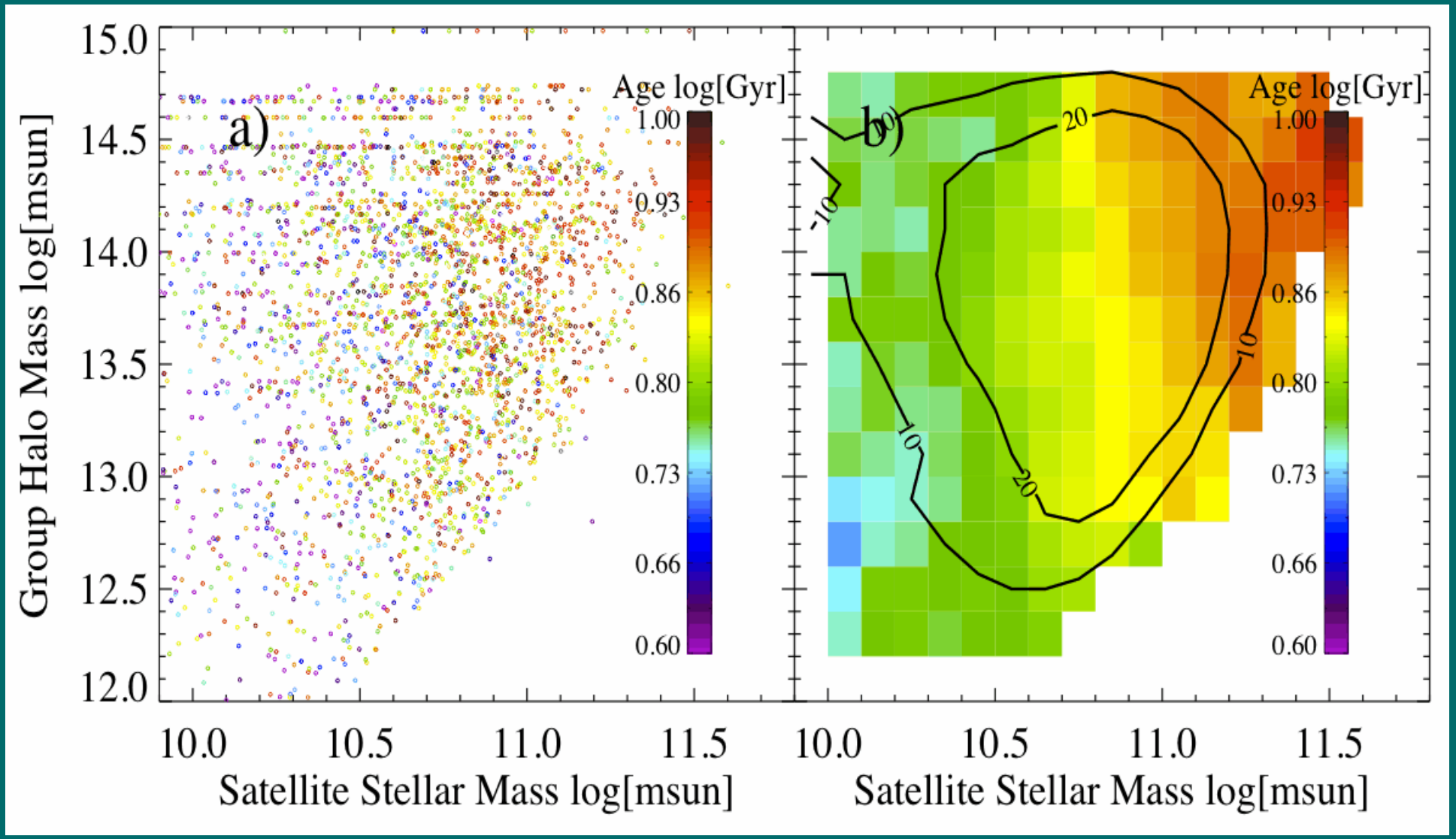
Genevieve Graves' Thesis (2009)

Age Correlated with Halo Mass *and* Residual Halo Mass for Centrals



$$\Delta_{halo} = \log M_{halo} - 1.39 \log M_* + 2.87$$

Not as Much for Satellites



A Little More Quantitative

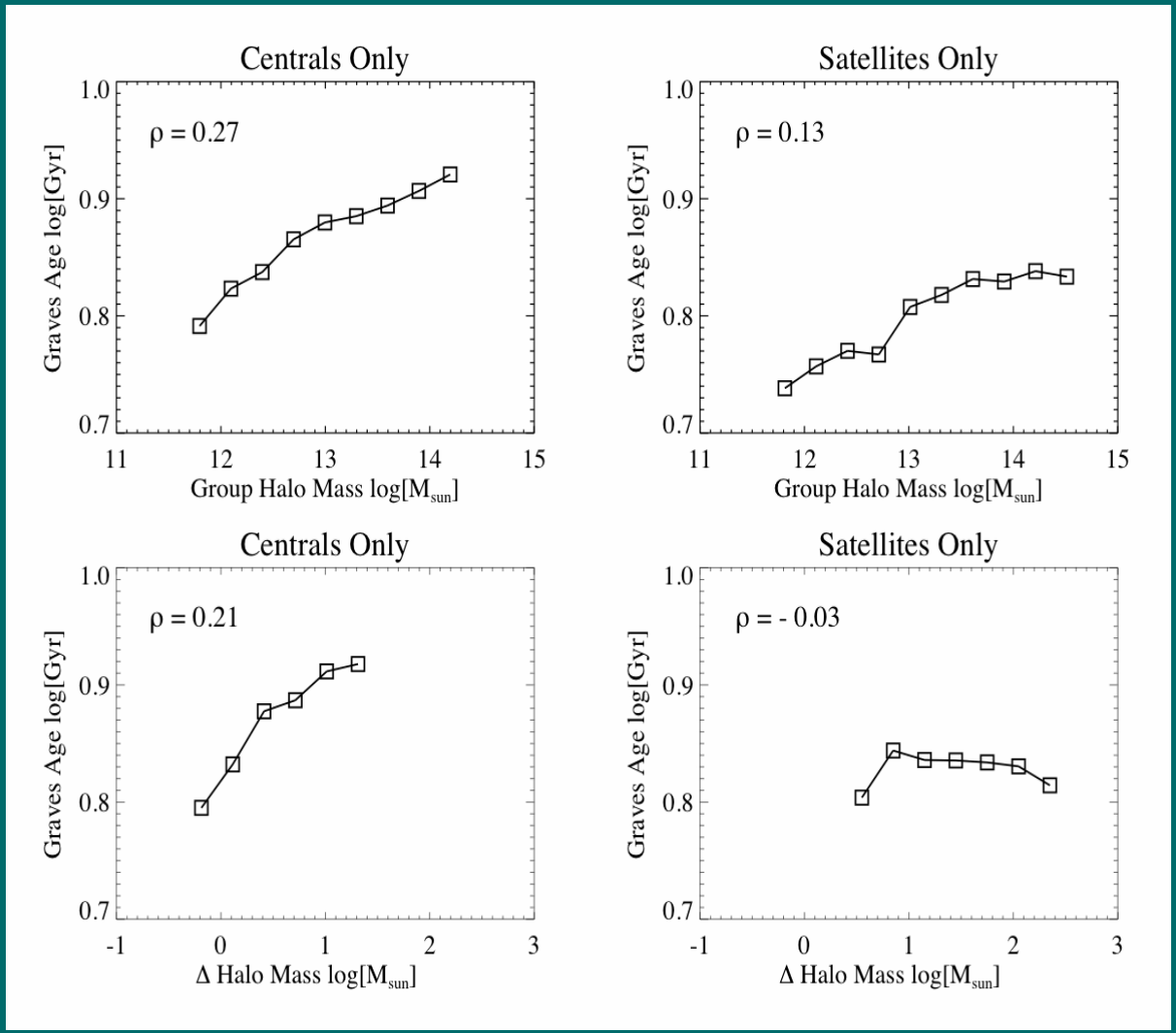


TABLE 5
STRUCTURAL AGE VS. M_{halo} & Δ_{halo}

sample	x-axis	n_{samp}	ρ	n_σ
Centrals	M_{halo}	10619	0.271	27.9
Centrals	Δ_{halo}	10619	0.211	21.7
Satellites	M_{halo}	7500	0.136	11.8
Satellites	Δ_{halo}	7500	−0.029	2.5

Results Insensitive to Sample Choices

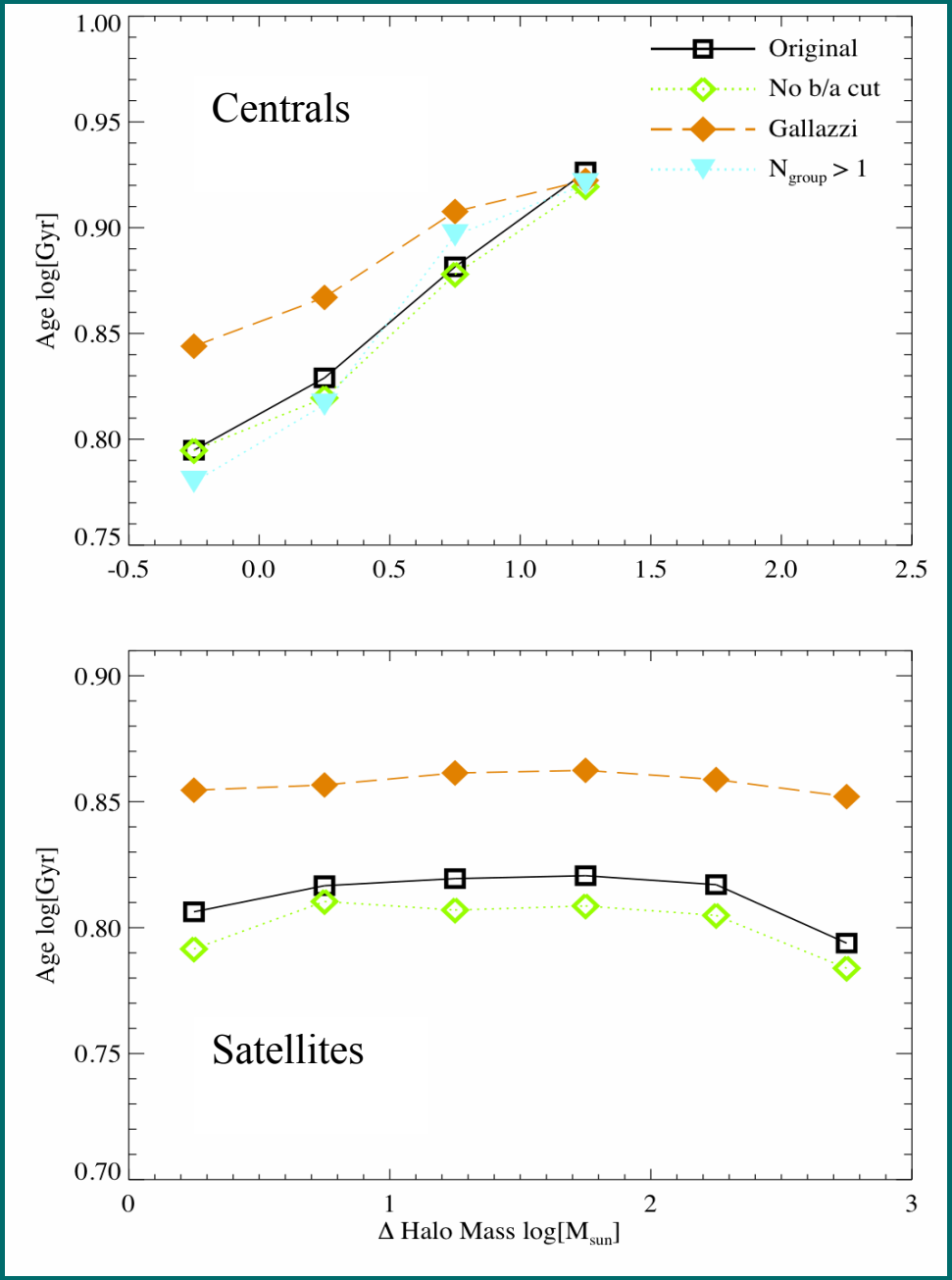


TABLE 6
SAMPLE CHOICES

sample	n_{samp}	ρ	n_σ
Original, Centrals	10619	0.211	21.7
No b/a cut, Centrals	12427	0.178	19.9
Gallazzi, Centrals	10619	0.173	17.8
$N_{group} > 1$, Centrals	3309	0.219	12.6
Original, Satellites	7500	−0.029	2.5
No b/a cut, Satellites	9191	−0.042	4.0
Gallazzi, Satellites	7500	−0.029	2.5

No Difference Between Bulges and Disks

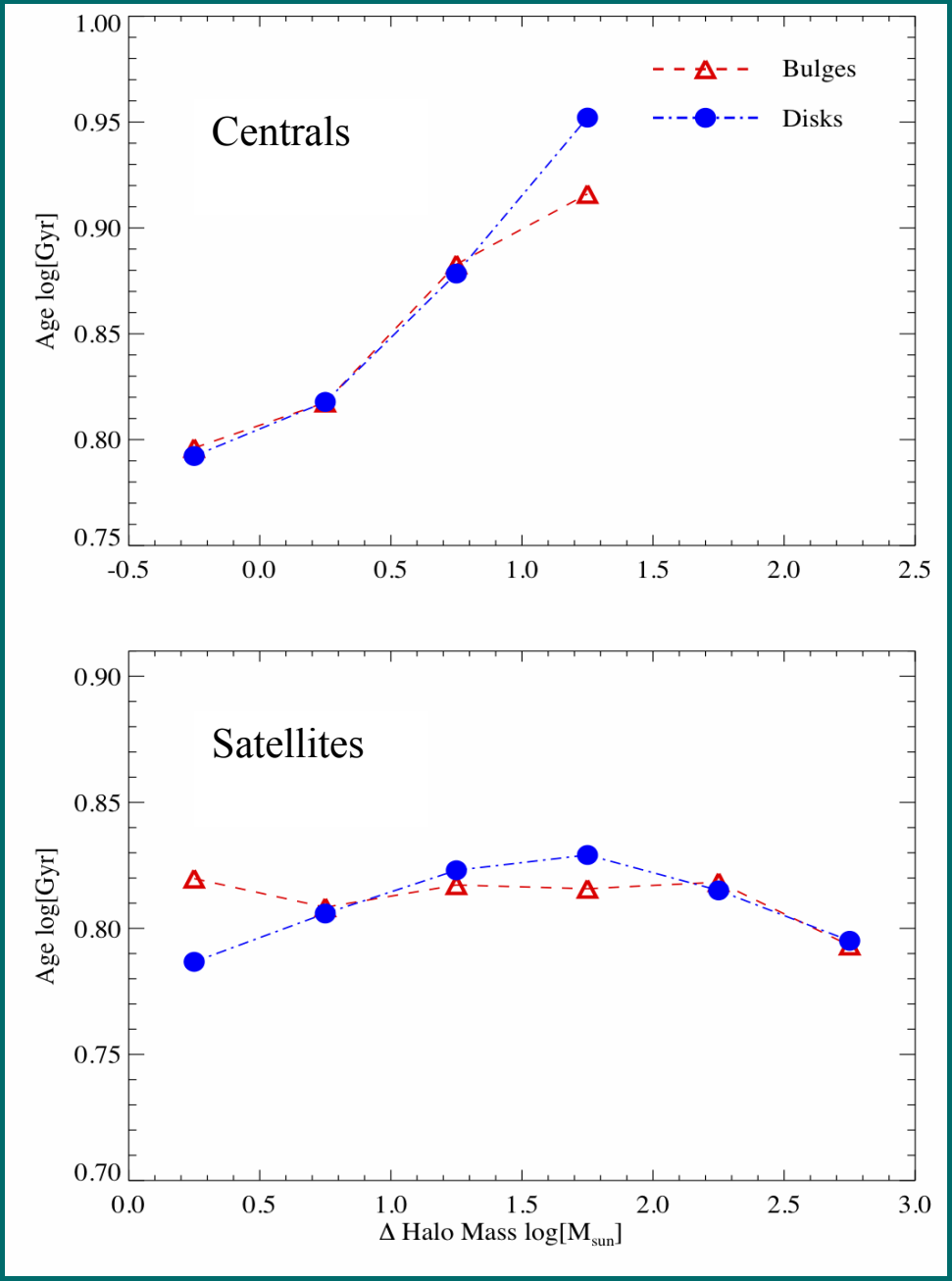


TABLE 7
BULGES VS. DISKS

sample	n_{samp}	ρ	n_σ
Bulges, Centrals	7009	0.190	15.9
Disks, Centrals	3619	0.149	8.9
Bulges, Satellites	4784	−0.018	1.3
Disks, Satellites	2716	−0.010	2.5

Or Between High and Low Mass

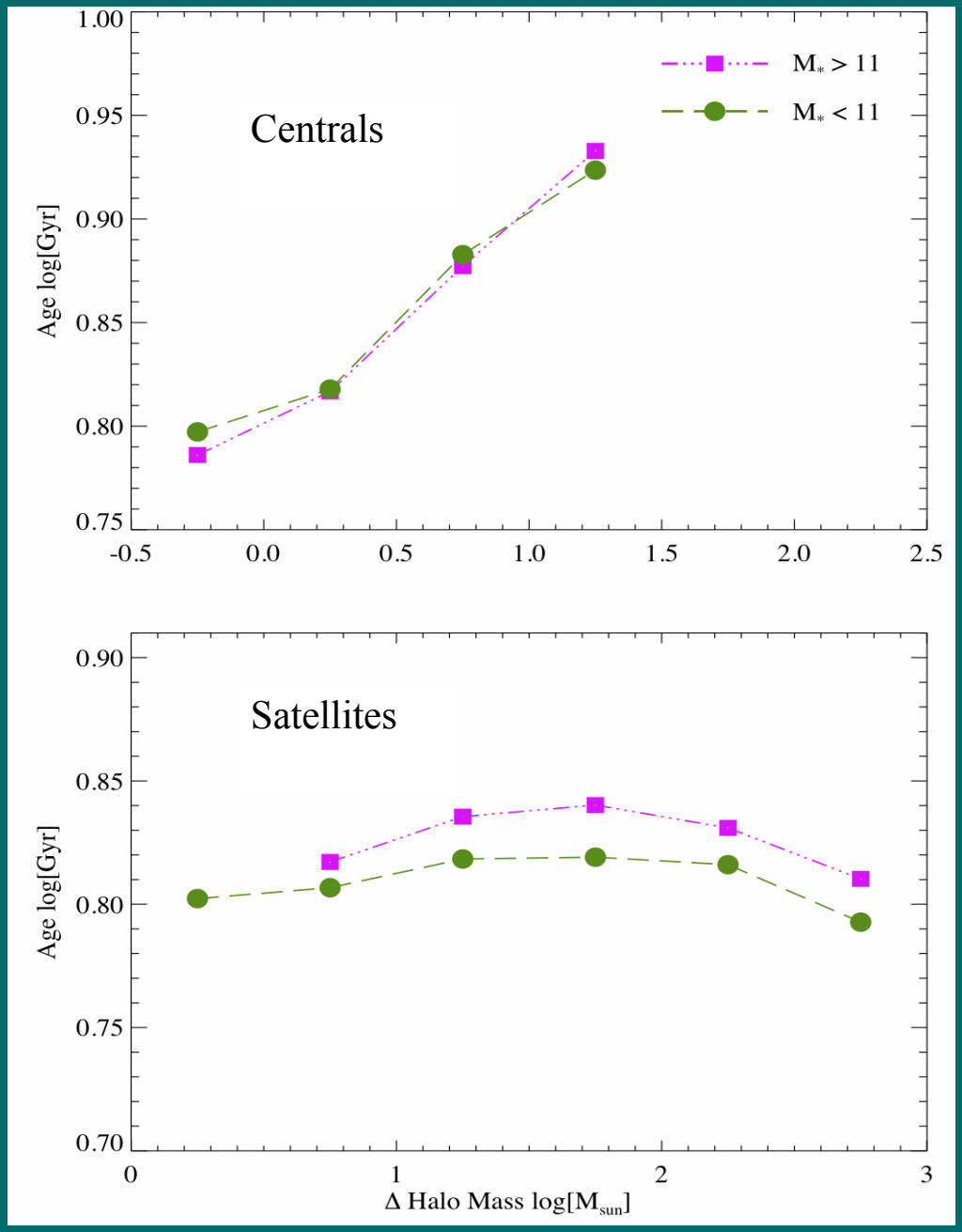
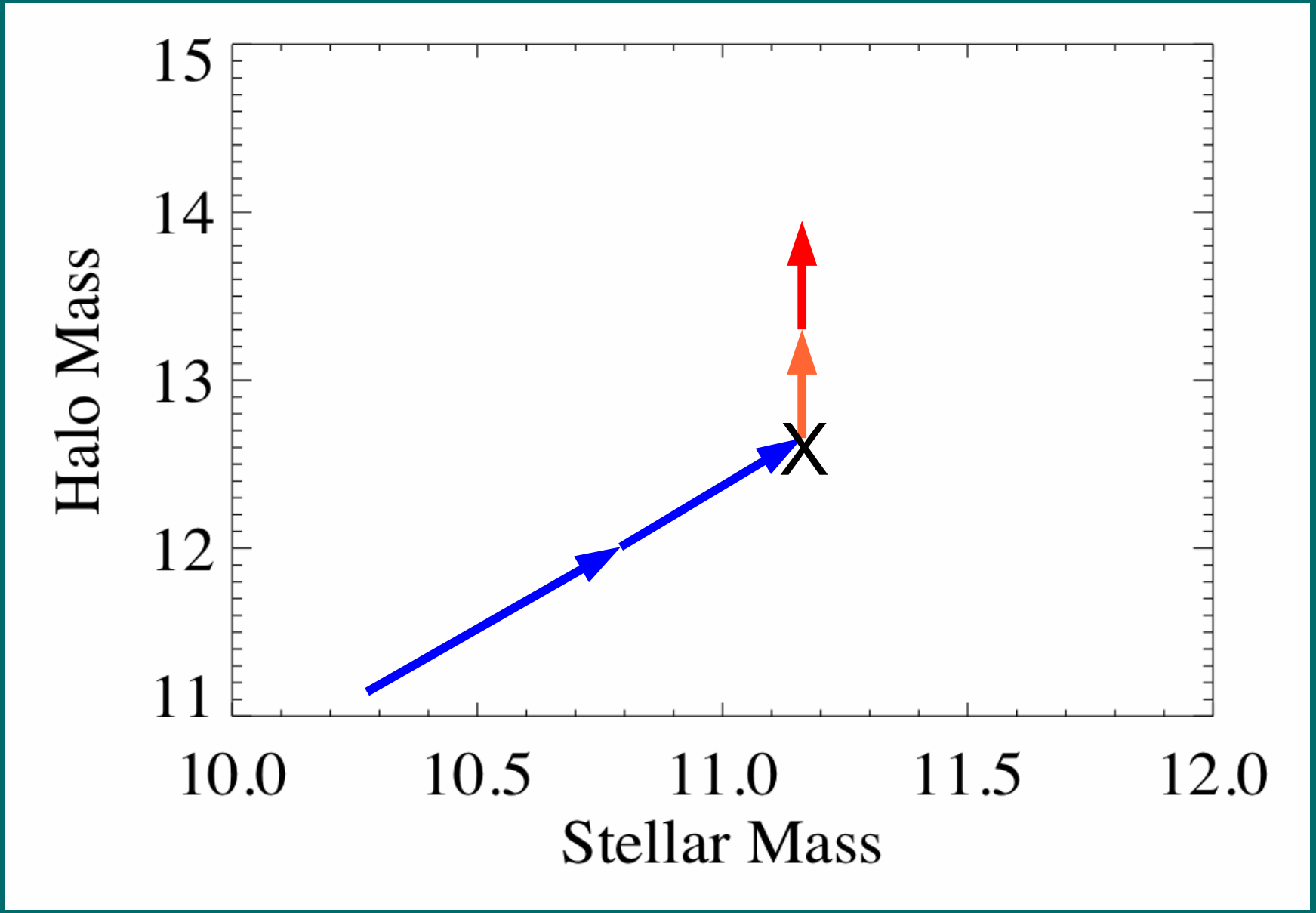


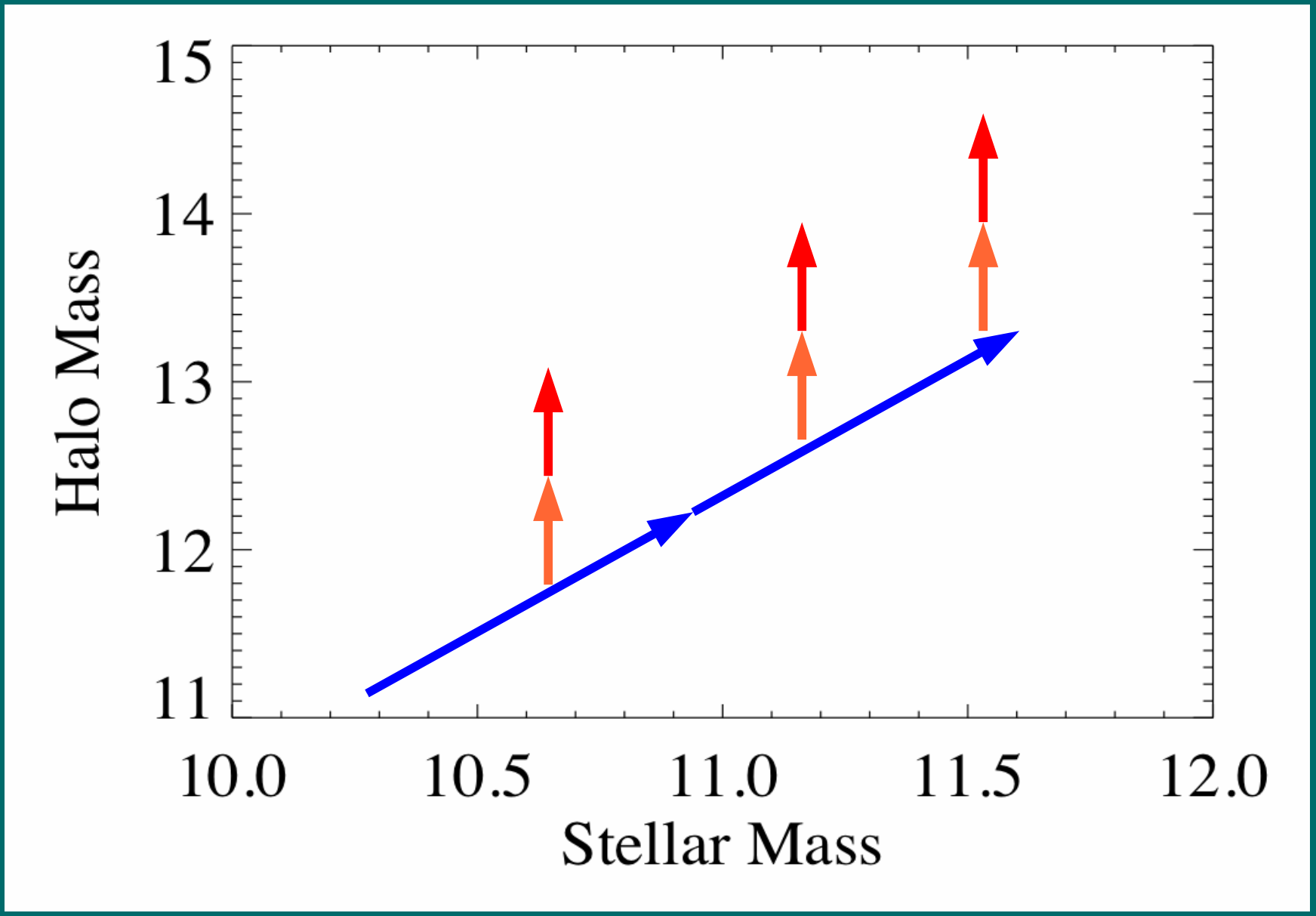
TABLE 8
HIGH MASS VS. LOW MASS

sample	n_{samp}	ρ	n_σ
$M_* < 11$, Centrals	8222	0.113	10.2
$M_* > 11$, Centrals	2397	0.257	12.6
$M_* < 11$, Satellites	6904	−0.005	0.39
$M_* > 11$, Satellites	596	−0.010	0.24

A Extremely Simple Description



Scenario 1: Very Wide Threshold



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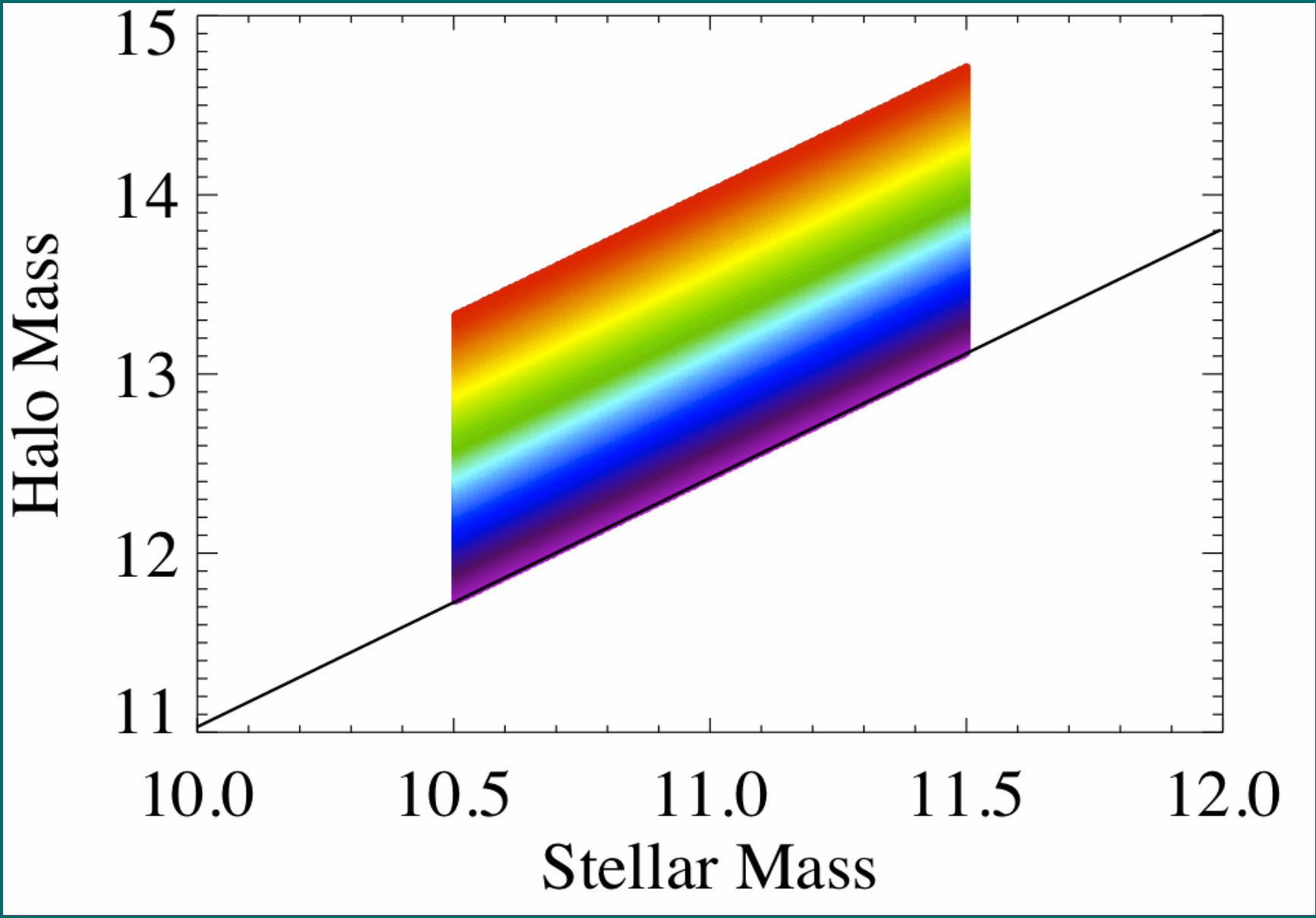
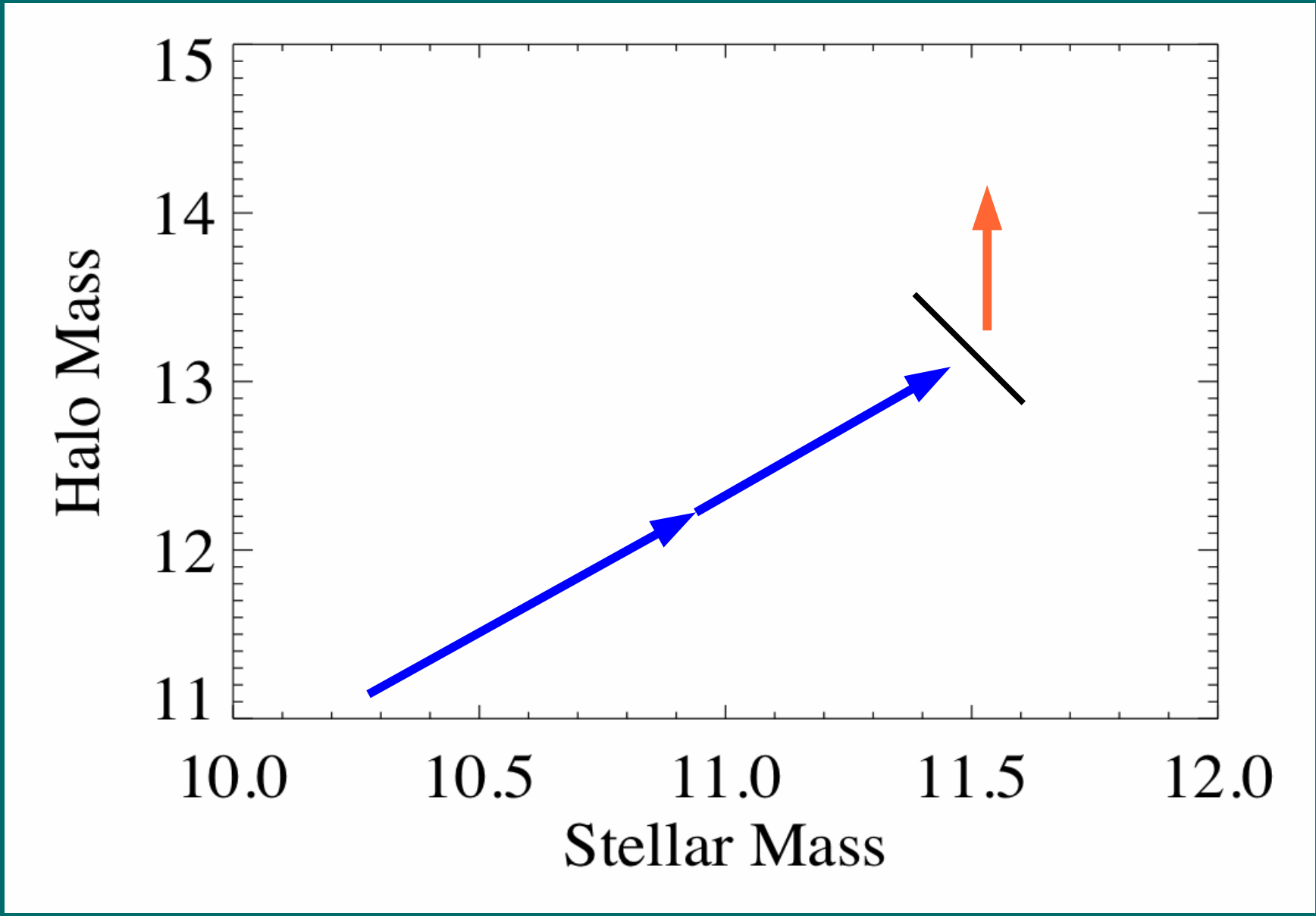


Scenario 2: Sharp Threshold Decreasing with Time



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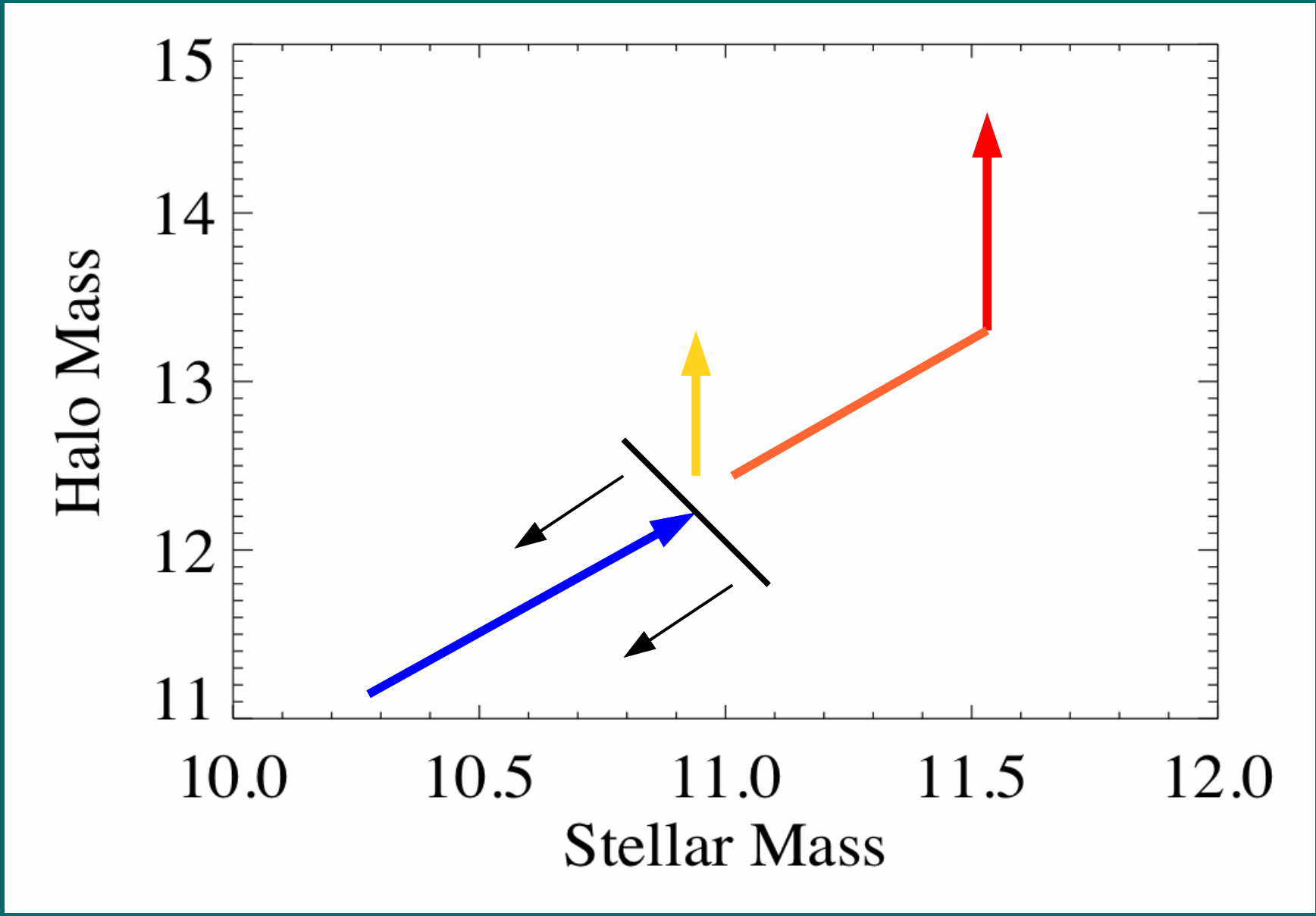

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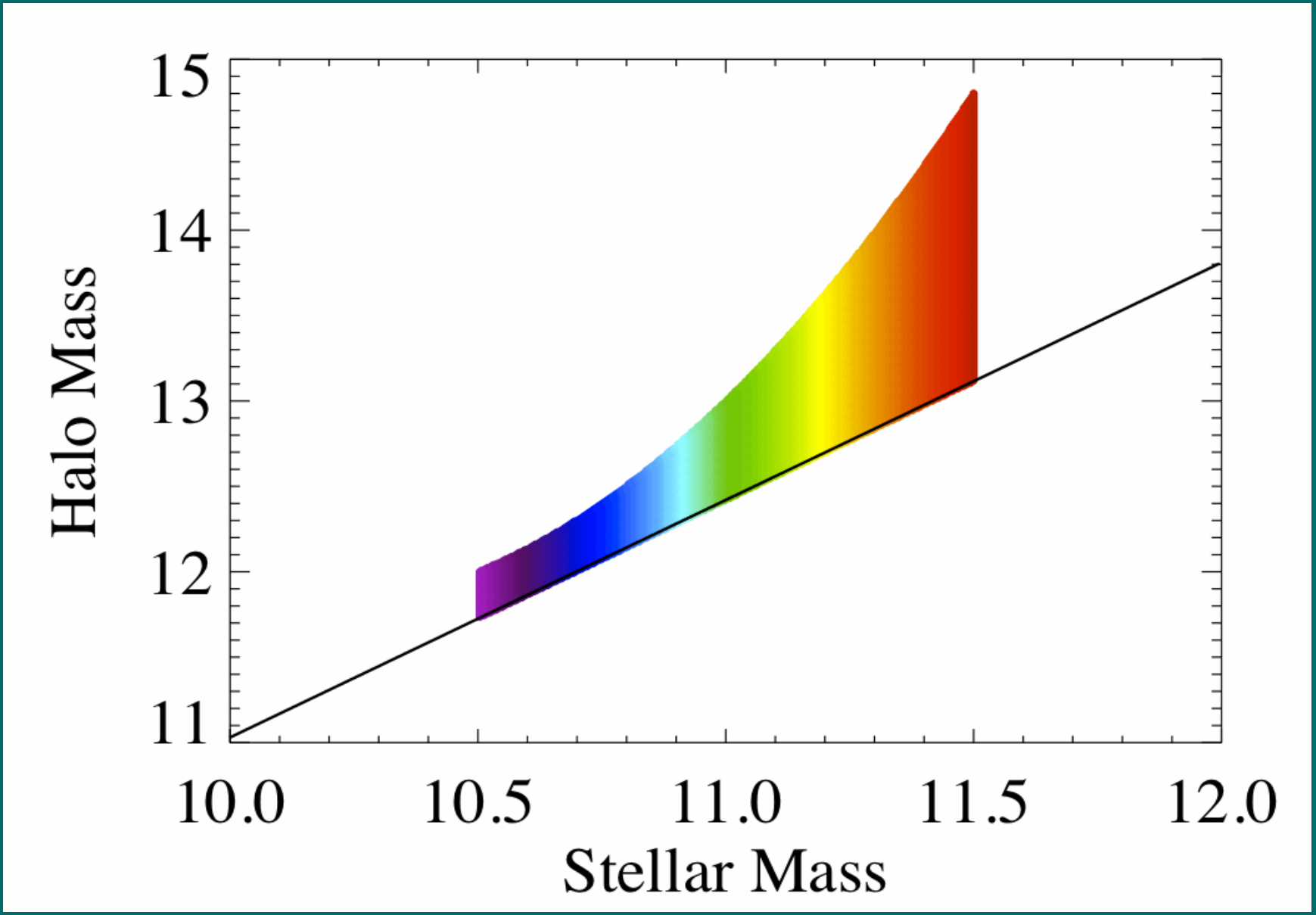
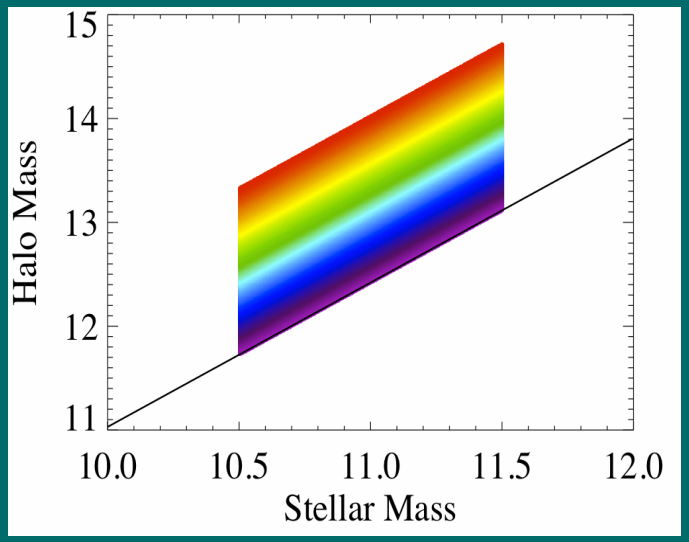


Comparing to Models, Could Constrain Threshold Width and Value as a Function of Redshift



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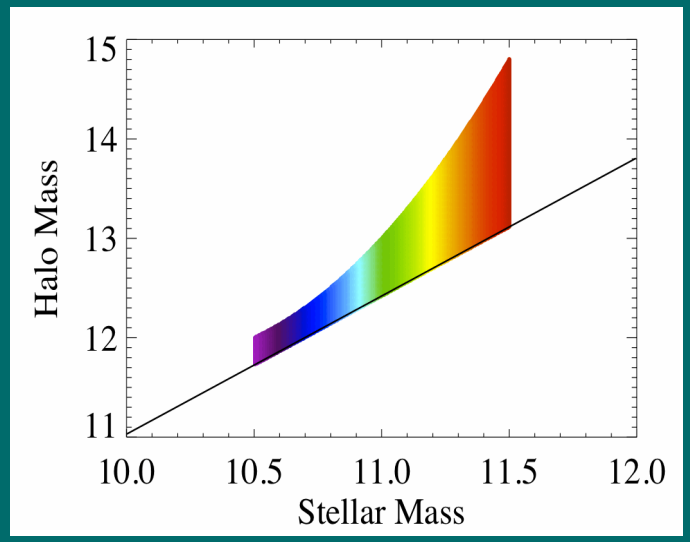

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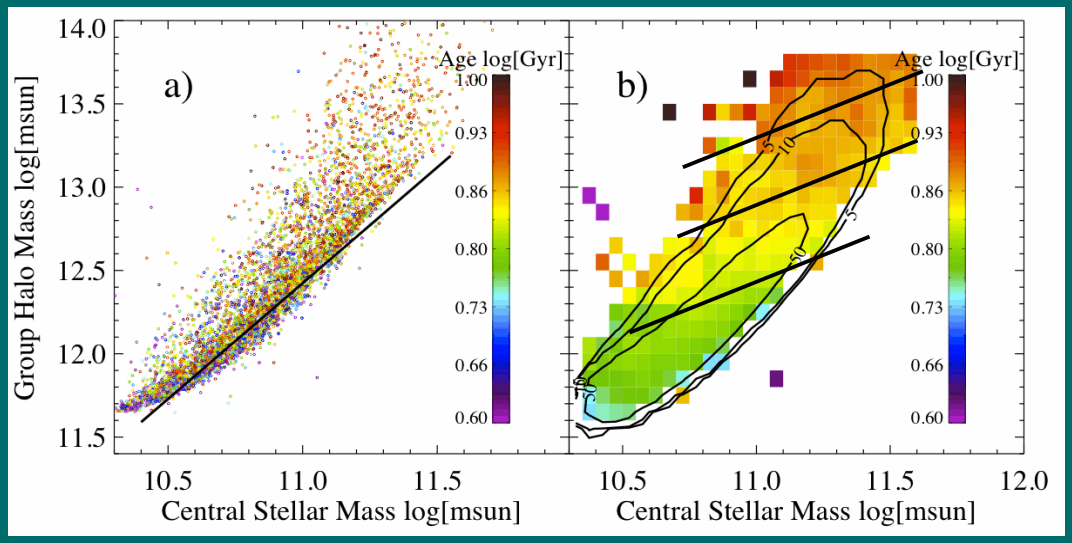

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Open Questions & Complications

- Dry merging of blue satellites onto red centrals can skew ages
- Scatter in baryon conversion efficiency on blue cloud could also produce effect in scenario 1

Conclusions

- The age of central galaxies increases with residual halo mass
- It is critical to distinguish between centrals and satellites when studying environmental trends
- The residual halo mass – age relation can help constrain quenching physics

Structural Age: The Math

$$M_{dyn} = \frac{5\sigma^2 R_e}{G}$$

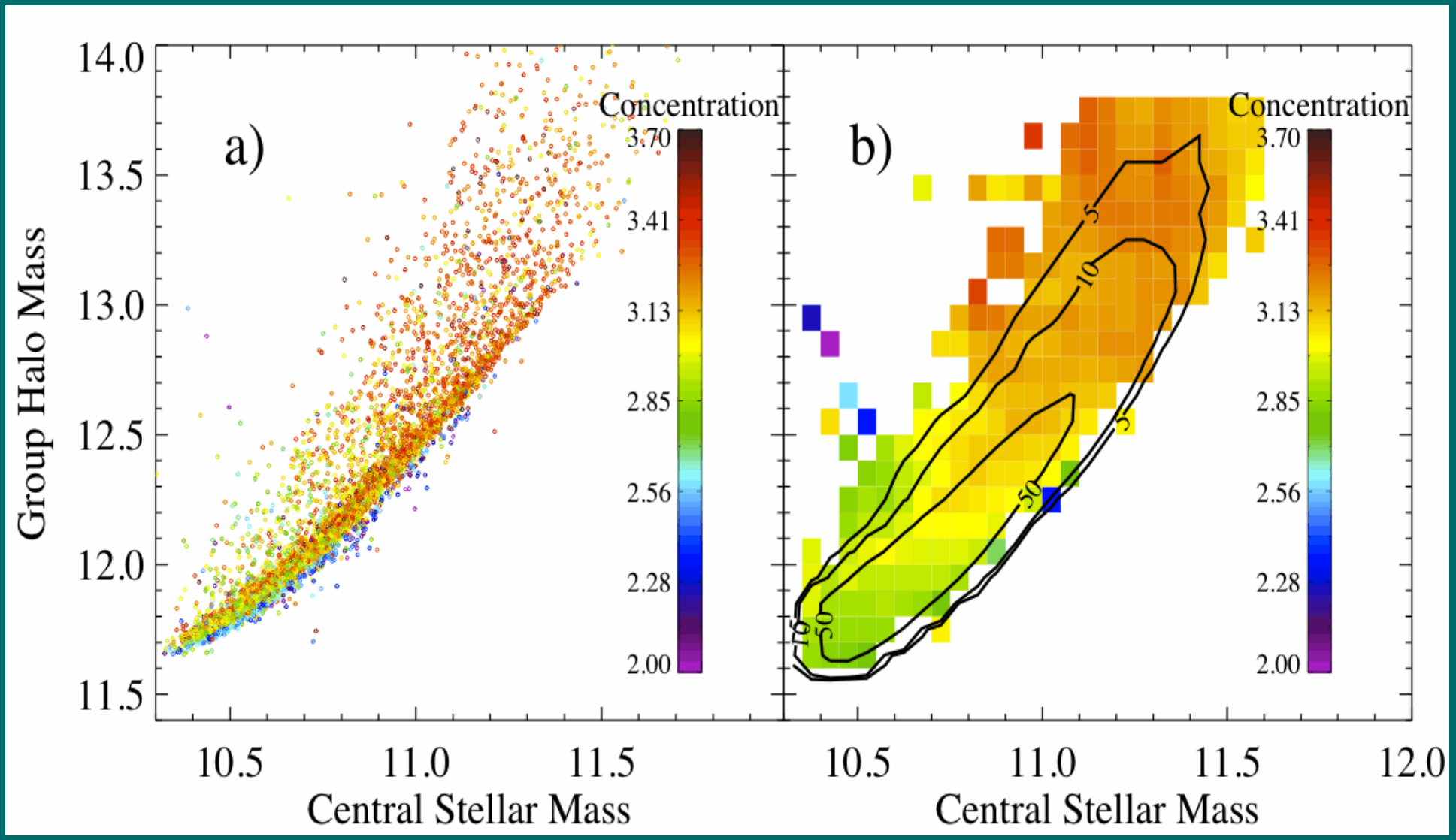
Cappellari *et al*. (2006)

$$\Delta_{ML} = \log\left(\frac{M_{dyn}}{L_v}\right) - .84\log\sigma - .21 * logR_e + 1.355 \quad (4)$$

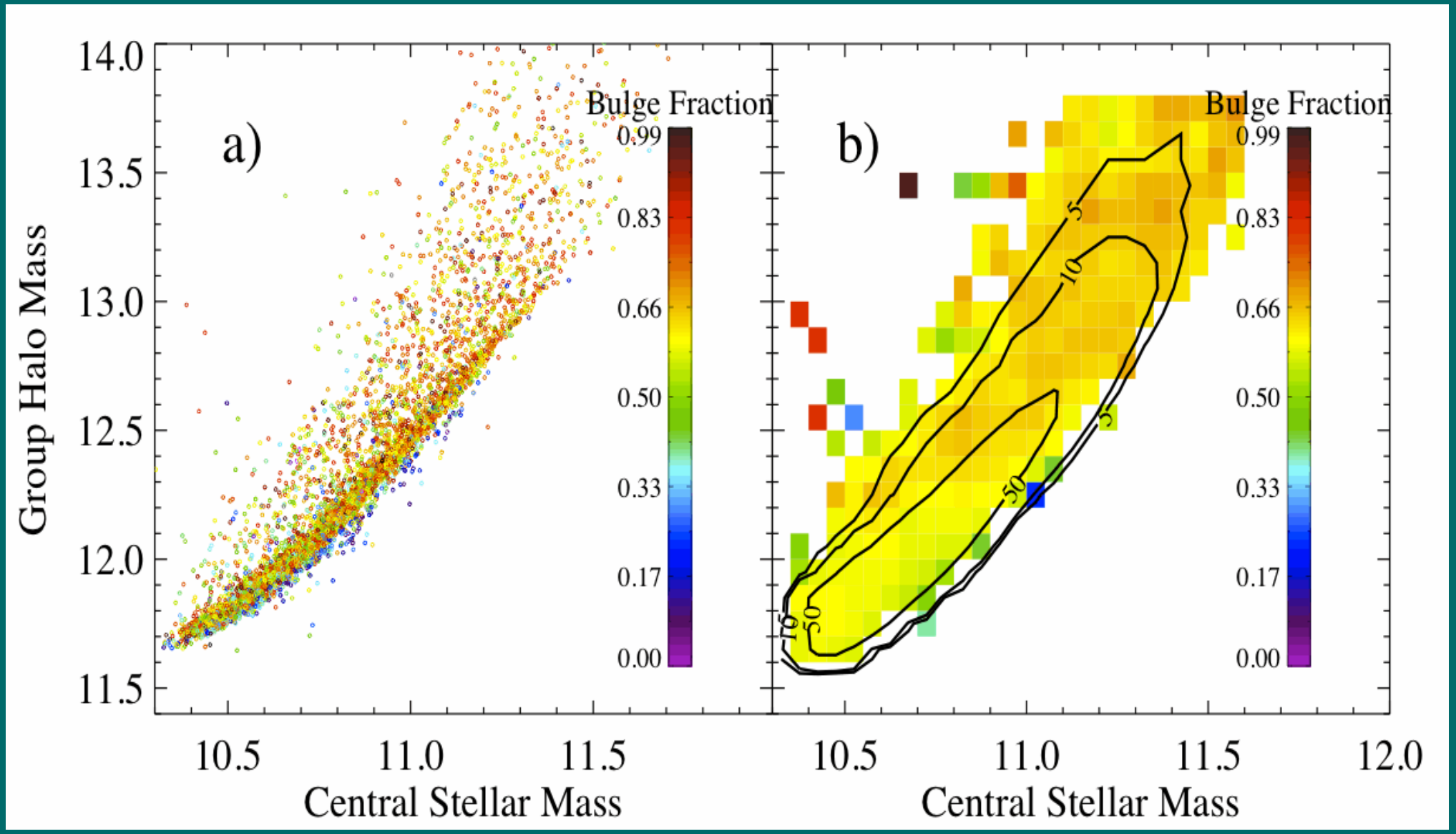
$$\log(age) = .63\log\sigma + .79\log\Delta_{ML} - .58 \quad (5)$$

Genevieve Grave's Thesis (2009)

Concentration



Gim2D Bulge Fraction



Concentration