Most Massive Galaxies with MUSE

[Scary Monsters]

Eric Emsellem
Davor Krajnović
Adrien Guérou

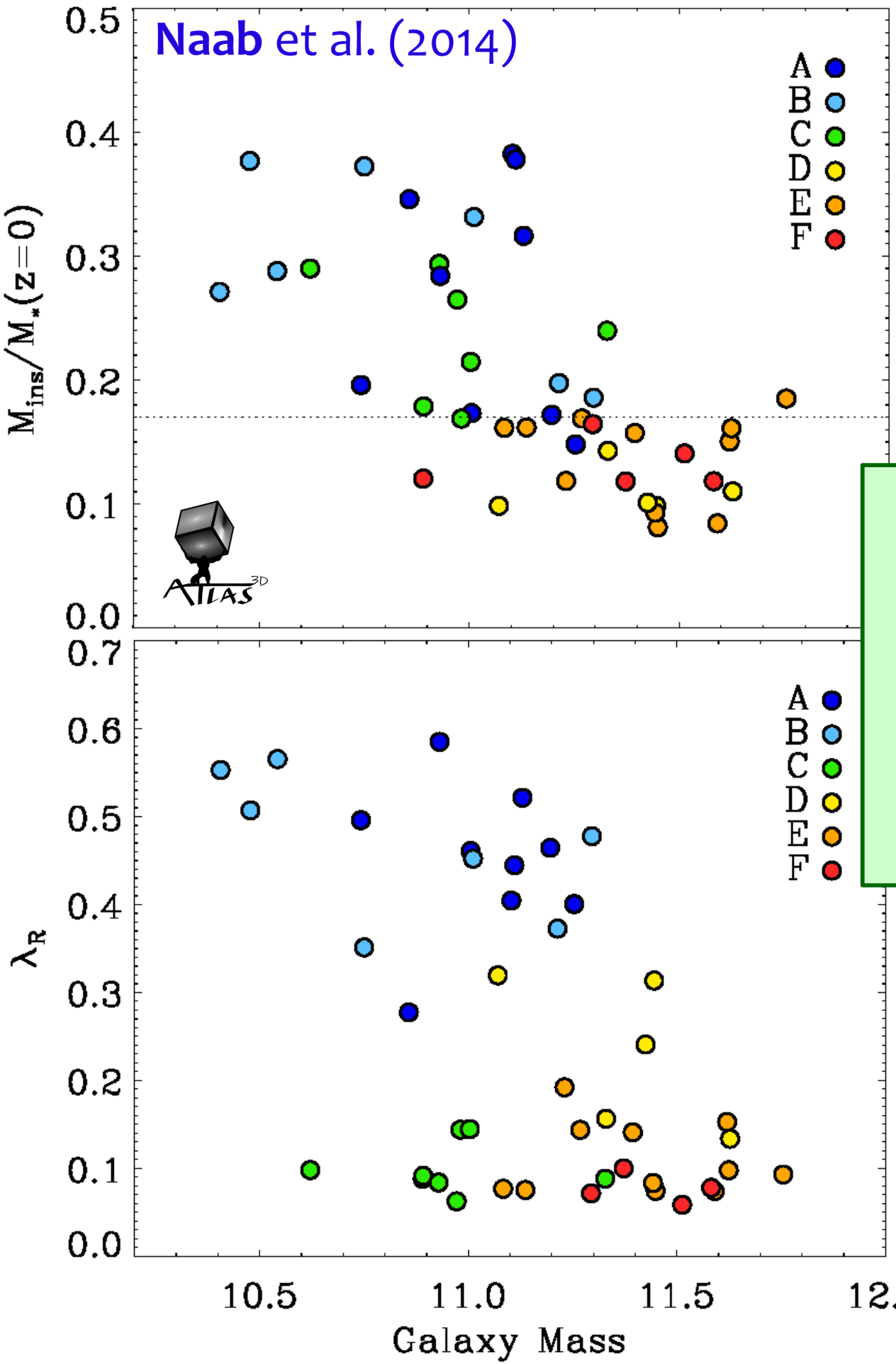
AIP

ESO

In situ – Stellar Mass

Angular momentum

Naab et al. (2014)



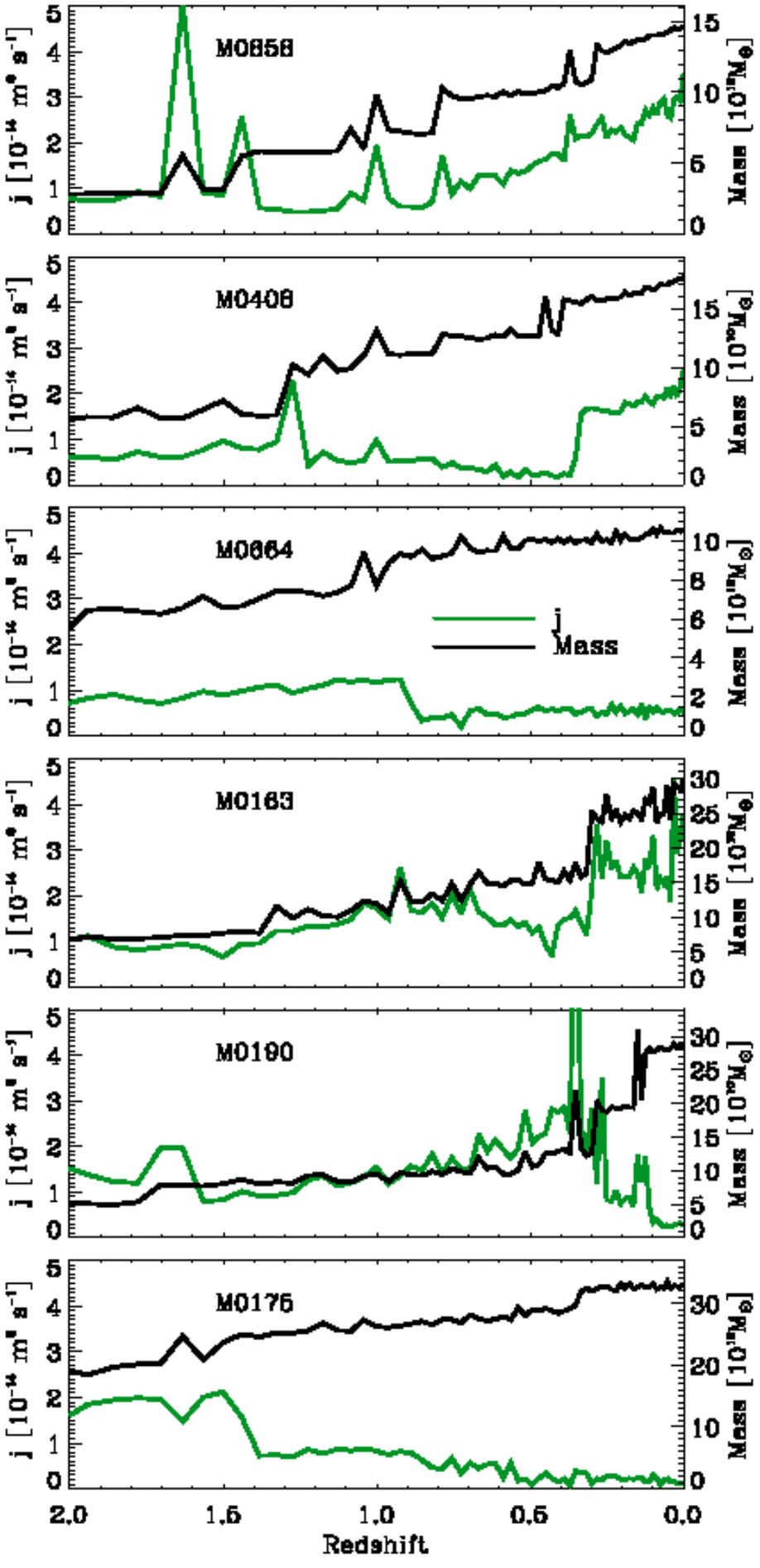
Various Mass regimes

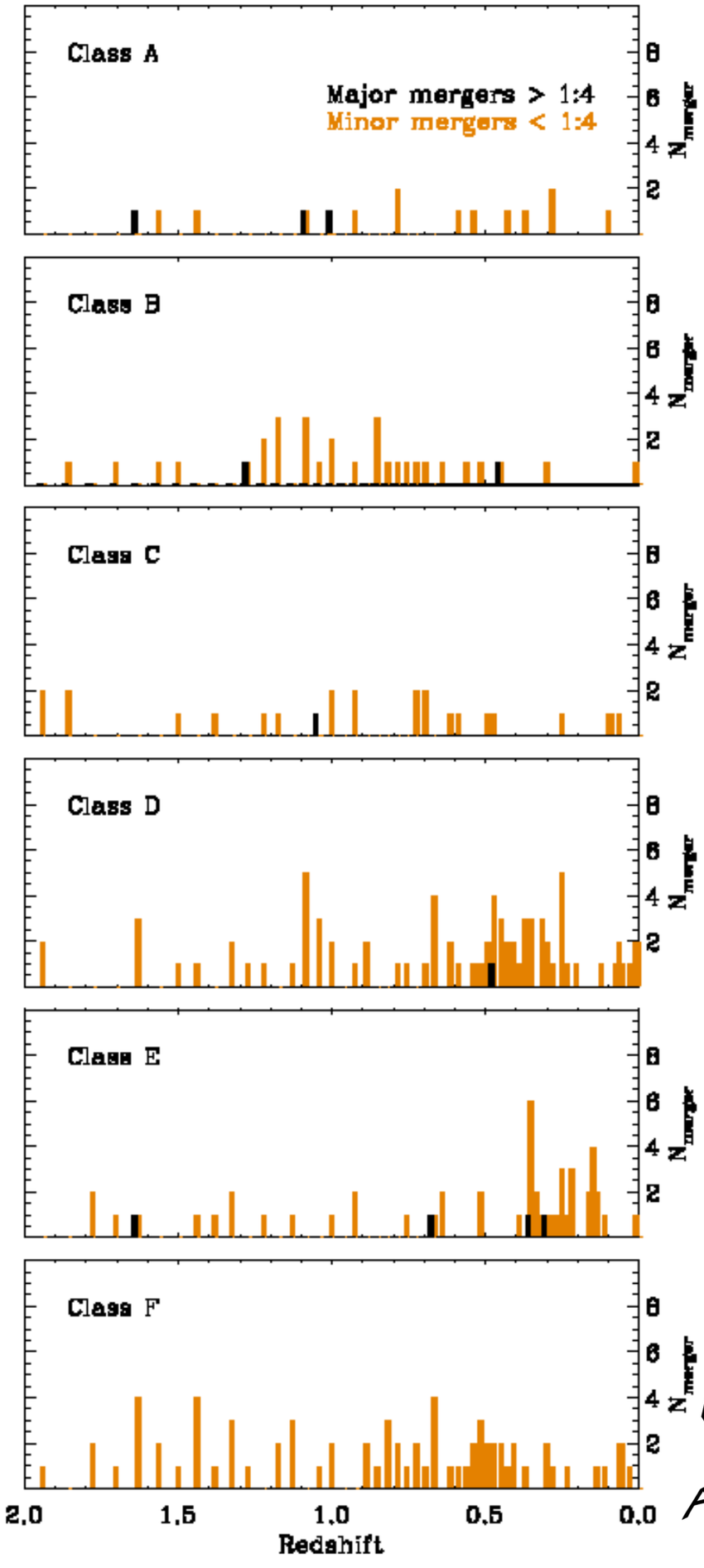
⇒ Most massive galaxies

In situ vs Ex situ

Not just one Path!

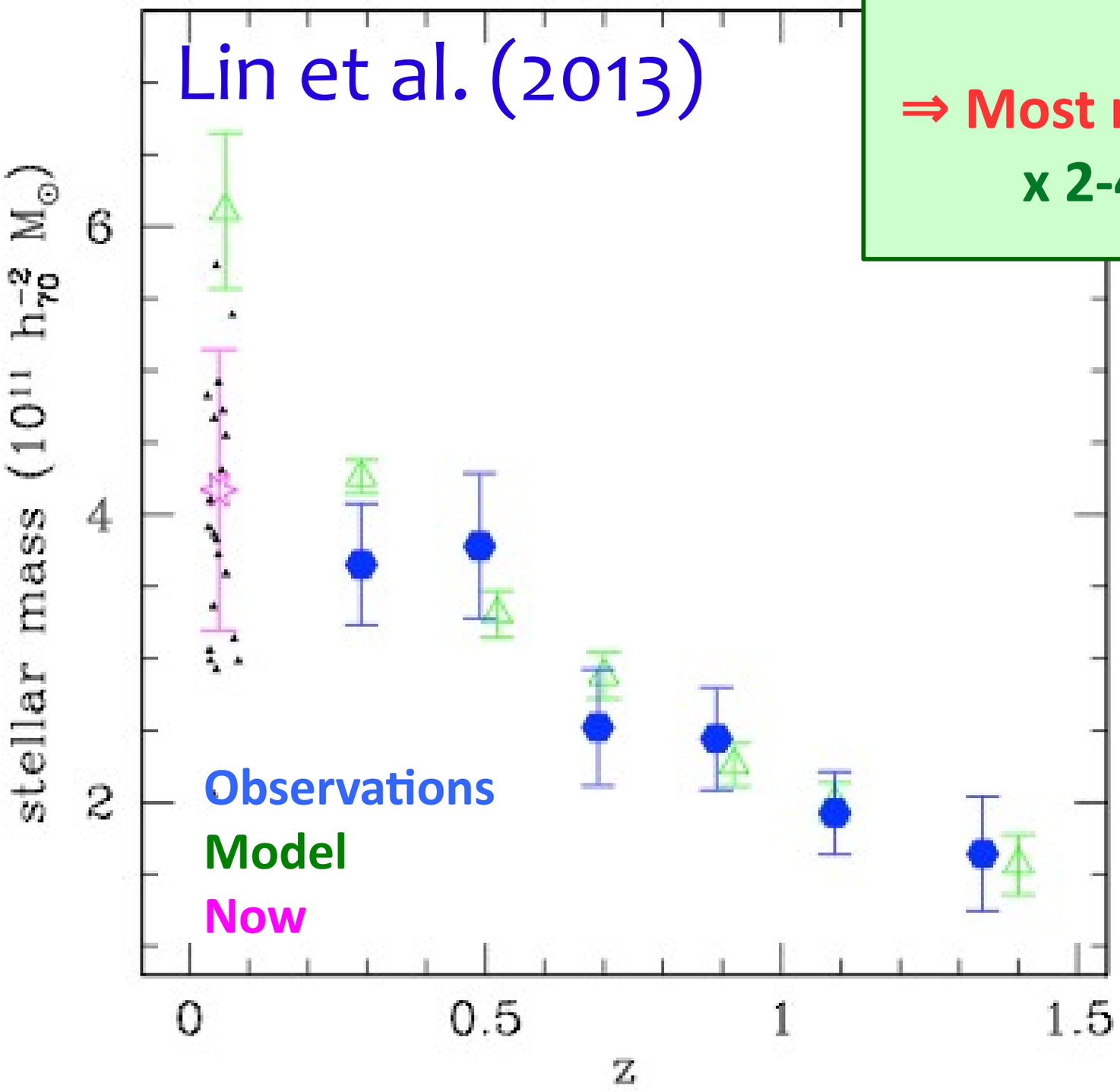
Angular momentum





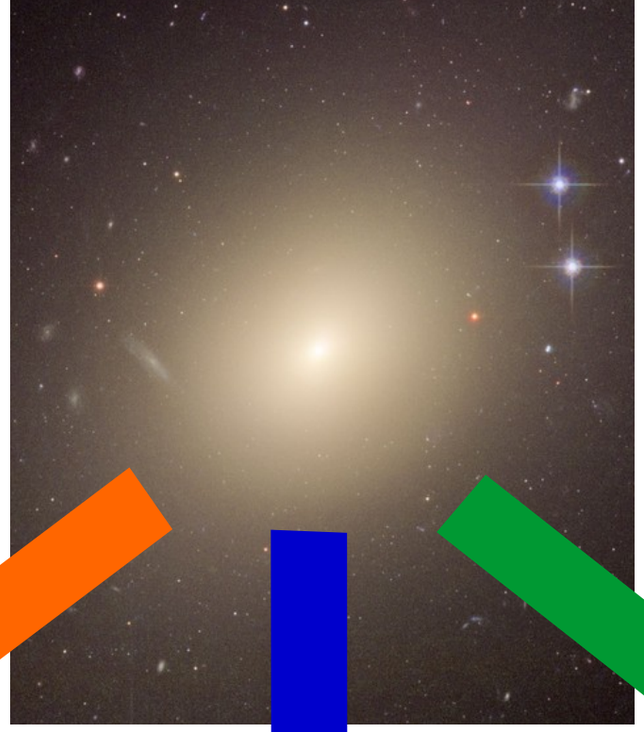
Naab, Oser, EE et al. (2014)

Mass Growth @ the high Mass end



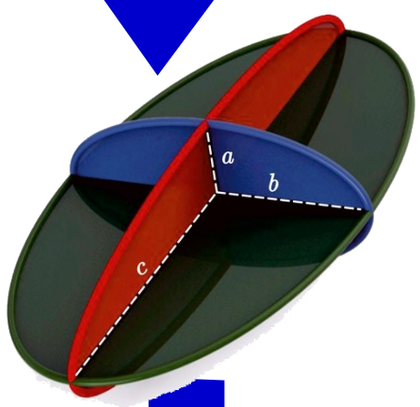
Time evolution

⇒ Most massive galaxies
x 2-4 since z=1.5



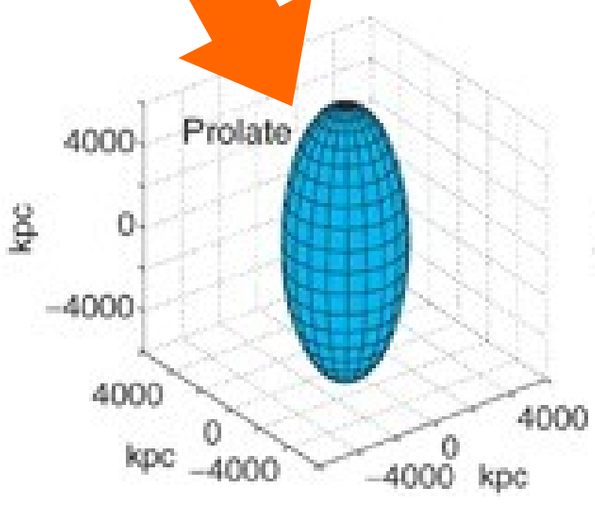

RUGBY
WORLD CUP
2015
GILBERT

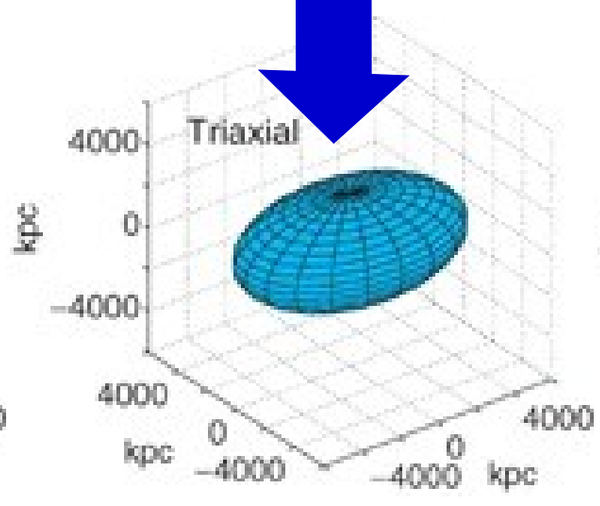
Or

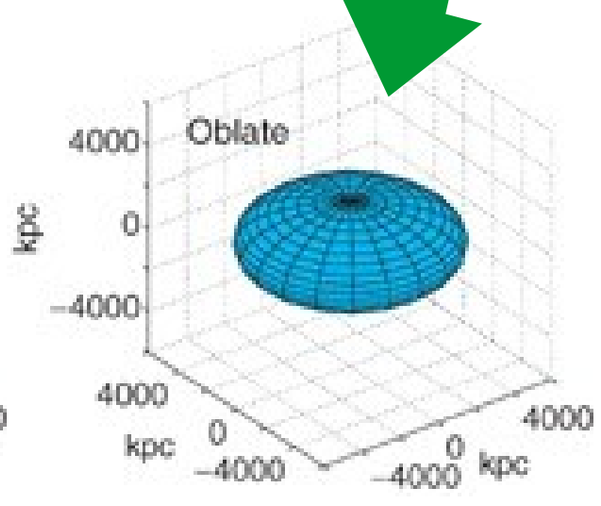

a
b
c

Or

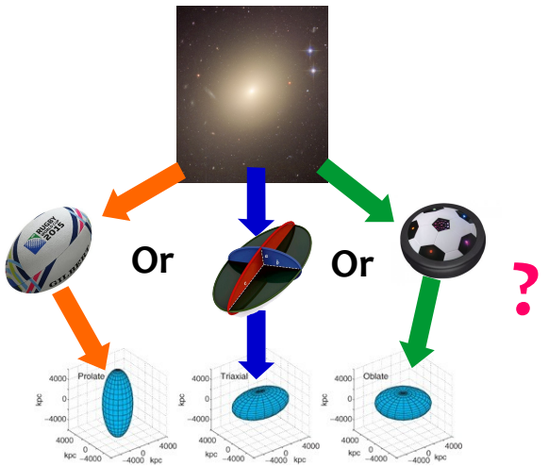
?

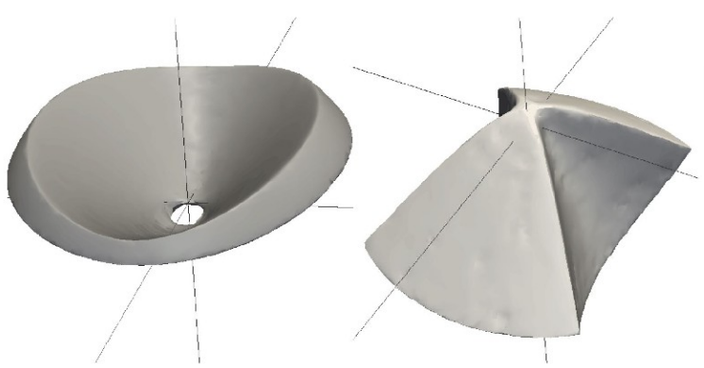

Prolate
4000
0
−4000
kpc
4000
0
−4000
kpc
4000
0
−4000
kpc


Triaxial
4000
0
−4000
kpc
4000
0
−4000
kpc
4000
0
−4000
kpc


Oblate
4000
0
−4000
kpc
4000
0
−4000
kpc
4000
0
−4000
kpc

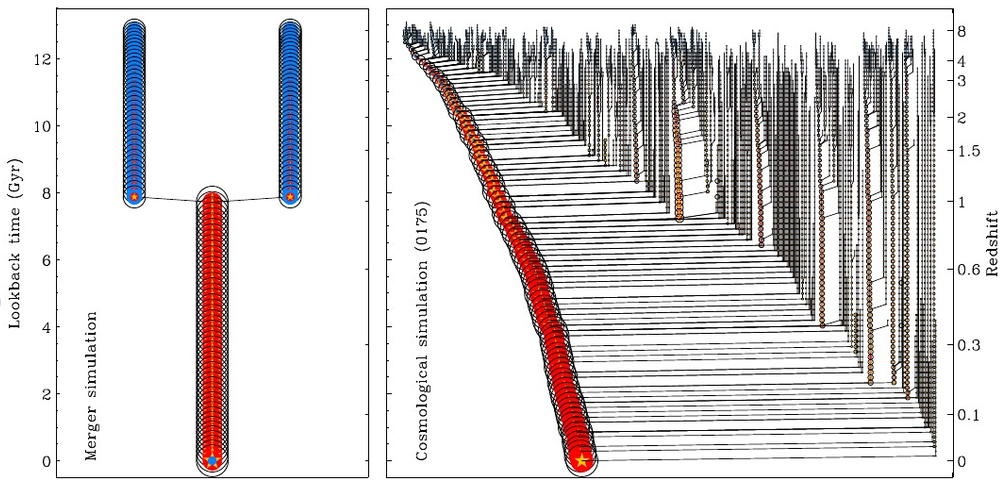
Why should we care ?



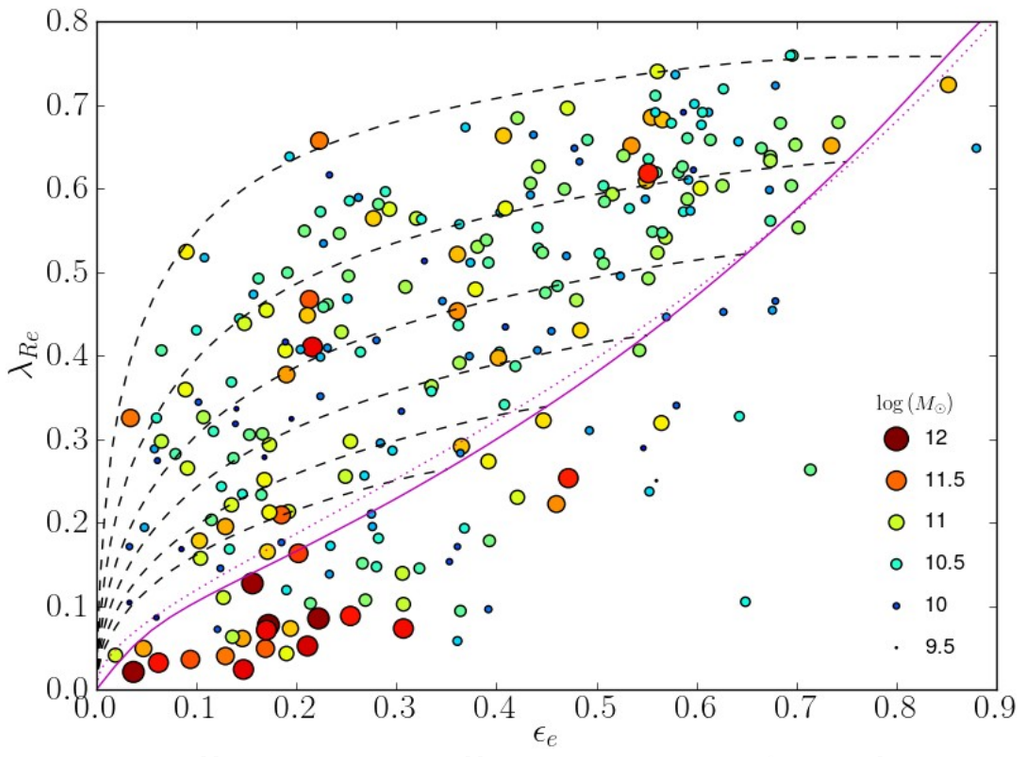


Merritt 2013

- ***Orbital structure***
  - Morphology, Dynamics, Mass
- ***Constraints on Formation / Evolution***
  - How are these formed / assembled ?



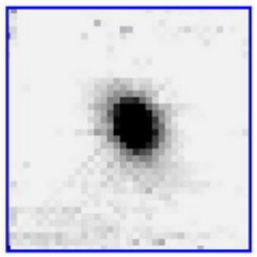
Naab, Oser, Emsellem et al. 2014

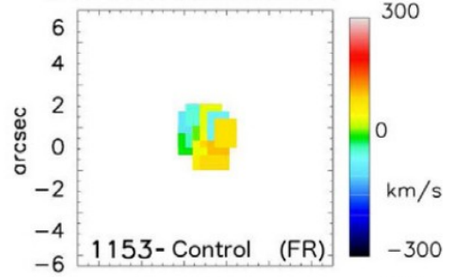


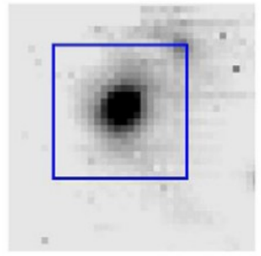
Emsellem, Cappellari, Krajnović et al. 2011

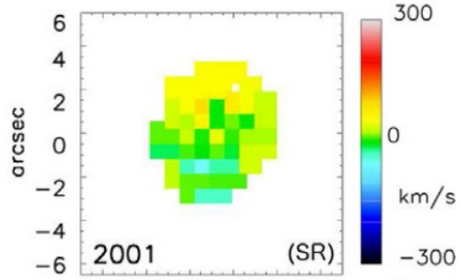
- ***Things change at high mass***
  - Angular momentum

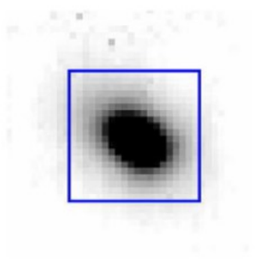
What's happening at Masses > $10^{11.5}$ $M_\odot$?

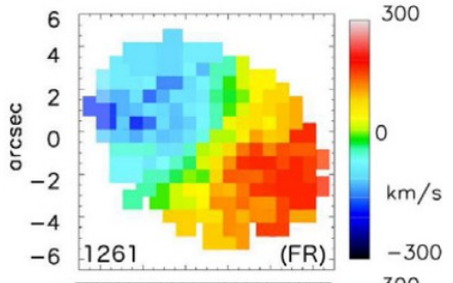


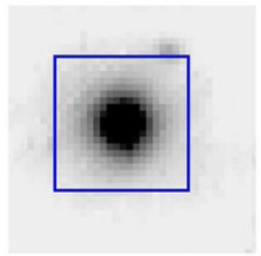


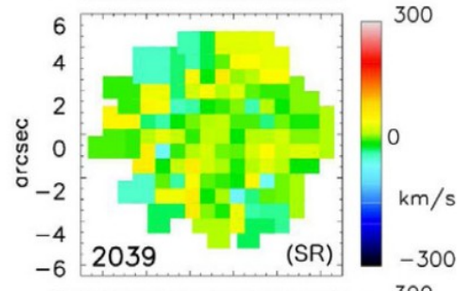


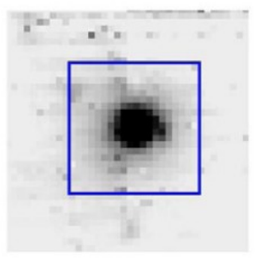


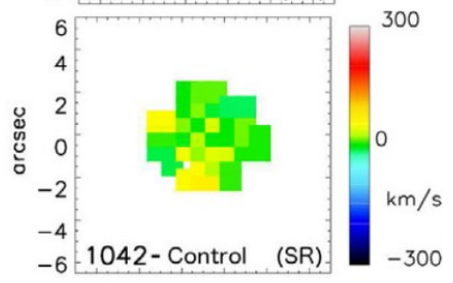


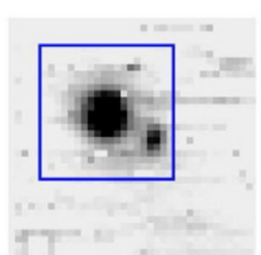


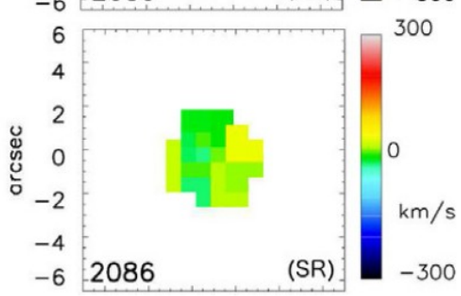


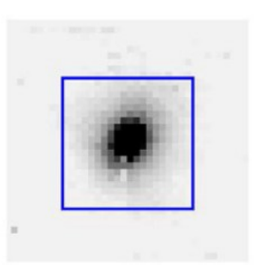


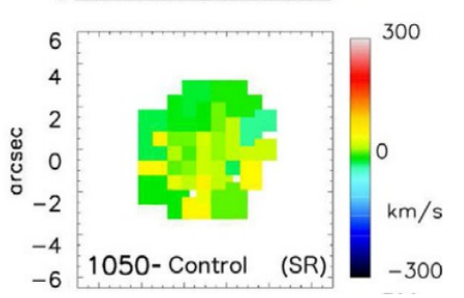




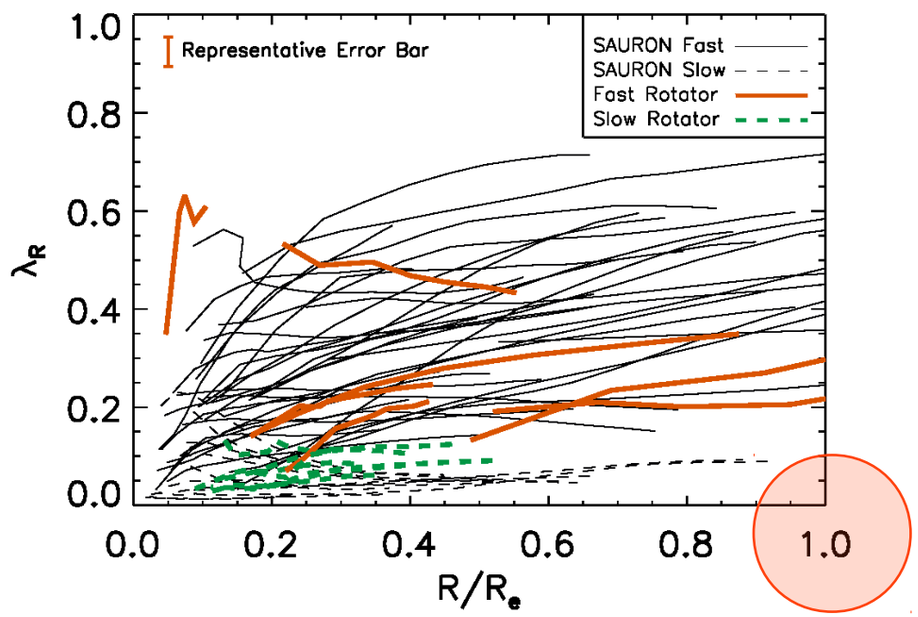


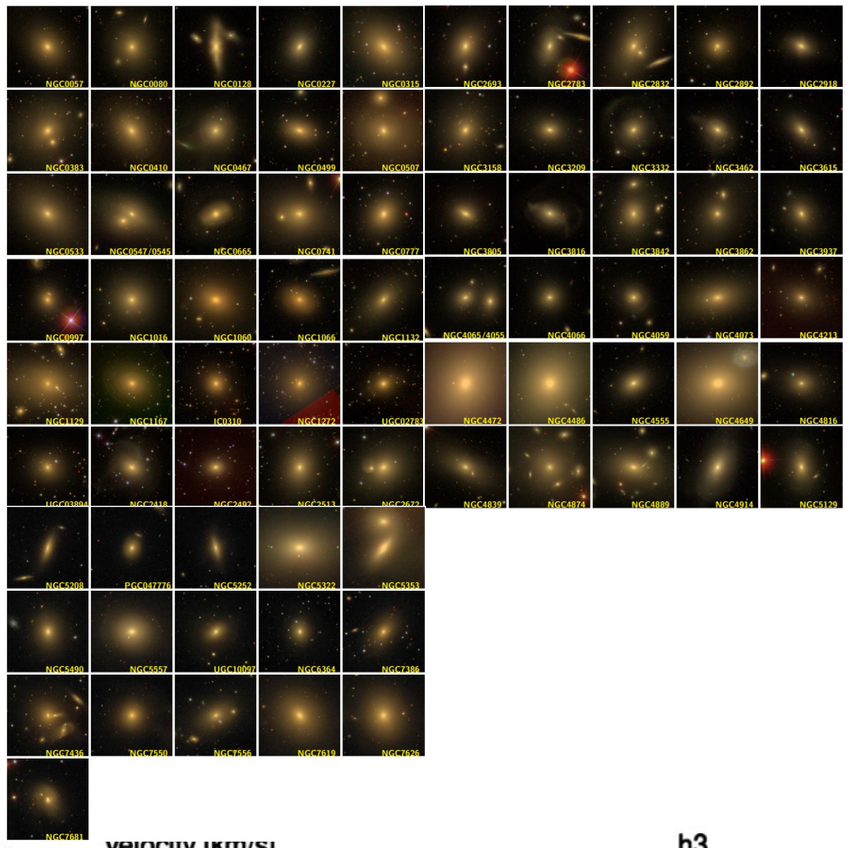


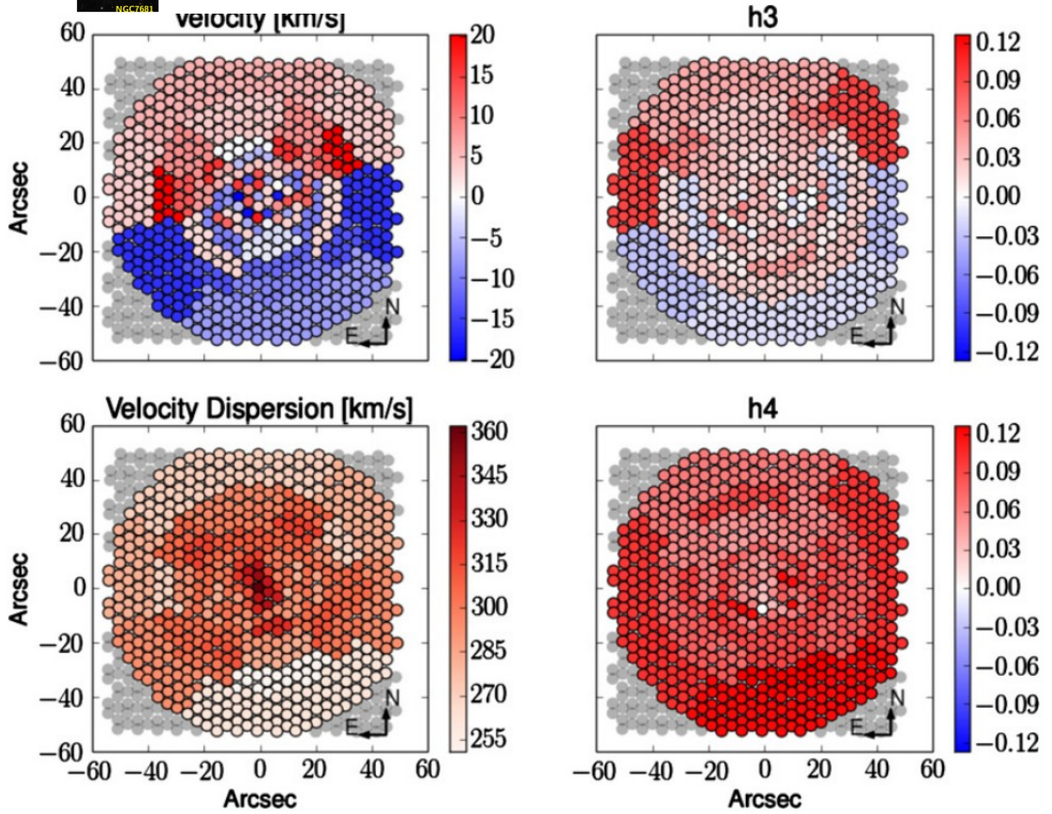




BCGs







Jimmy, Brough et al. 2013

[VLT/VIMOS]

Ma et al. 2014

[MASSIVE – Mitchell Spec + AO-NIFS]

The 3MG Project

a MUSE GTO programme

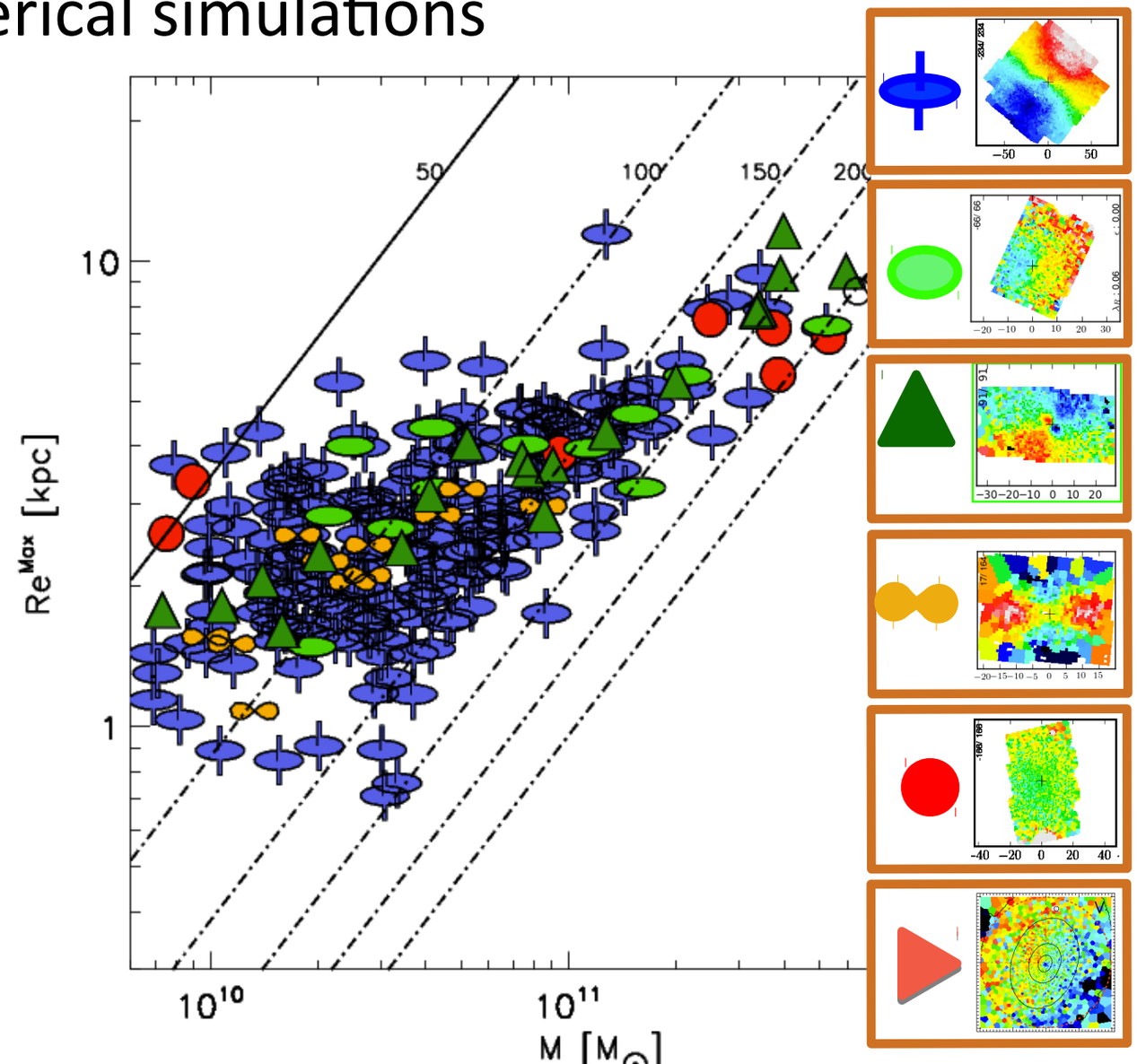
PI Eric Emsellem; Davor Krajnović

Goals:

Dynamical state, Dark matter content,

SFH, IMF + Test predictions of numerical simulations

e.g. Hoffman et al. 2010, Bois et al. 2011, Naab et al. 2014, Röttgers et al. 2014, Vogelsberger et al. 2014 (Illustris), Schaye et al. 2015 (EAGLE), Hirschmann et al. 2015…



How:

Stellar content + dynamics

of the most massive galaxies

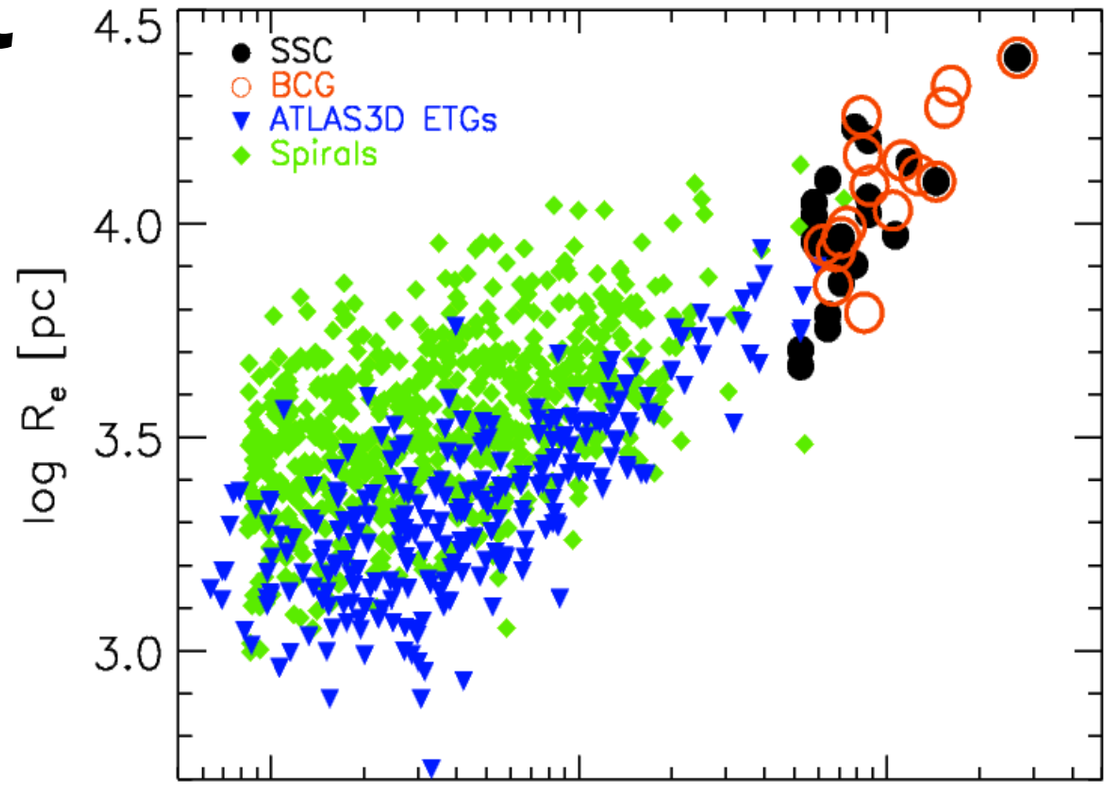
in densest environments

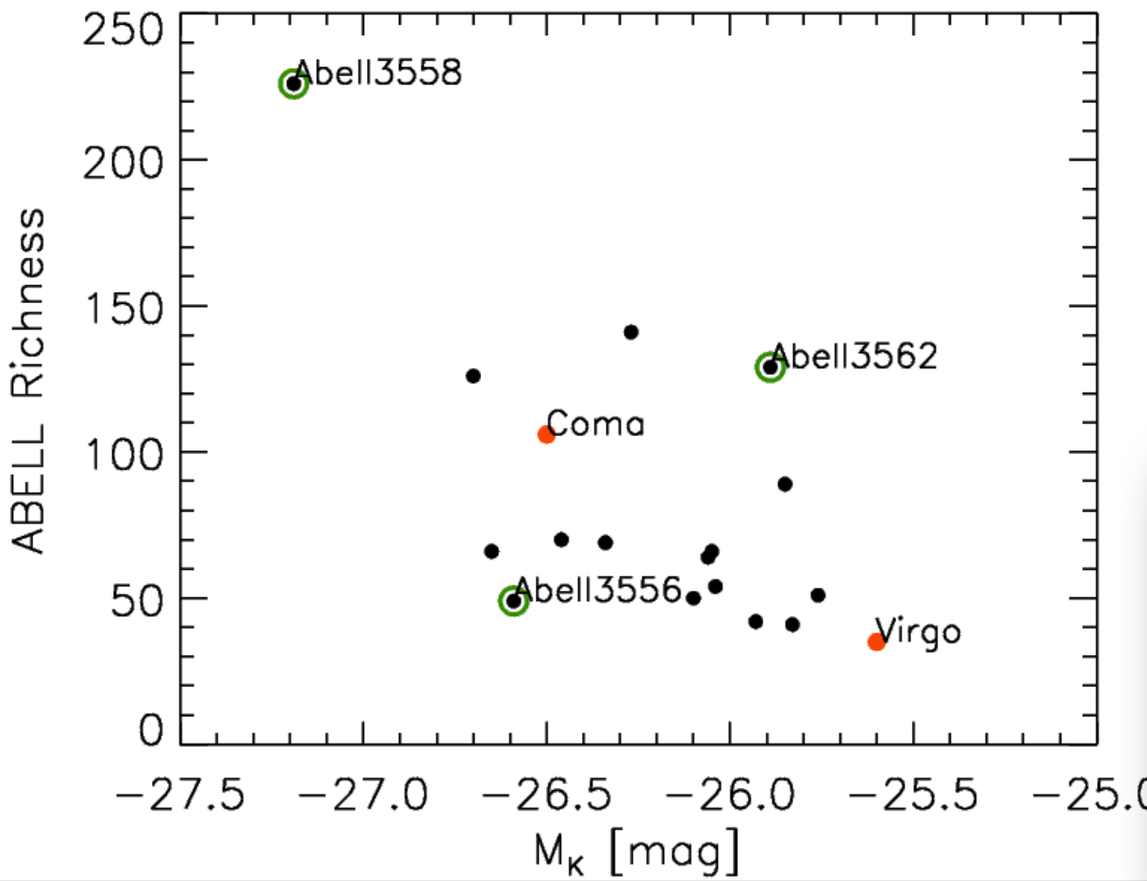
The 3MG Project

More massive,
richer, clusters

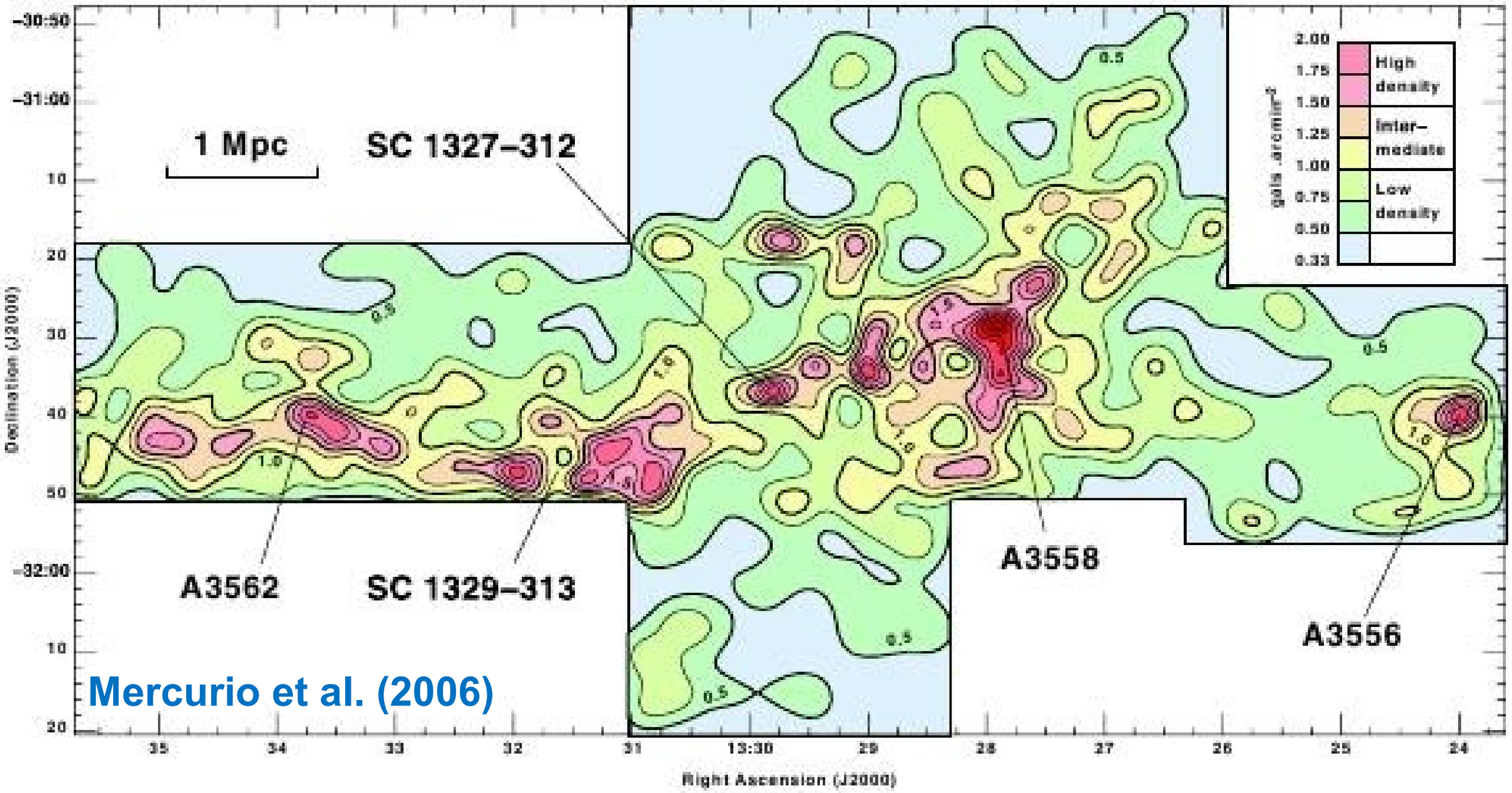
→ **2** sub-samples (z~0.04)

Shapley Super Cluster
(brighter than -25.7 mag in K)
+
BCGs in rich clusters





Shapley Super Cluster

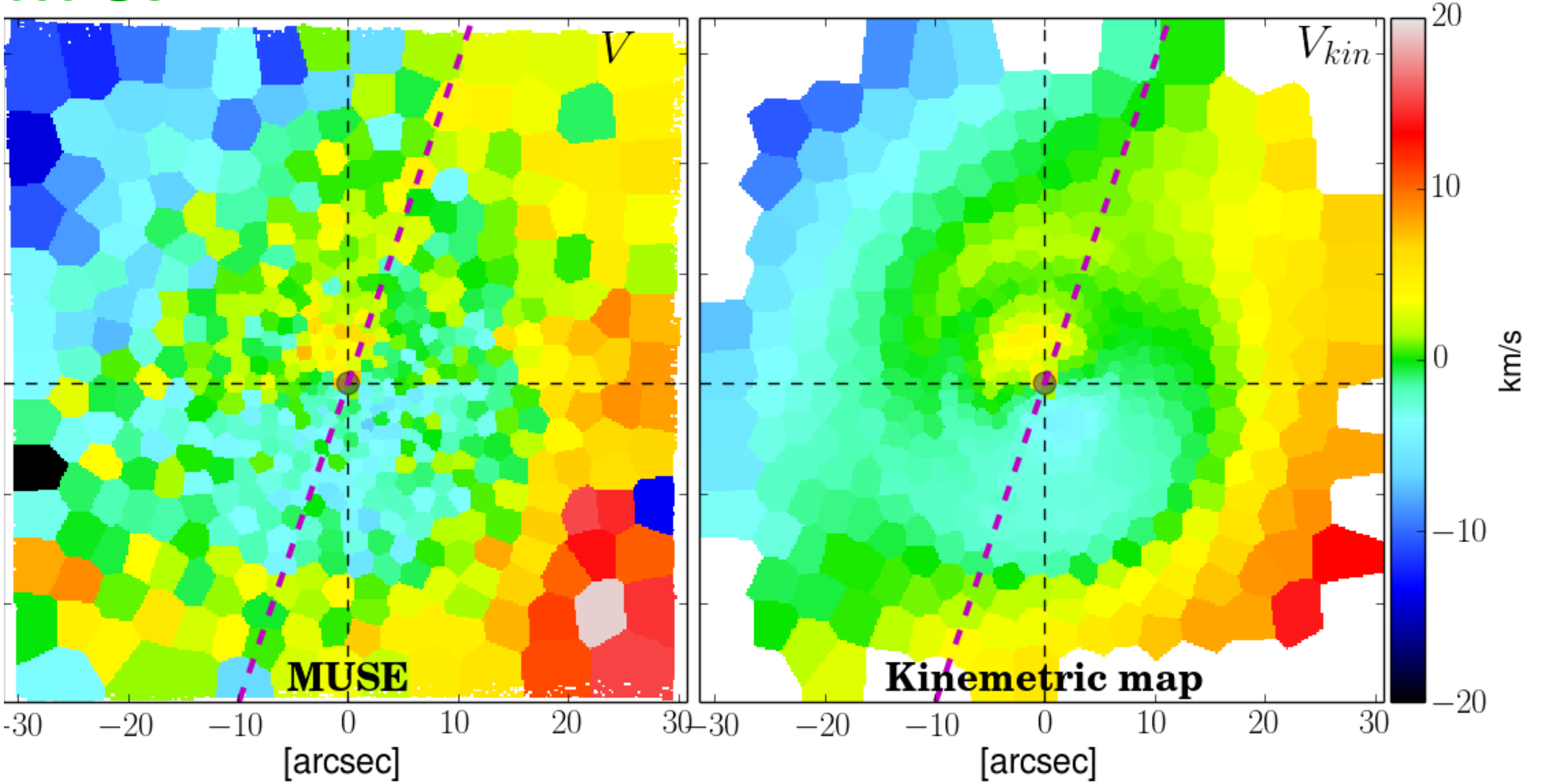


Mercurio et al. (2006)

~200 Mpc [~1kpc / arcsec]

Why MUSE?

M 87

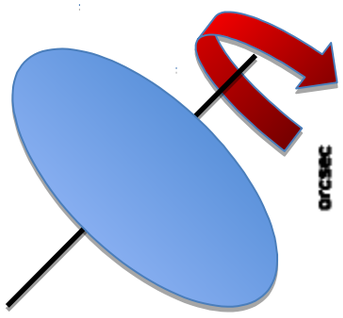


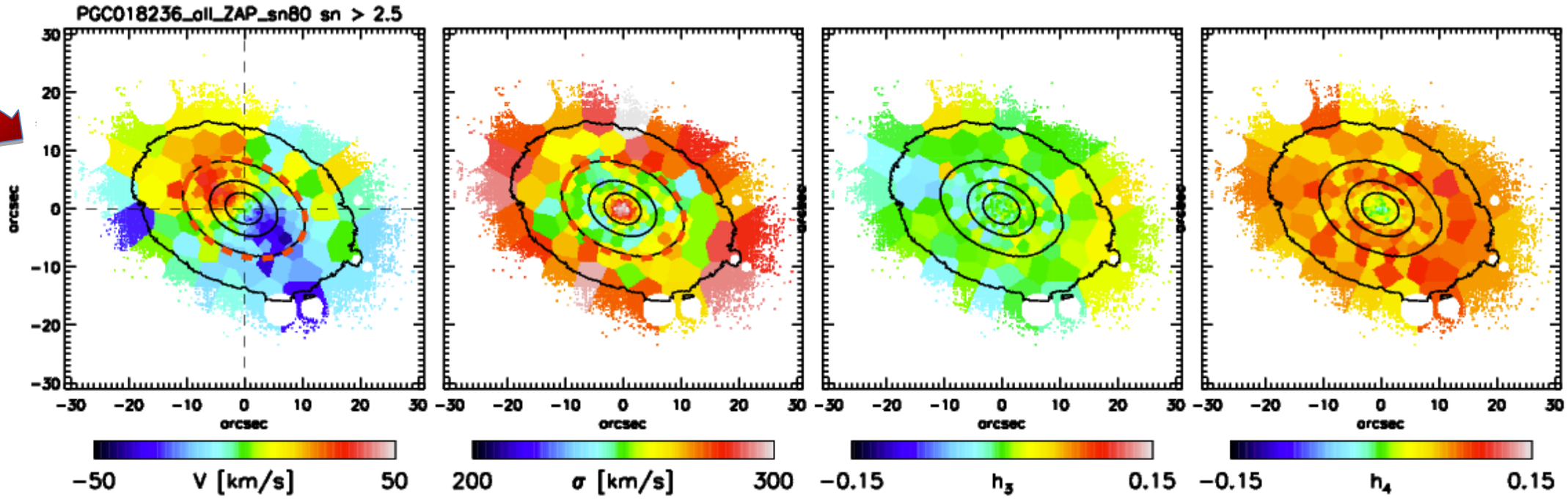
Emsellem, Krajnović, Sarzi 2014

MUSE (V-R-I) "Snapshot" Images

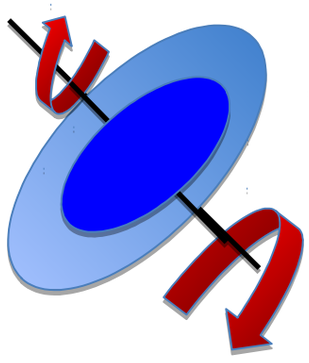
PGC018236 and PGC019085

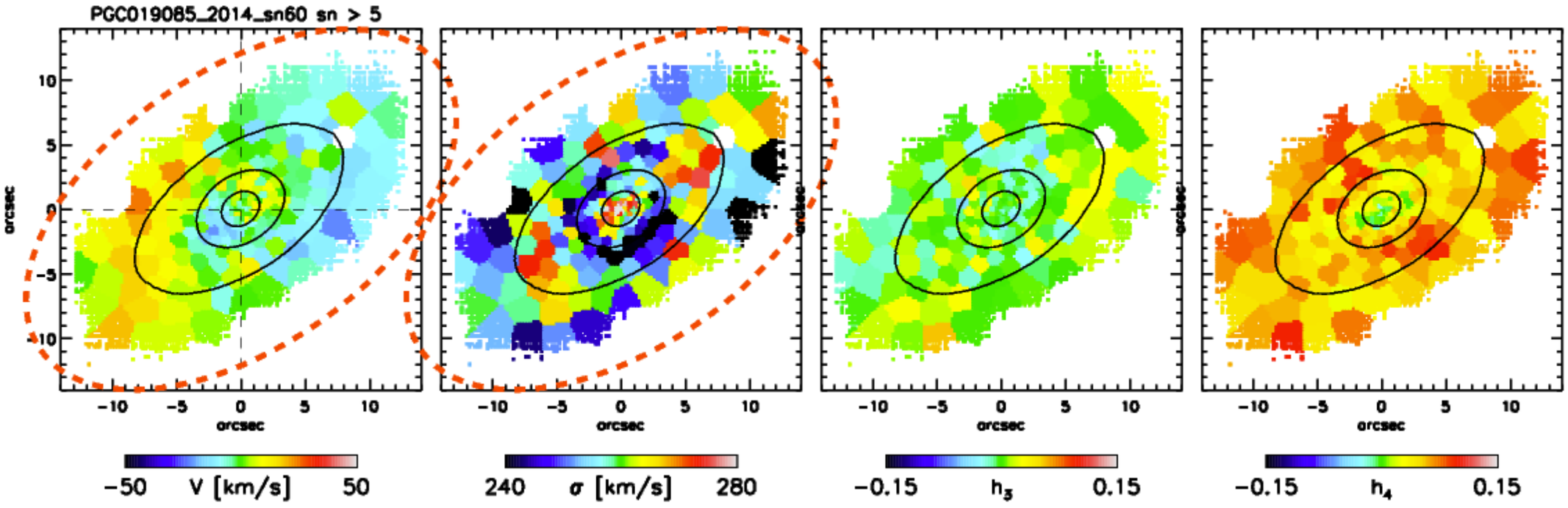
Rotation around minor axis





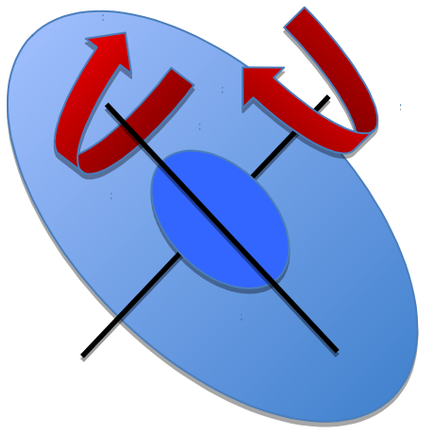
Rotation around minor axis – counter rotation

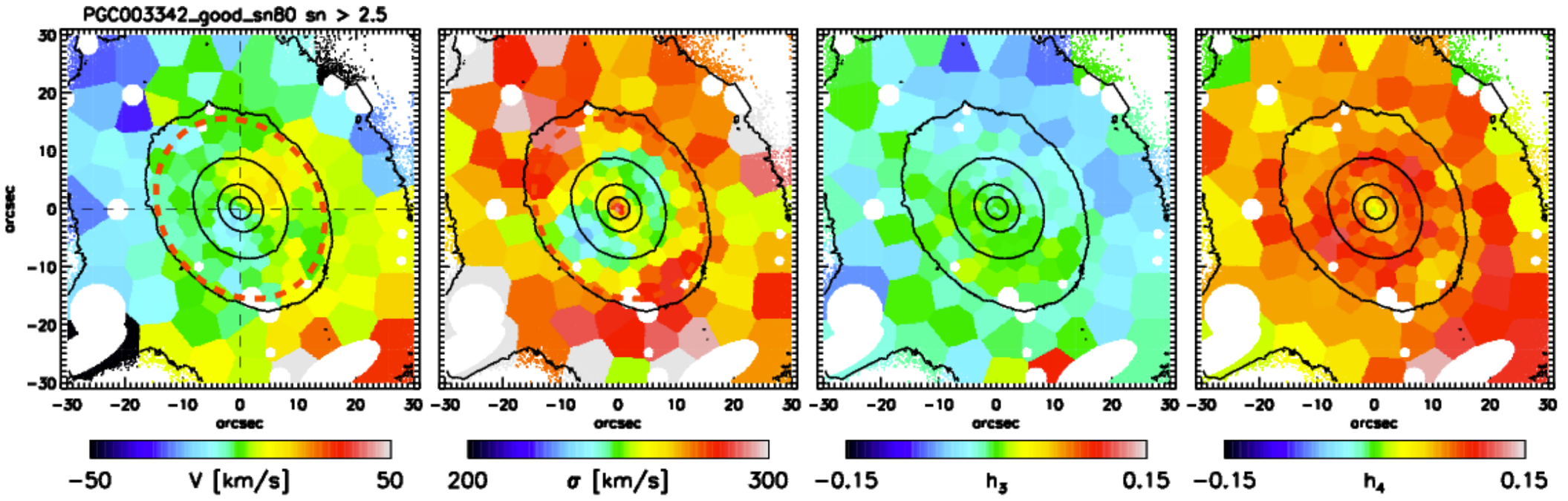




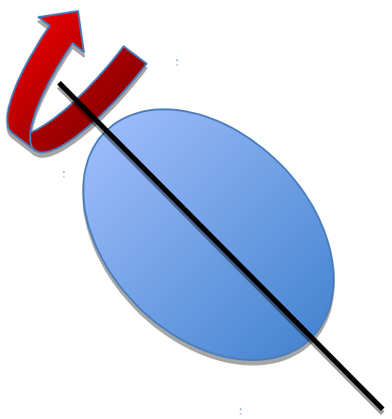
PGC003342 and PGC065588

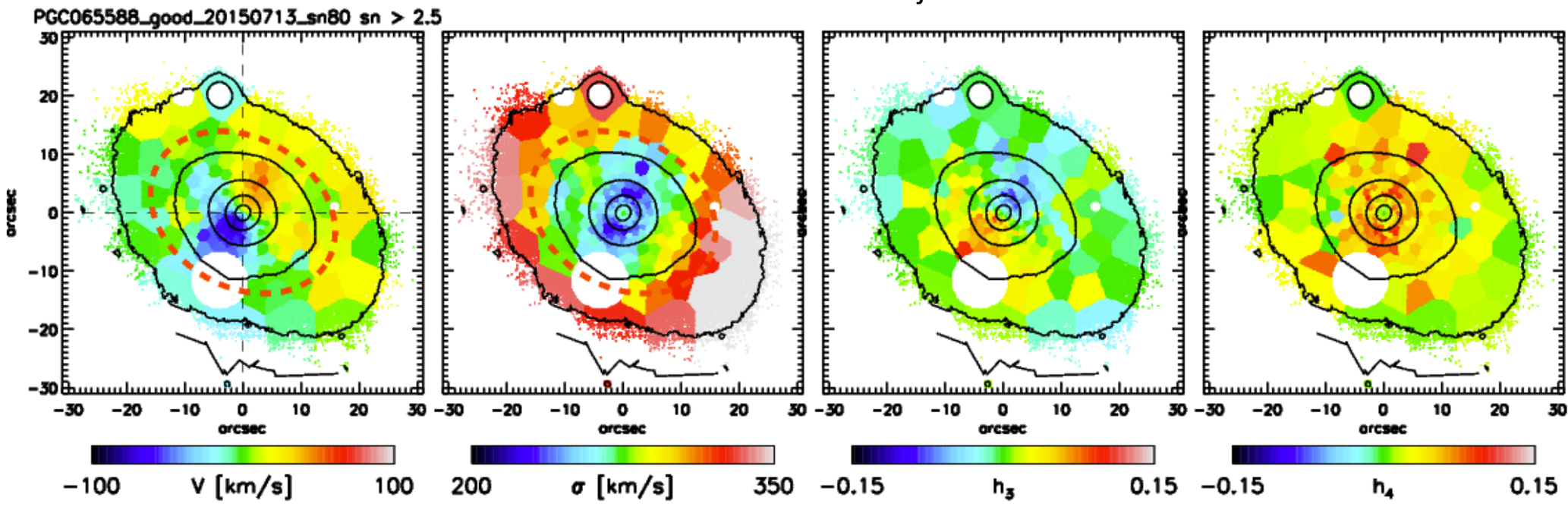
Rotation around minor and major axis





Rotation around major axis





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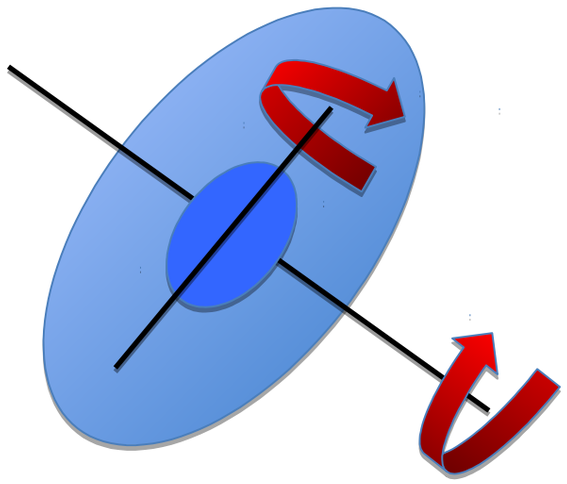
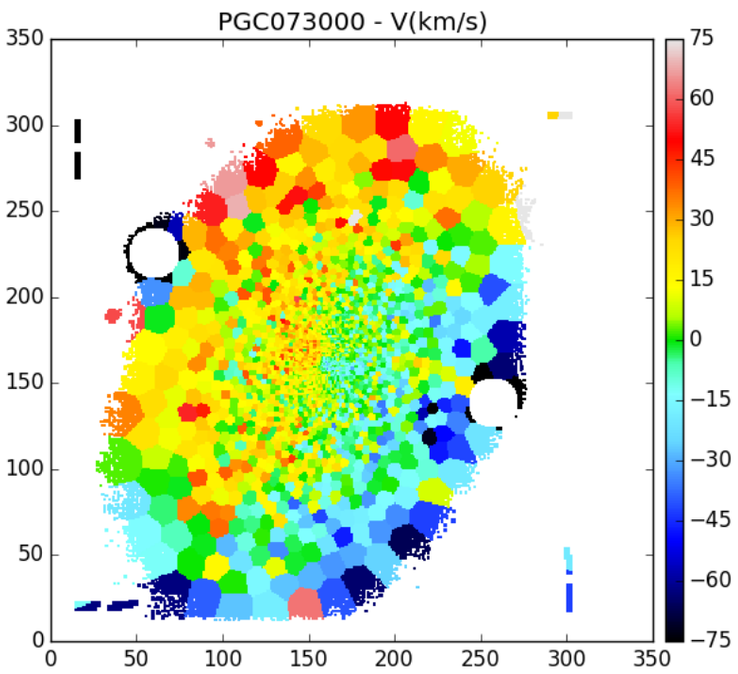
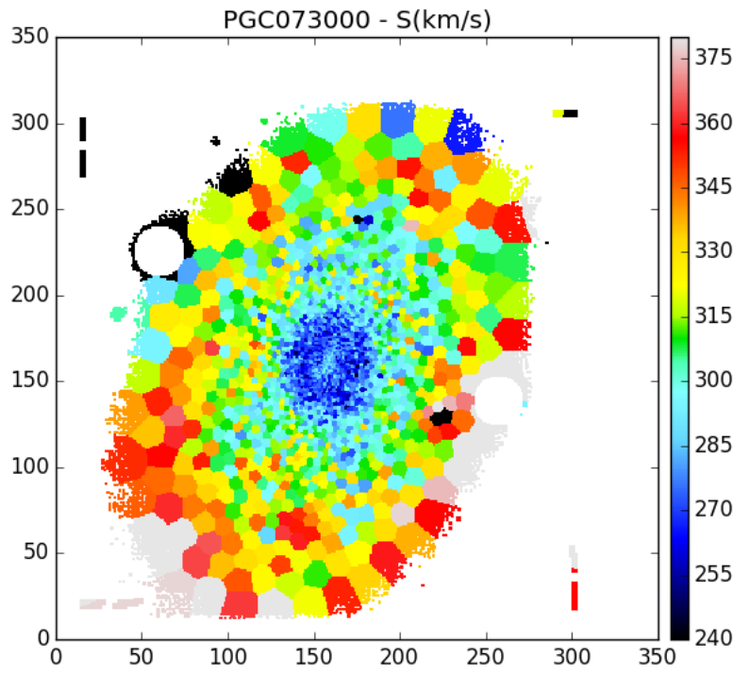


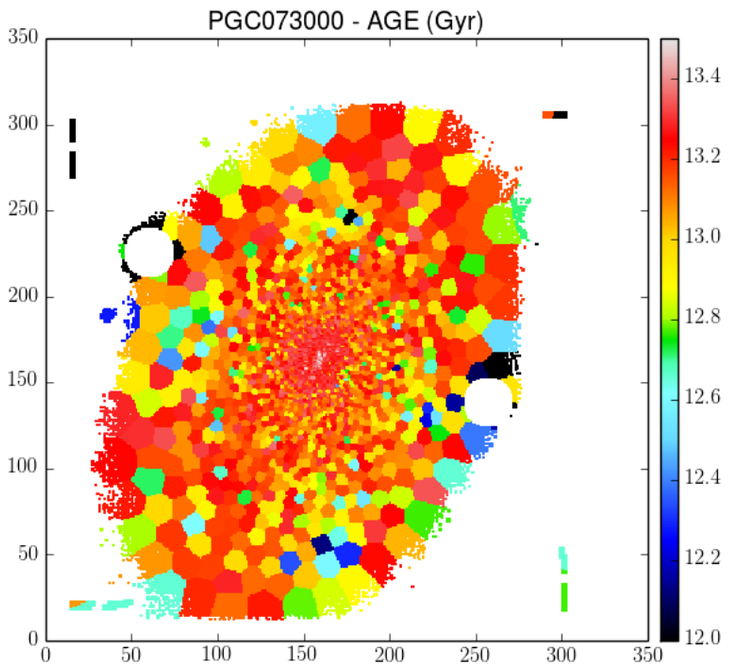
MUSE colour

Velocity

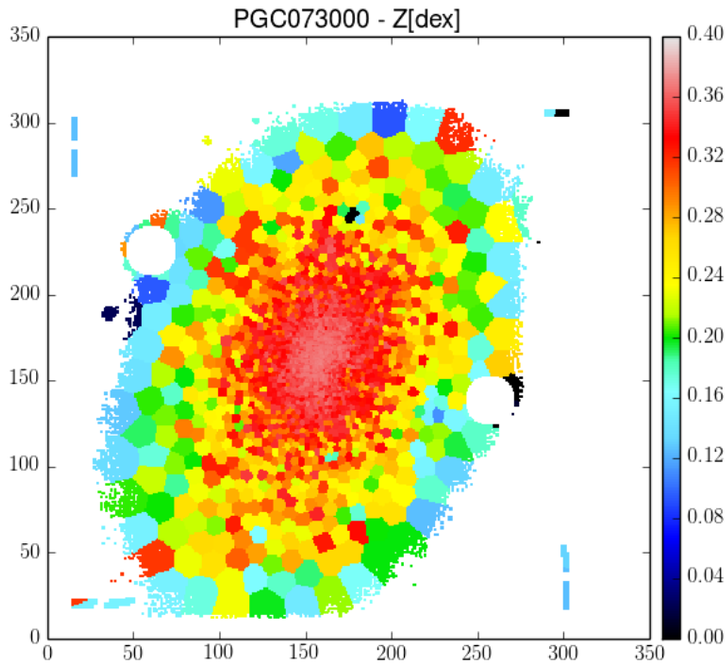


Dispersion





Age

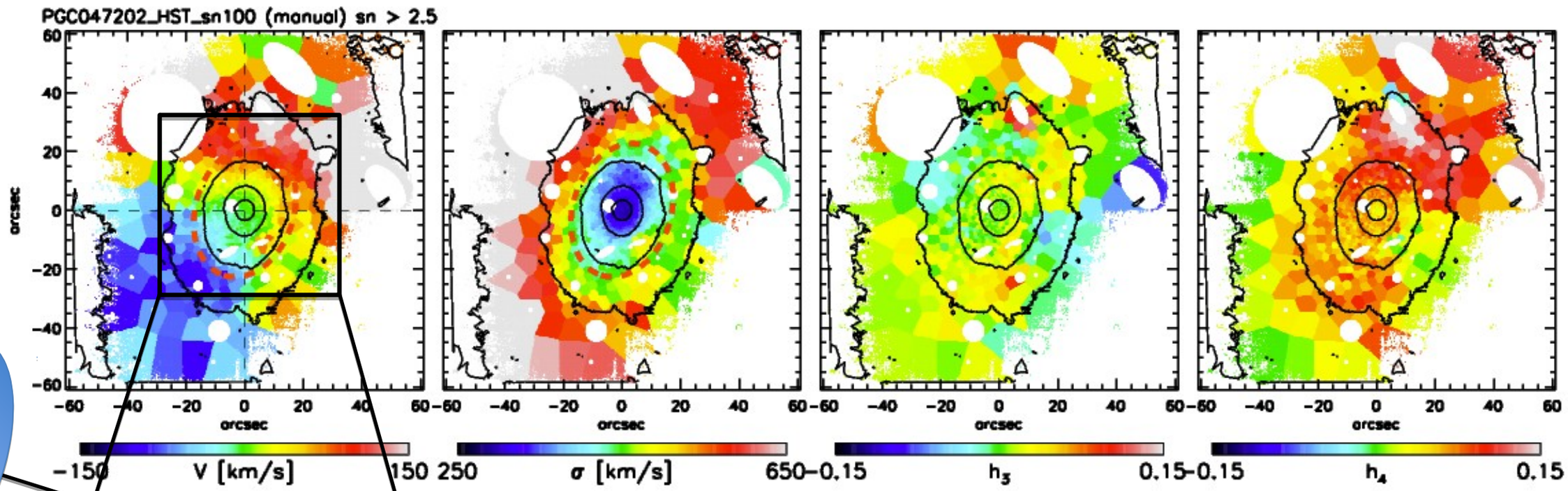


Metallicity

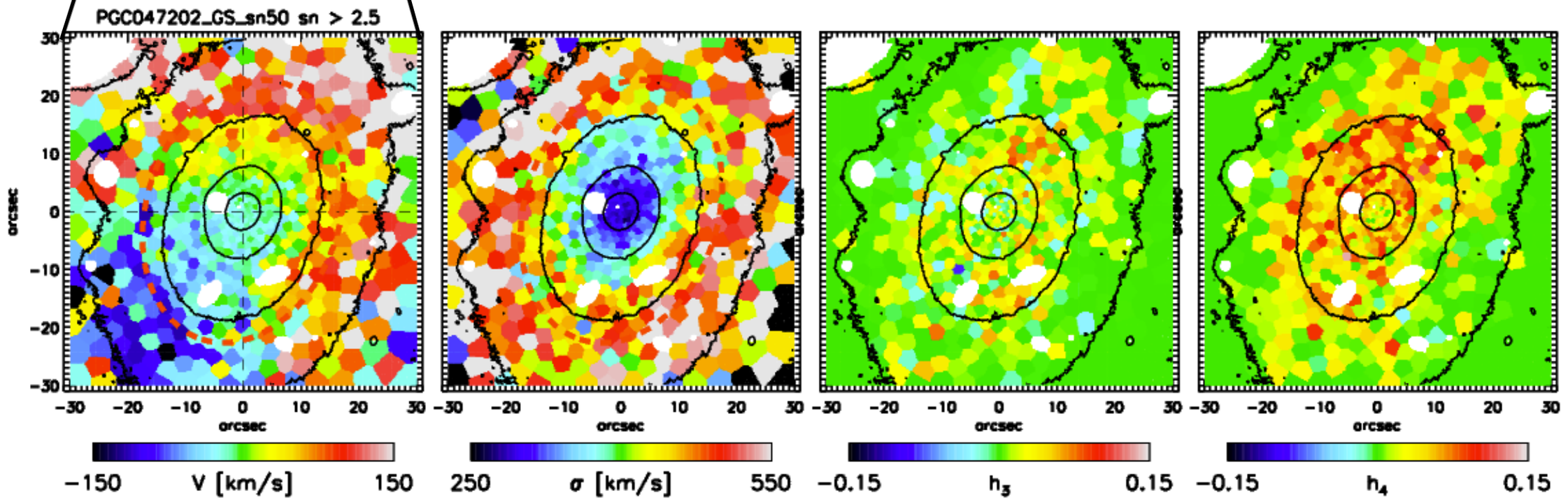
PGC047202

*The most massive galaxy **in Shapley***

PGC047202

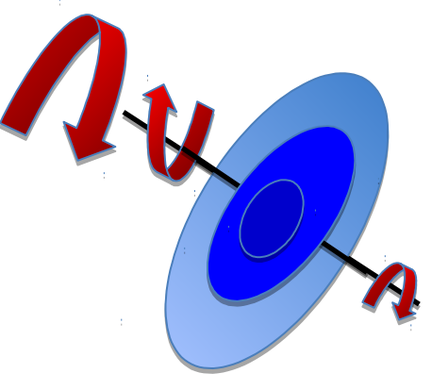


Rotation around minor axis

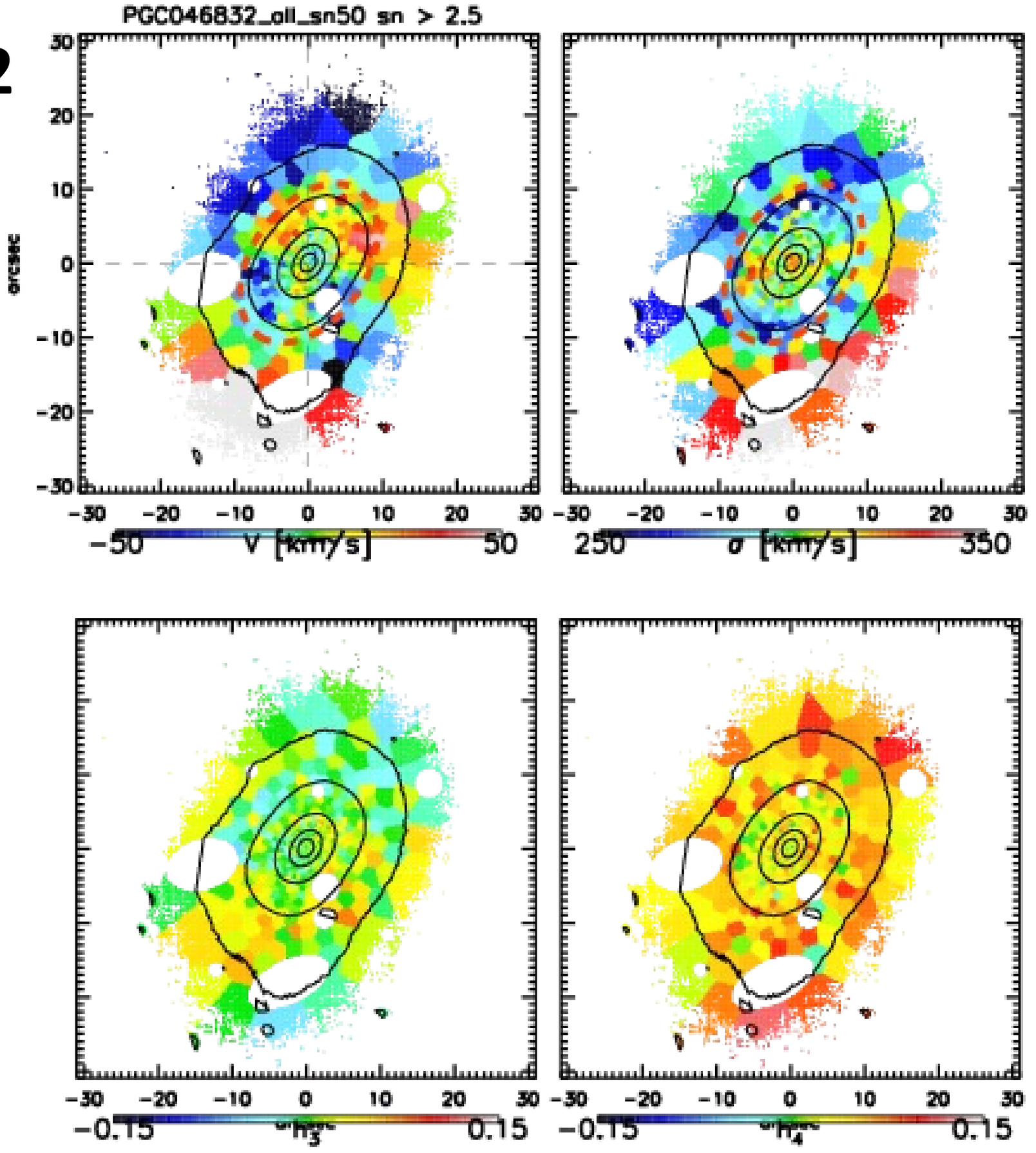


• ds

PGC046832



A double KDC



First Results

> ½ show prolate-like rotation ?

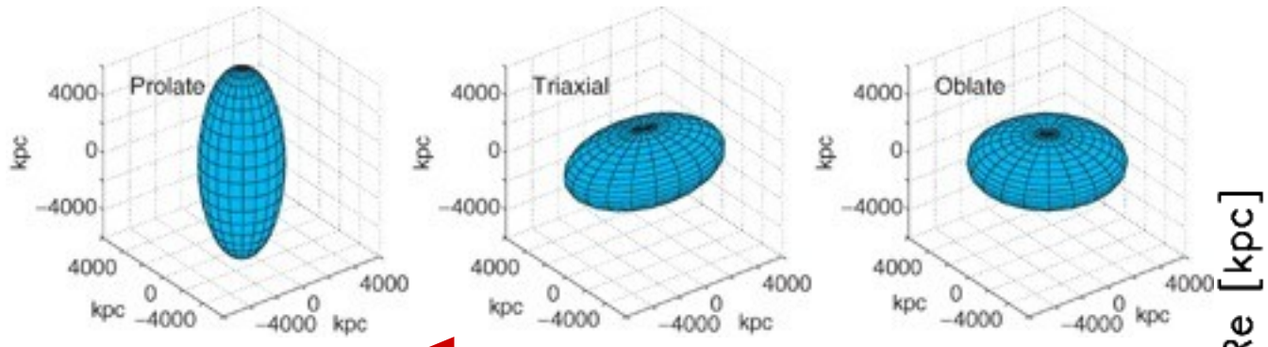
TYPE	#
Prolate-like	8
Oblate-like	5
Including > 3 KDC	
Non-rotators	1 (?)

First Results

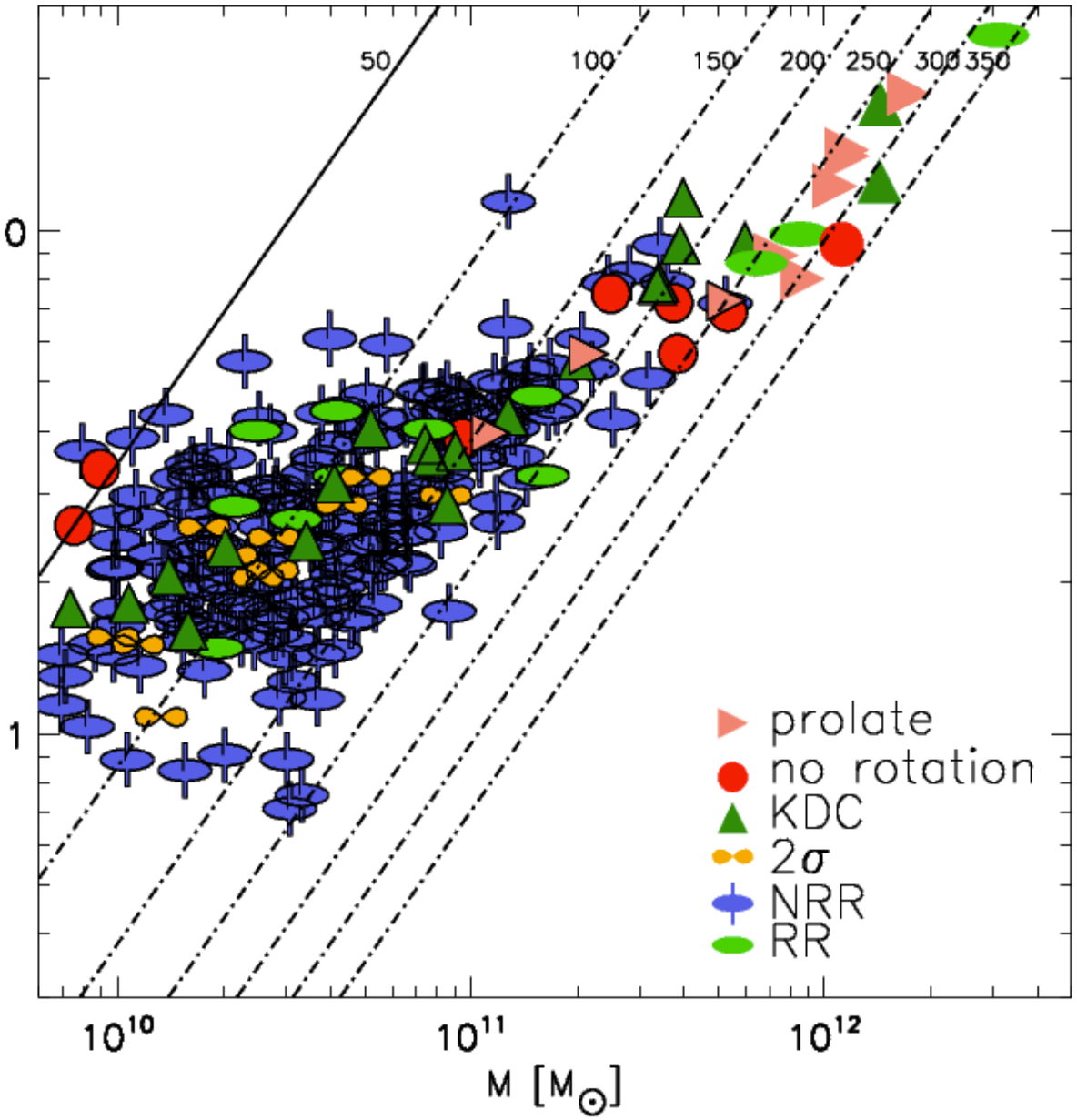
The morphology of galaxies change with mass

Oblate ⇒ Mildly Triaxial ⇒ Prolate ?

Geometry



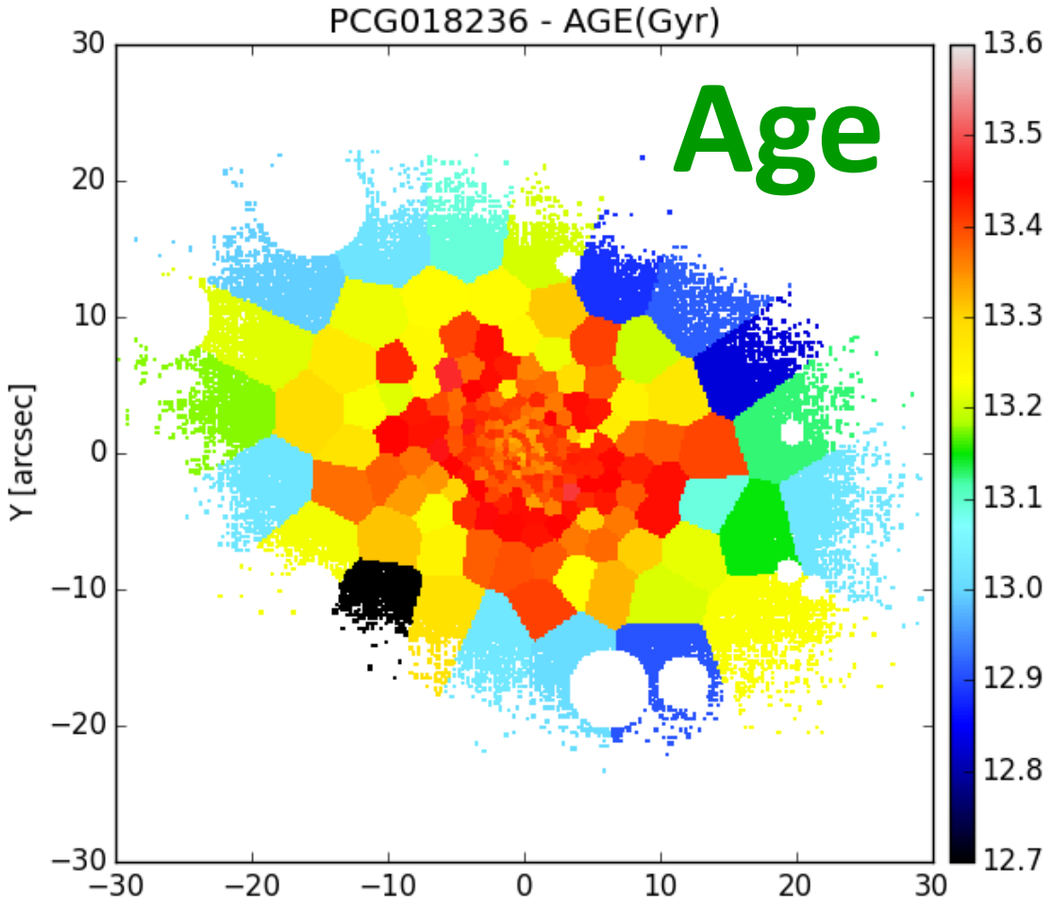
Mass

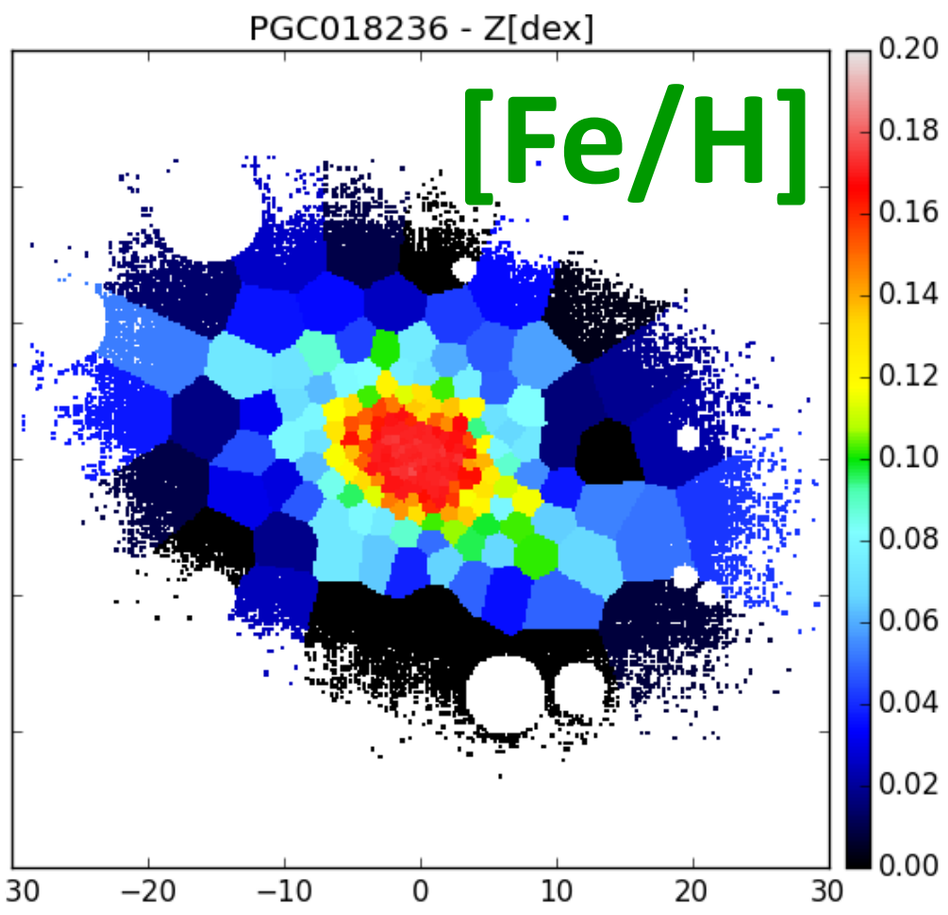


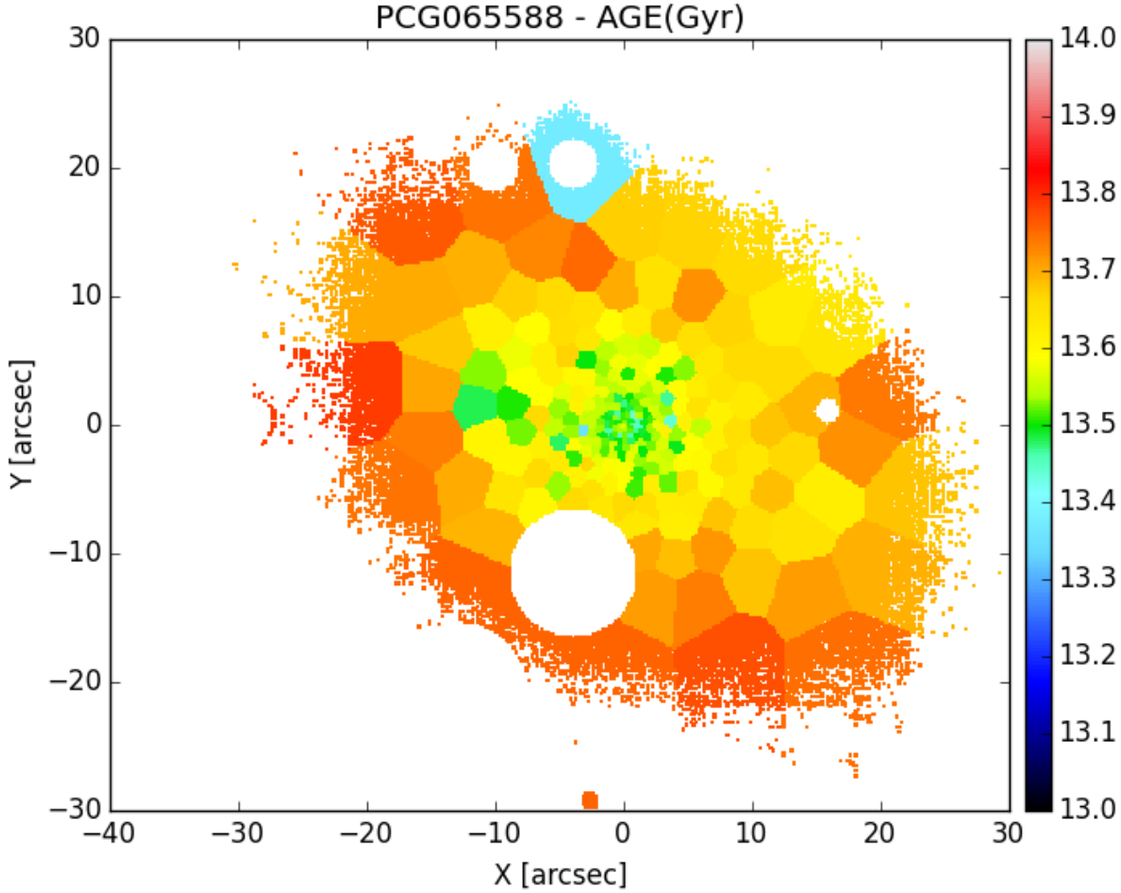
Questions

Dynamical models ?

Assembly history?


PCG018236 - AGE(Gyr)
Age
Y [arcsec]
X [arcsec]


PGC018236 - Z[dex]
[Fe/H]
X [arcsec]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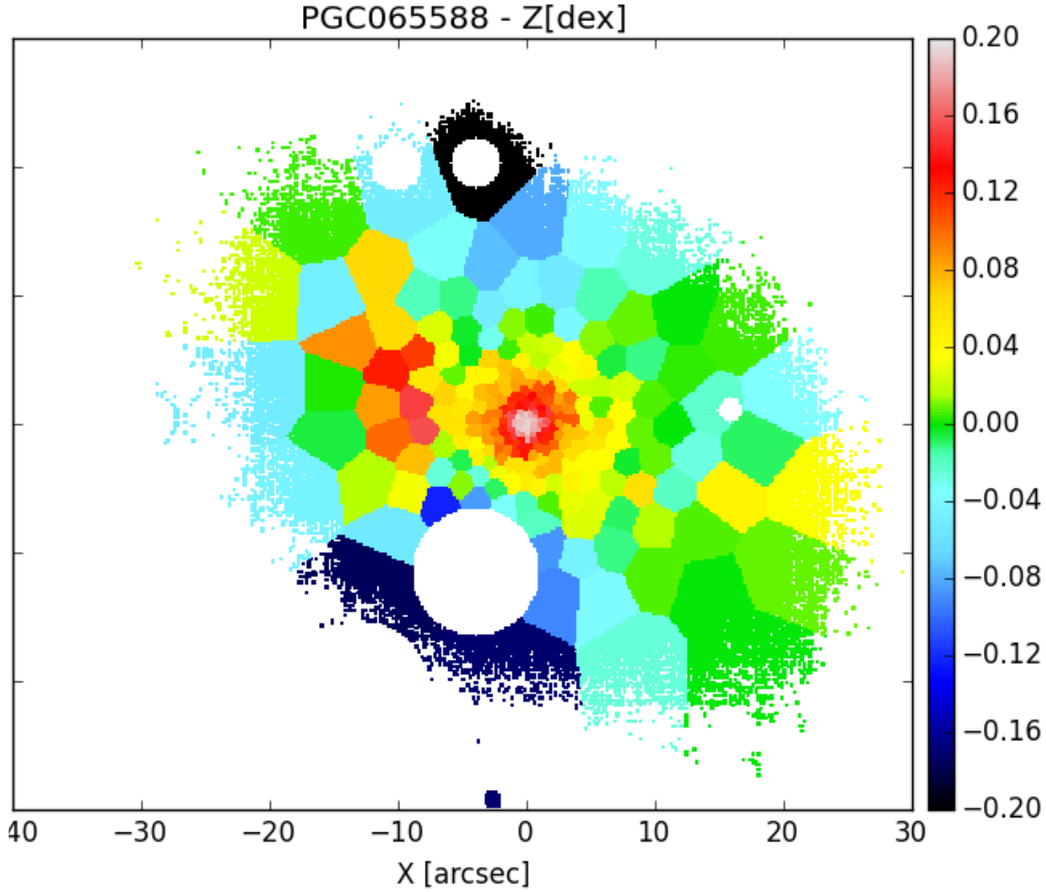
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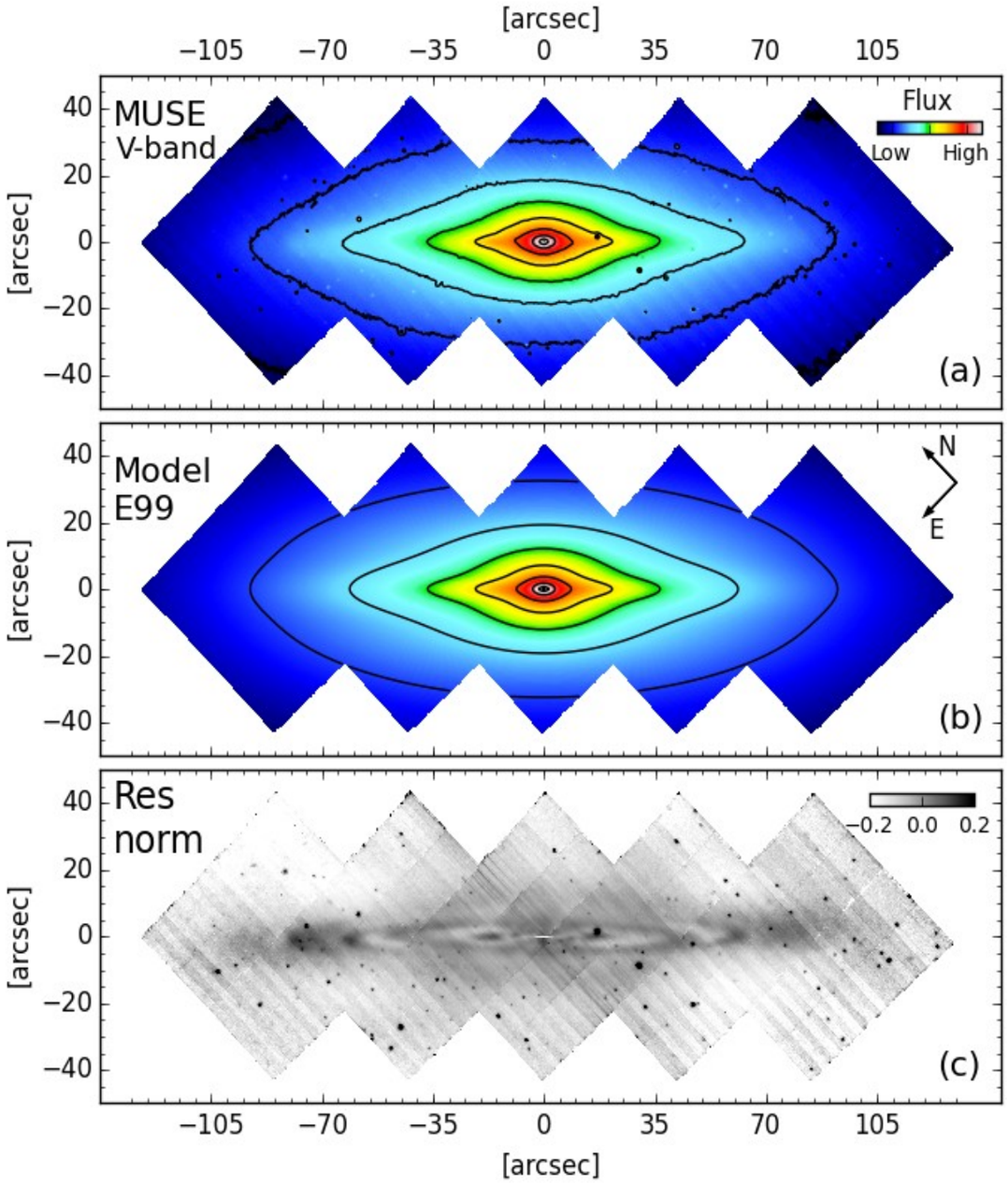
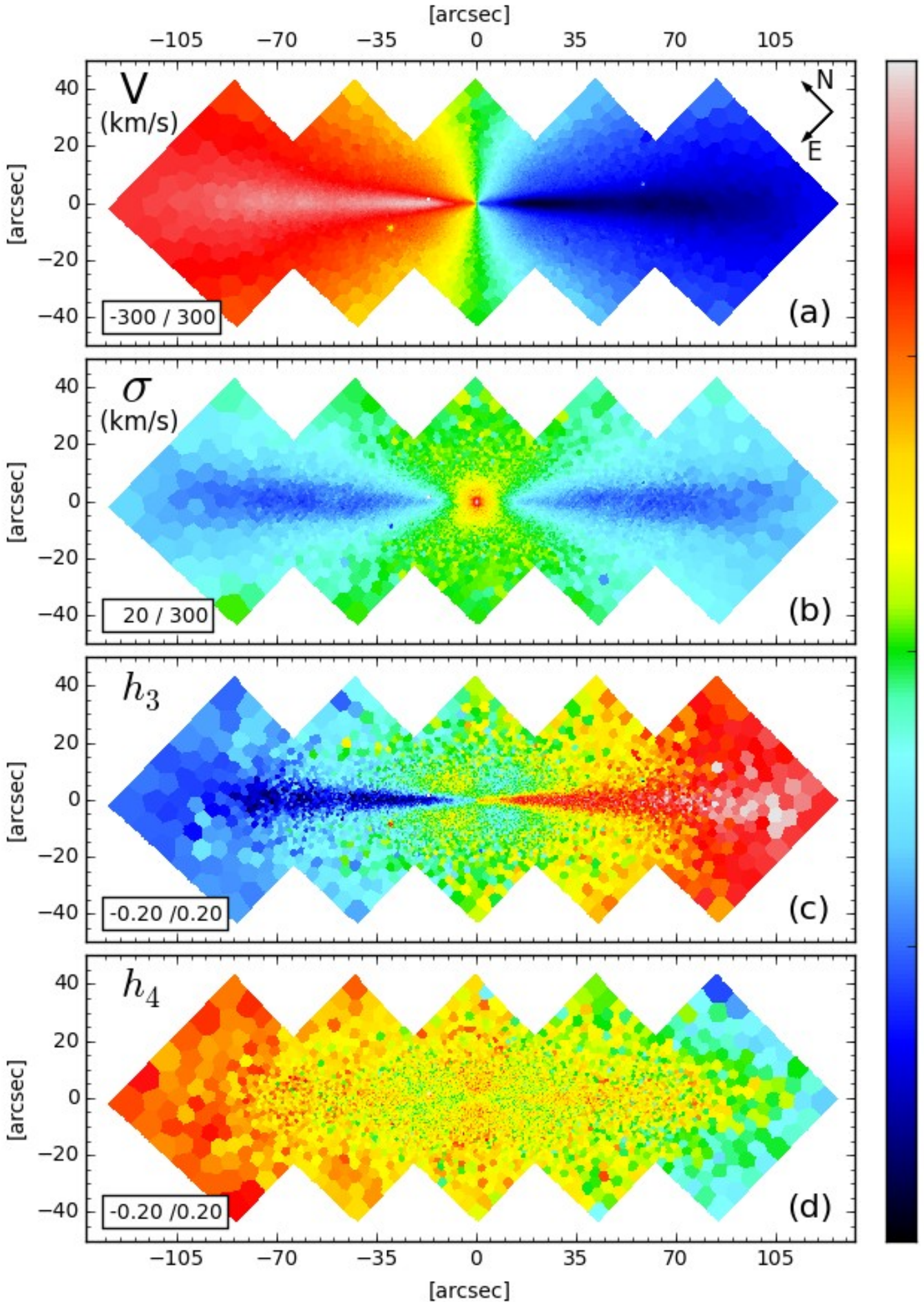
Mass Assembly

NGC 3115

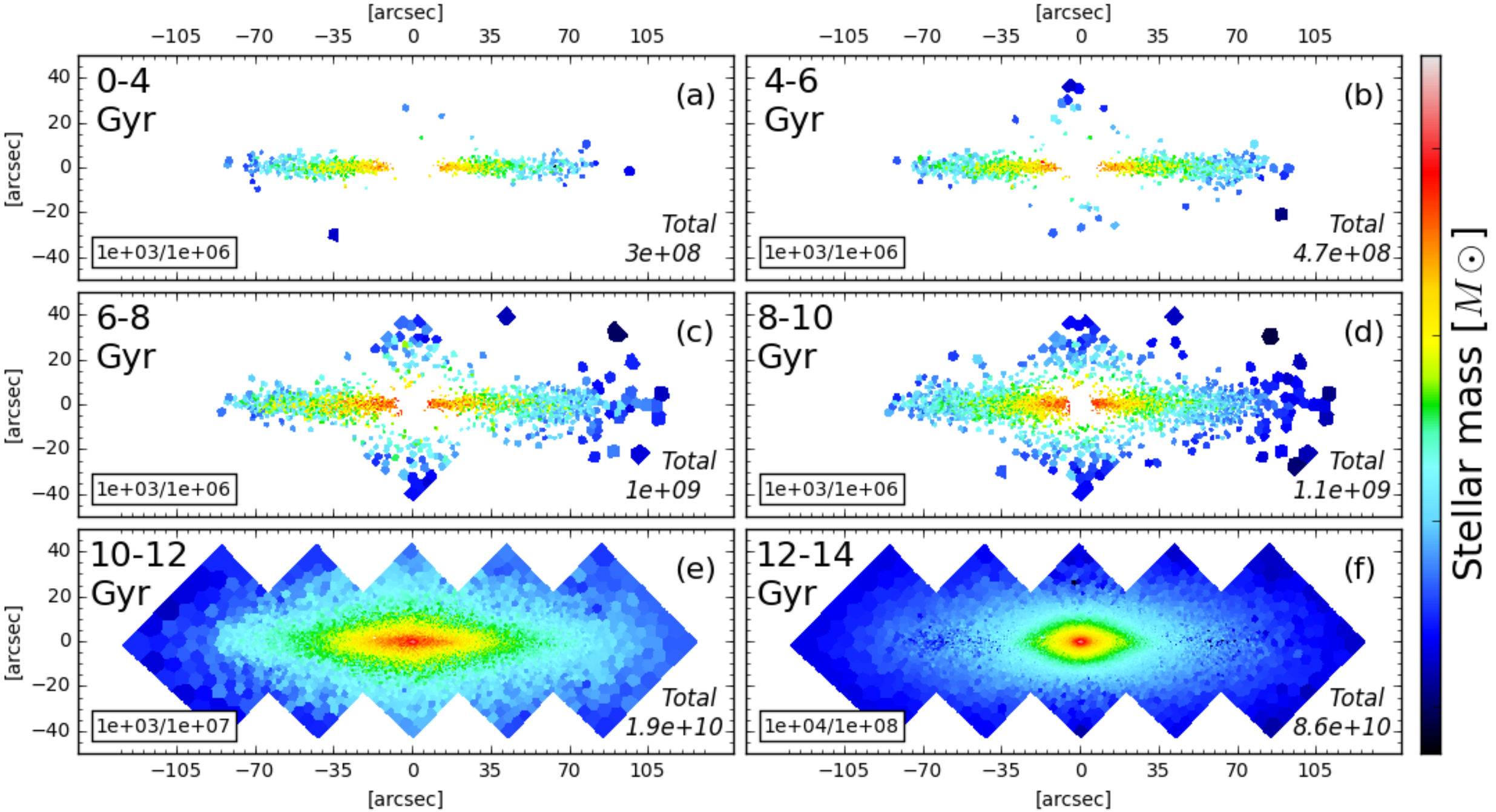




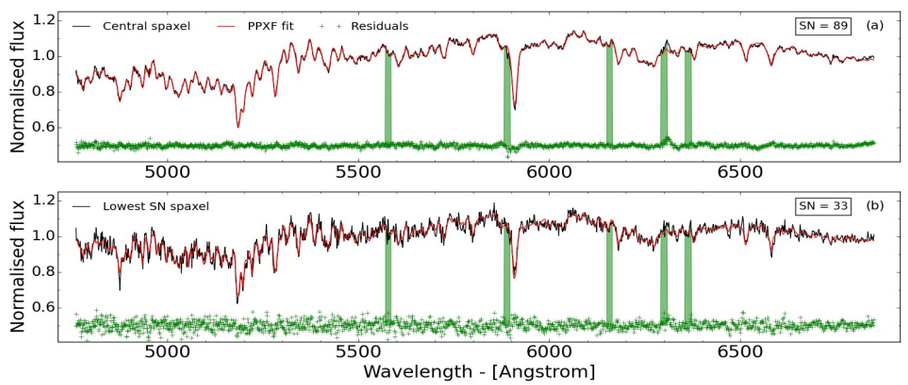
Guérou et al. 2016

Mass Assembly

NGC 3115



Guérou et al. 2016



How are we doing?

- **We have great tools !**
  - Zeroth order : Mass, scale
  - First order : velocity moments, age, metallicity

  - BUT → are we just getting V, σ, … for any galaxy we observe… ?

aren't we doing this since… 1990?

WHAT IS MISSING ?

- True coupling (dynamics/stellar pop) + new perspective

  Some (Tequila-weighted) ideas to be applied on M3G Galaxies

  ⇒ f[(x,y,z), M, t, [Fe/H], Ang. Mom.]

  (must be robust for comparisons with simulations)

Something new?

- At VERY high mass ⇒ Prolateness rules ! (?)
- Mass profile ⇒ transition to the cluster HALO
- Probing the mass assembly via spectral fitting