

THE FATE OF MASSIVE HIGH- REDSHIFT COMPACT GALAXIES

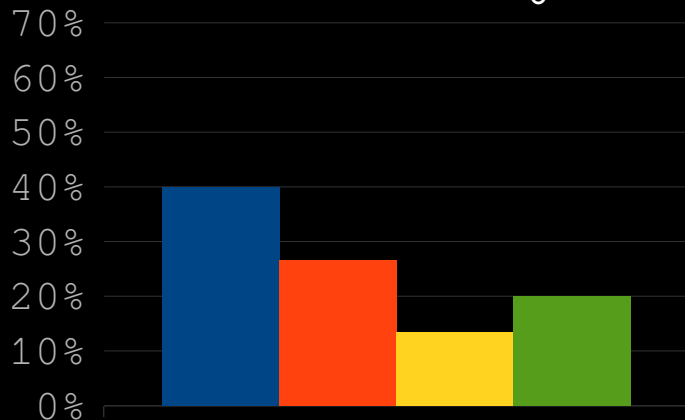
Ignacio G. de la Rosa
Instituto de Astrofísica de
Canarias

In collaboration with

Francesco La Barbera
Ignacio Ferreras
Jorge Sánchez Almeida

9 Gyrs ago....

Massive Galaxy Census ($M^* \gtrsim 10^{11} M_{\odot}$)



Peth et al. (2015)

■ Disks

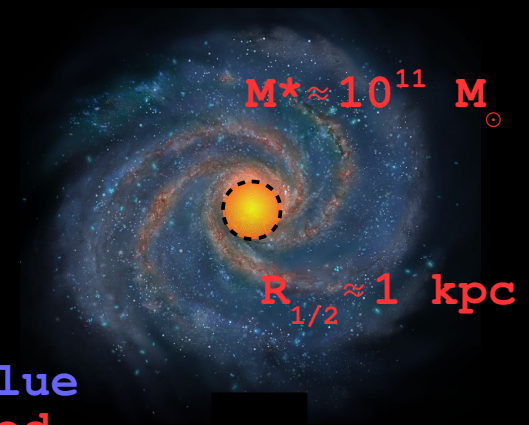
■ Compact Spheroids

■ Extended Spheroids

■ Peculiar

23 % Blue

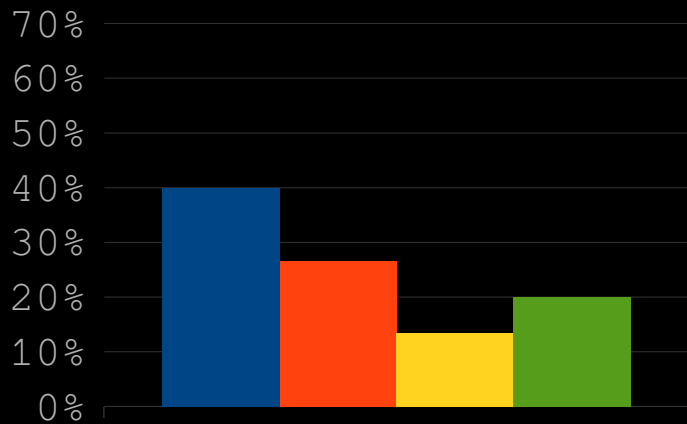
77 % Red



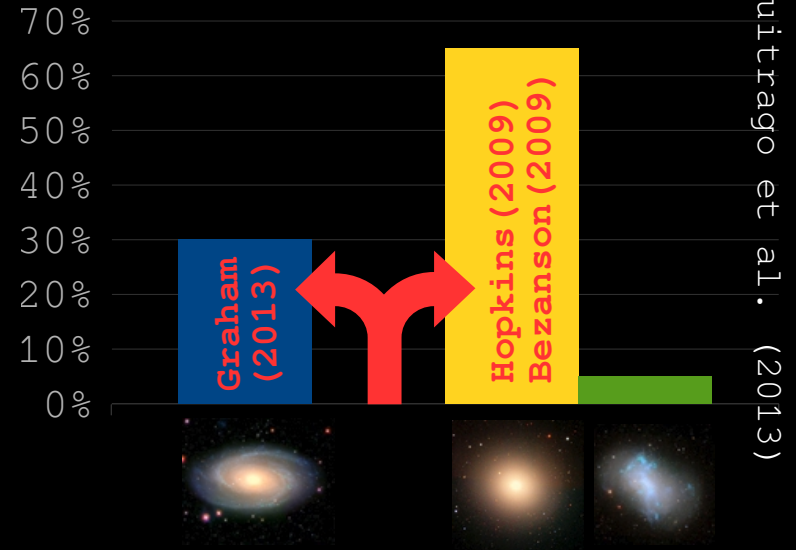
Red nuggets = high-redshift quiescent massive galaxies

Massive Galaxy Census

9 Gyrs ago....



Present day



Hypothesis:

Red nuggets have survived...

...masked as the compact core of 3-D (spheroid) or 2-D (disk) envelopes.

Testable predictions:

* Red nuggets must be structurally similar to compact cores

* Red nuggets number density ($z \approx 1.5$) = compact core number density ($z \approx 0$)

TOOLS :

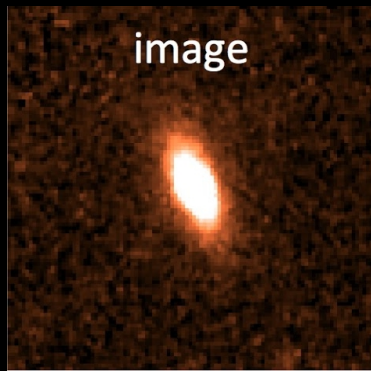
A CATALOG OF BULGE, DISK, AND TOTAL STELLAR MASS
ESTIMATES FOR THE SLOAN DIGITAL SKY SURVEY

J. TREVOR MENDEL^{1,2}, LUC SIMARD³, MICHAEL PALMER², SARA L. ELLISON², AND DAVID R. PATTON⁴

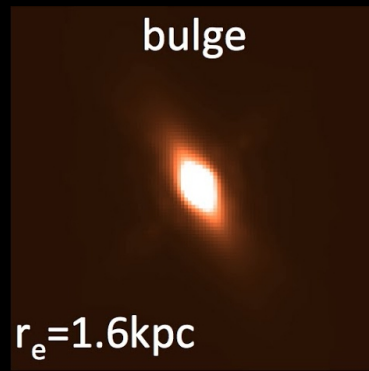
(2014)

~ 660,000 galaxies

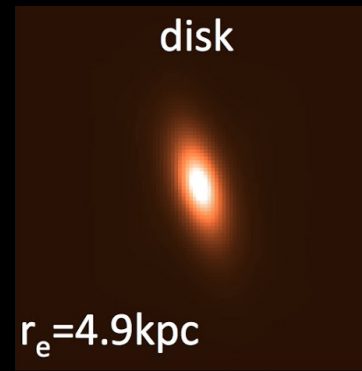
BULGE + DISK DECOMPOSITION



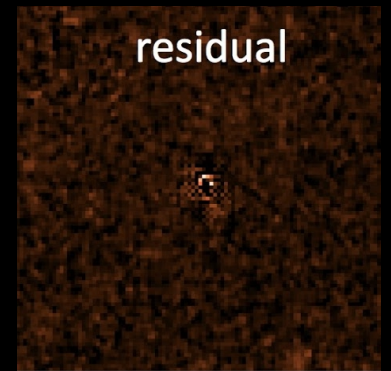
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+



+

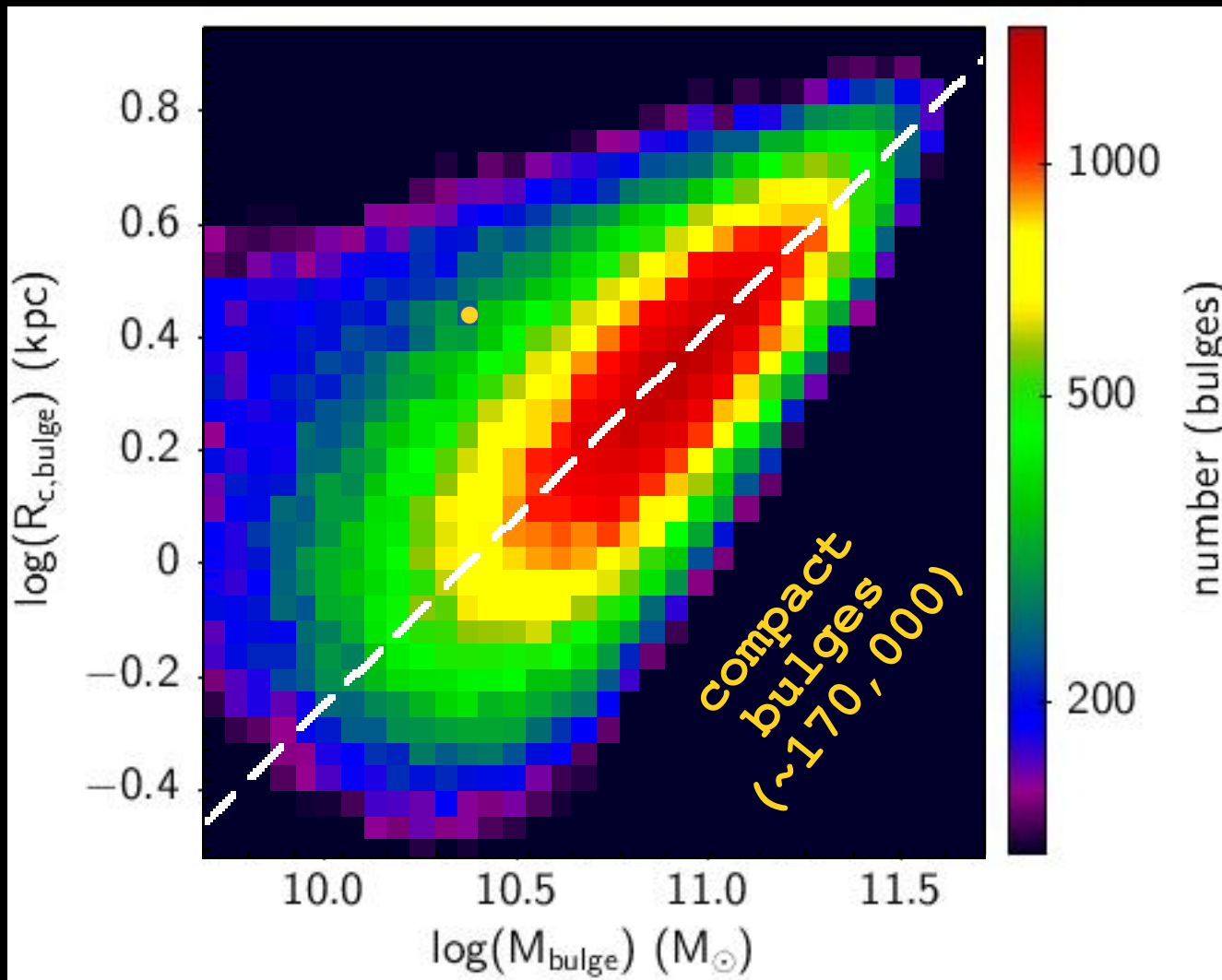


COMPACTNESS CRITERIUM

$$\log(R_{\text{eff},c} [\text{kpc}]) < (\log(M^* [M_{\odot}]) - 10.3) / 1.5$$

Barro et al. (2013)

456, 169 bulges
in $0.025 < z < 0.15$

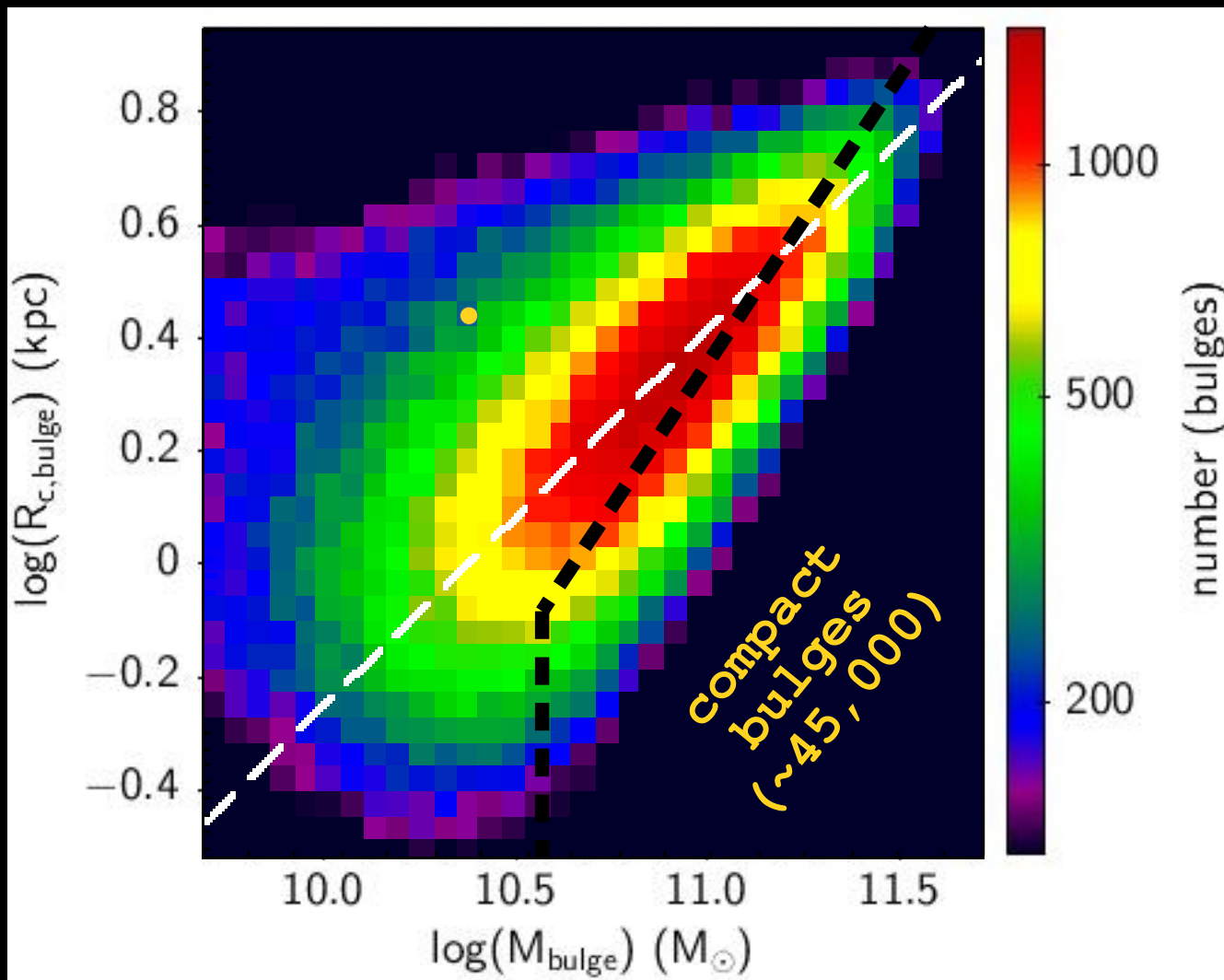


COMPACTNESS CRITERIUM

$$\log(R_{\text{eff},c} [\text{kpc}]) < \log(M^* [M_{\odot}]) - 10.7$$

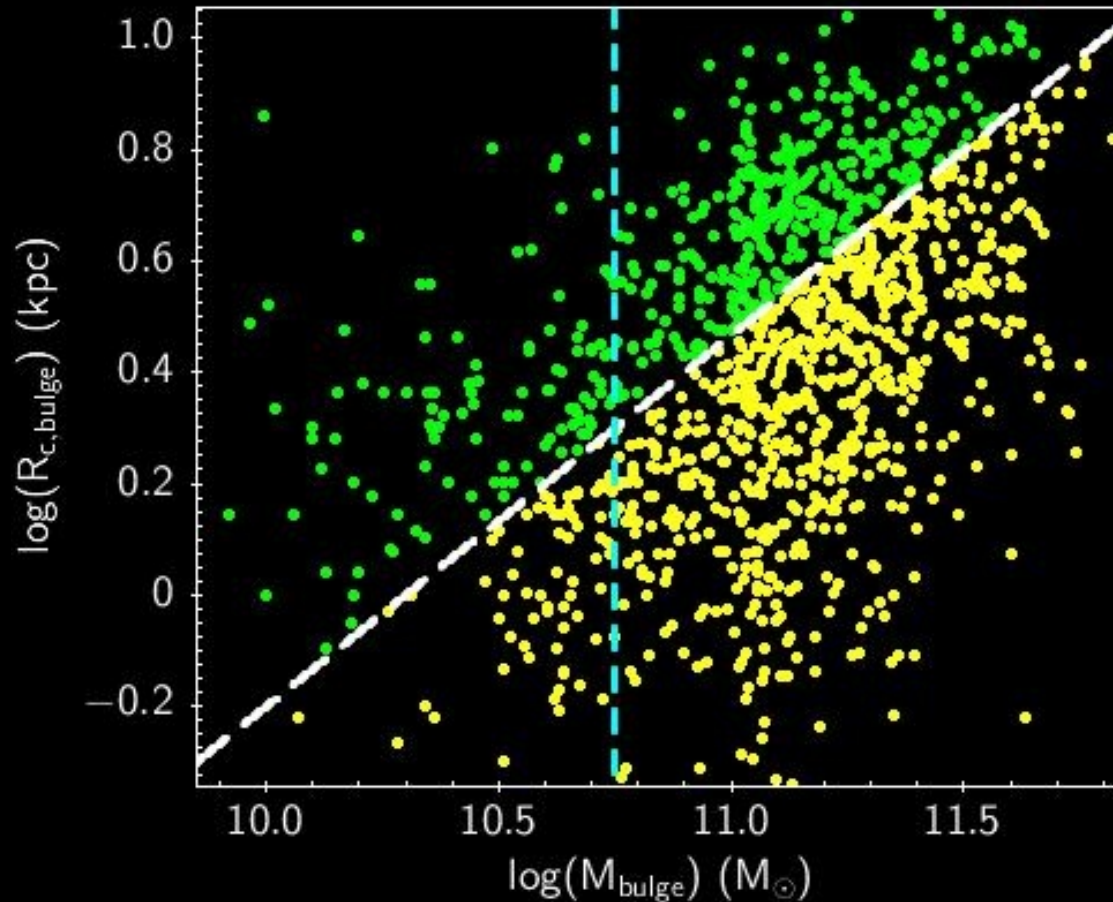
van Dokkum et al. (2015)

456, 169 bulges
in $0.025 < z < 0.15$



RED NUGGETS

1,226 compact galaxies from 29 sources
 $0.18 < z < 2.67$



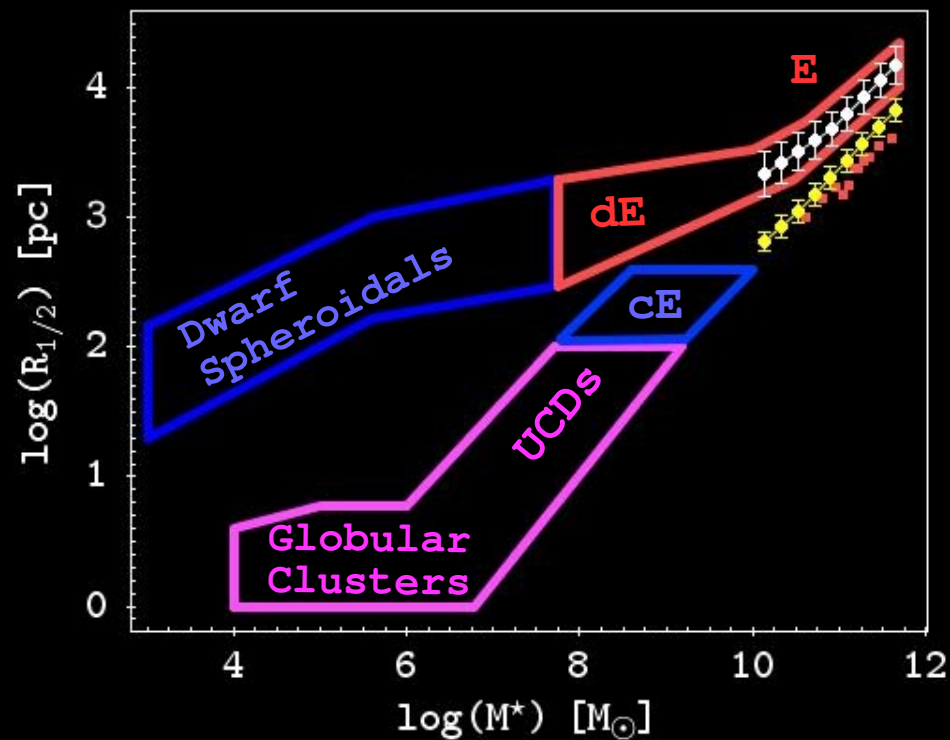
763 red nuggets (46 % with σ)

Testable prediction (I)

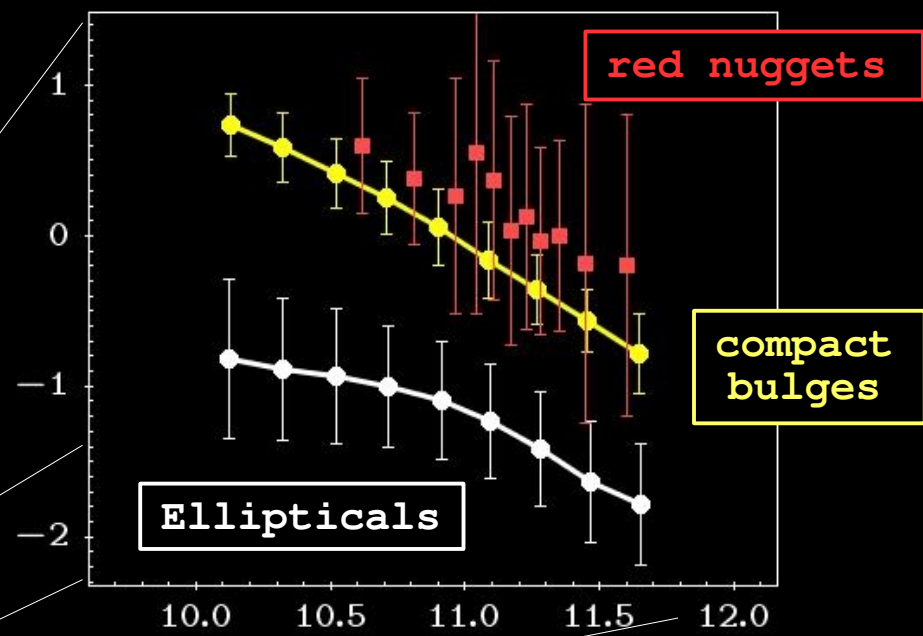
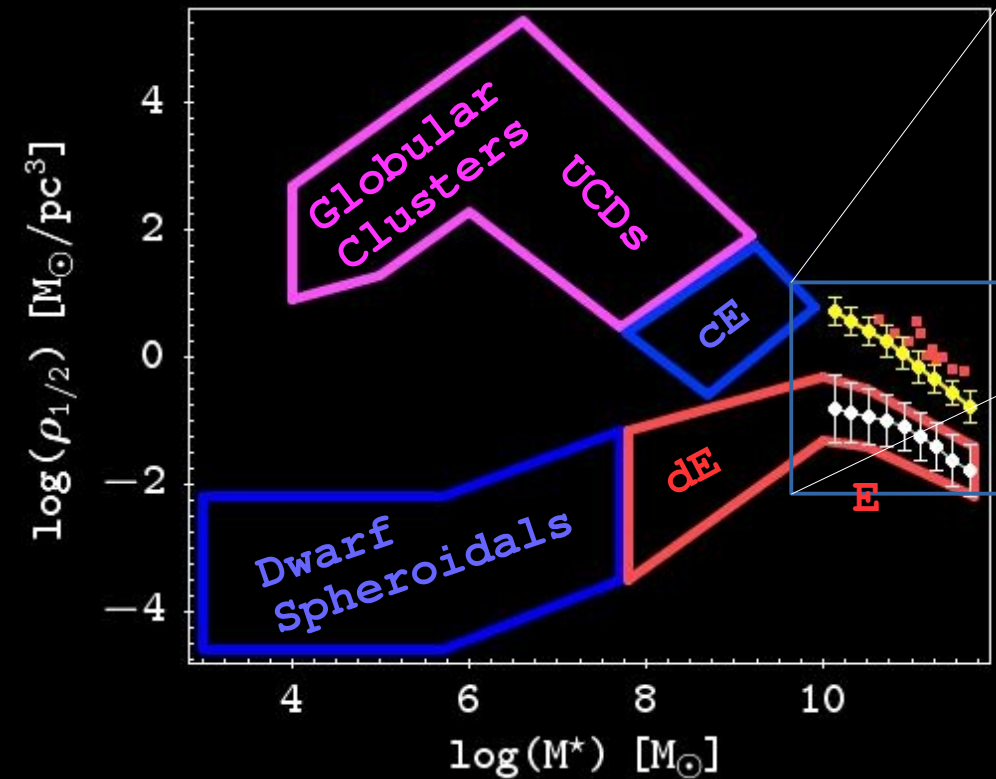
- * Red nuggets must be structurally similar to compact cores

SPHEROIDS

MASS-SIZE



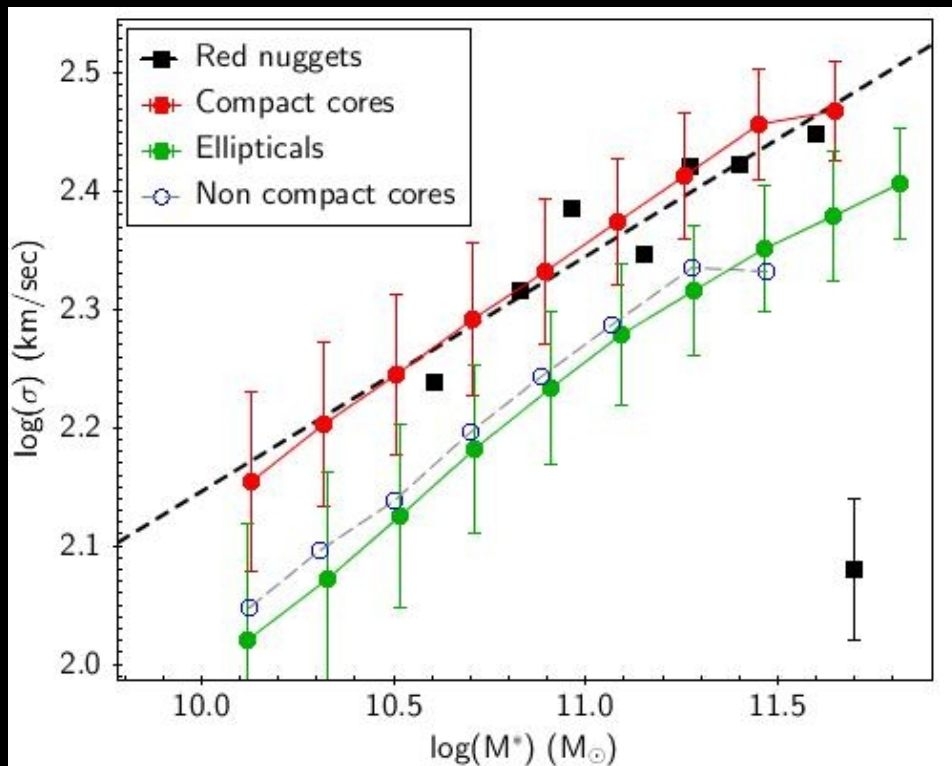
MASS-DENSITY



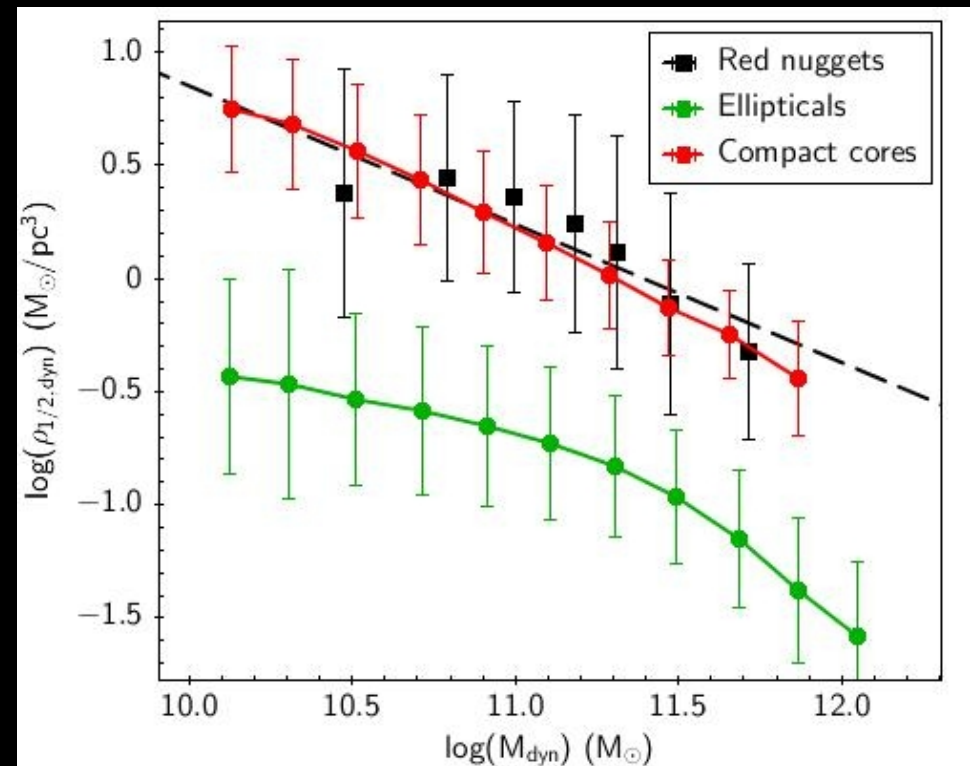
[Maps adapted from Graham (2013)]

KINEMATICS

MASS* - σ



MASS_{dyn} - DENSITY

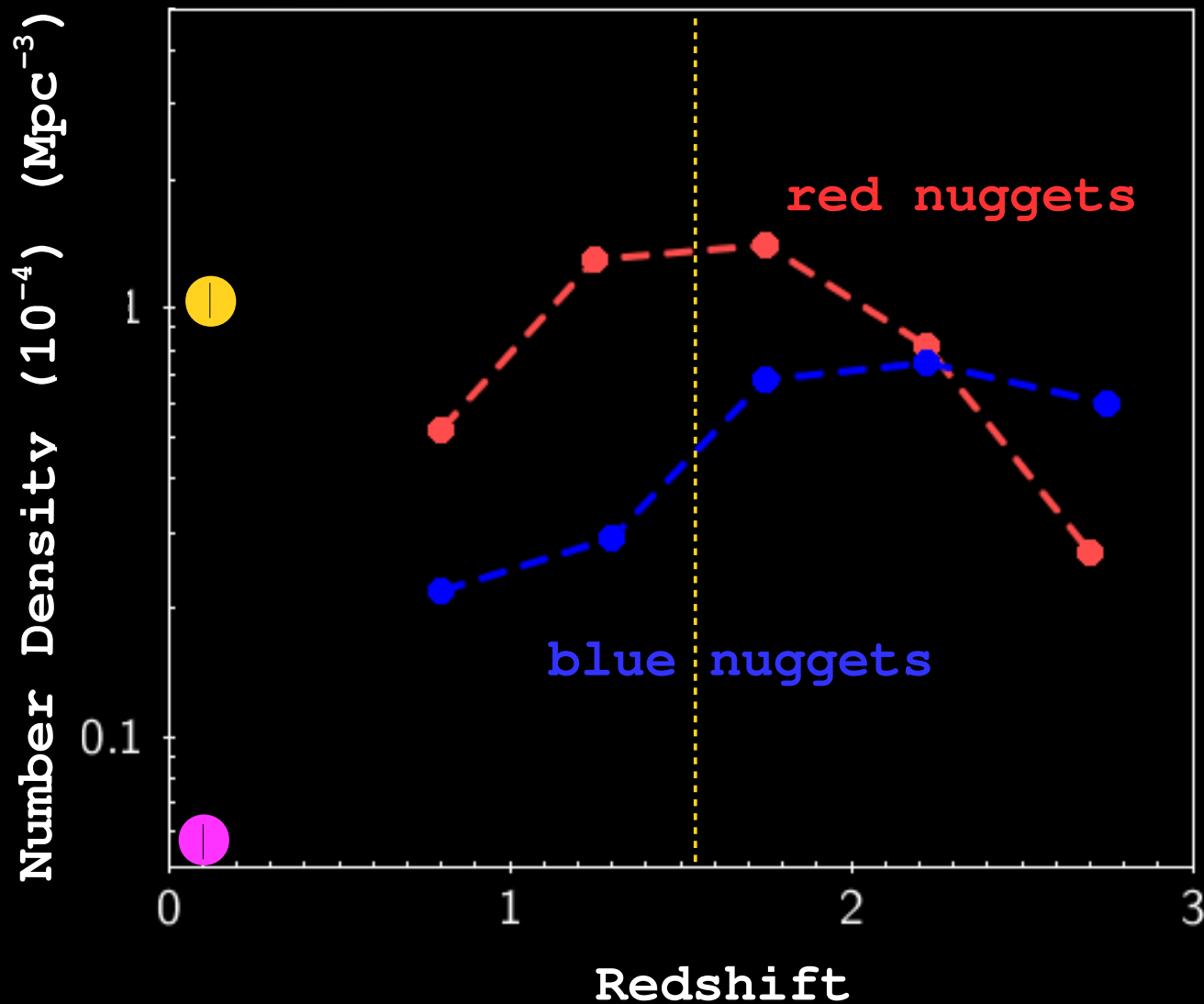


Testable prediction (II)

* Red nugget number density ($z \approx 1.5$) =
compact core number density ($z \approx 0$)

Number Density Evolution

vD15-compact. + $\log(M_{\text{bulge}}^*) > 10.6$



How many compact cores?

How many compact galaxies?

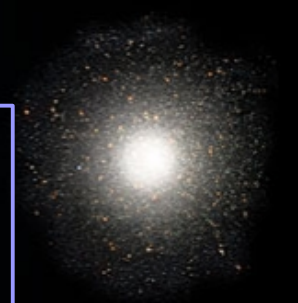
EXTRA MASS



$z=0$

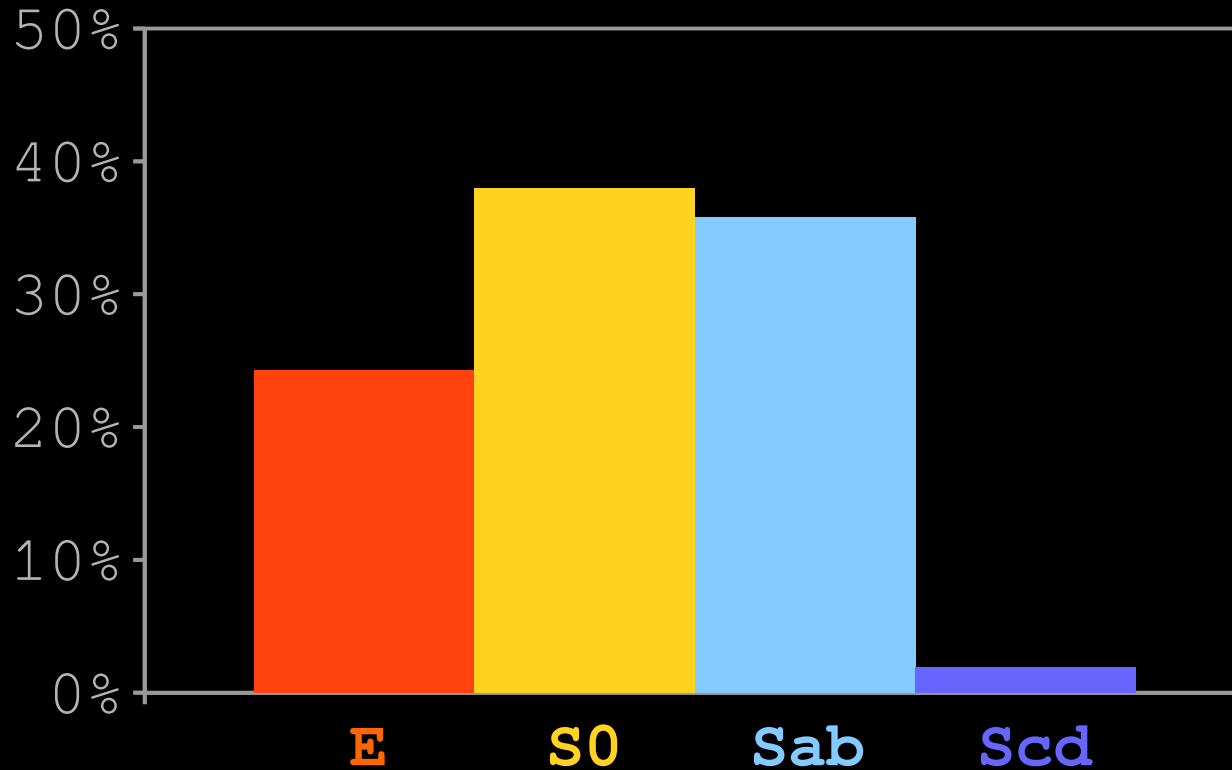


$$\langle M_{\text{extra}}^* \rangle \approx 2.8 \times 10^{10} M_{\odot}$$
$$\sim 2.5 M_{\odot} \text{ yr}^{-1}$$



$z \sim 1.5$

WHERE DID RED NUGGETS END?



Local galaxies with $\log(M_{\text{galax}}^*) \gtrsim 10.75 M_{\odot}$ hosting a compact core with $\log(M_{\text{core}}^*) \gtrsim 10$ (Barro13-compactness)

Morphology from Huertas-Company et al. (2011)