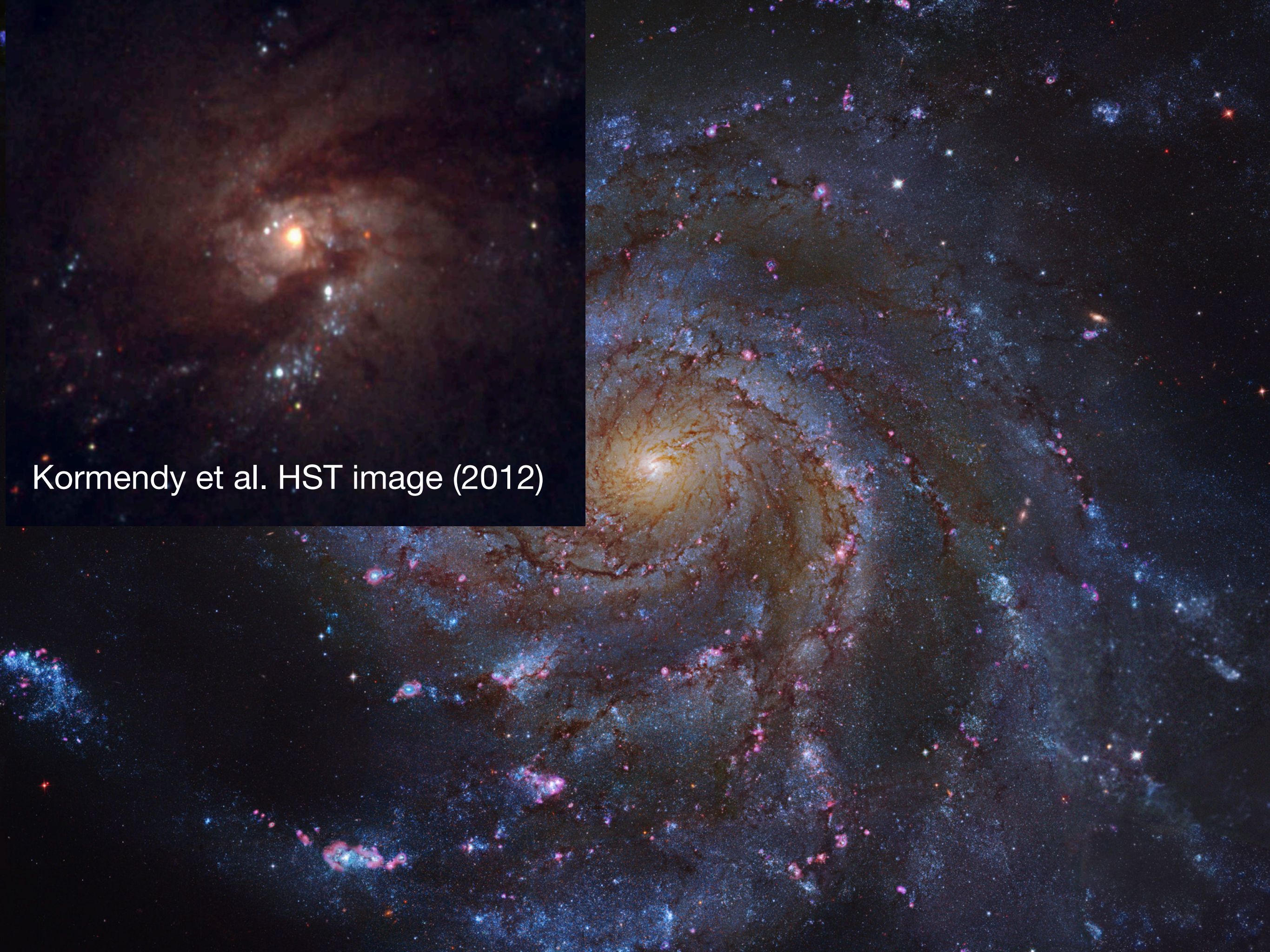


Kormendy et al. HST image (2012)



There are two common forms of galaxies, spirals and ellipticals.
Galaxy formation was a bistable process.



M 101



M 87

There are exceptions; they are important but not very common nearby

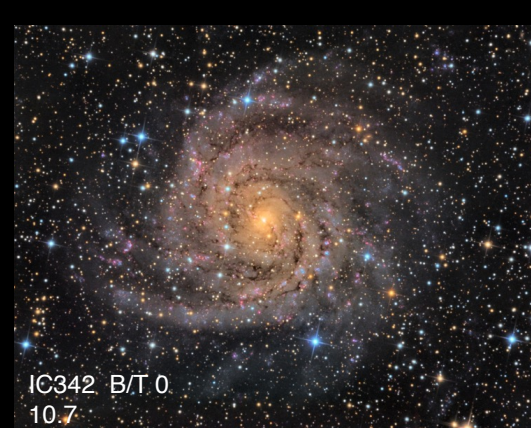




NGC 6946 B/T 0
11.0



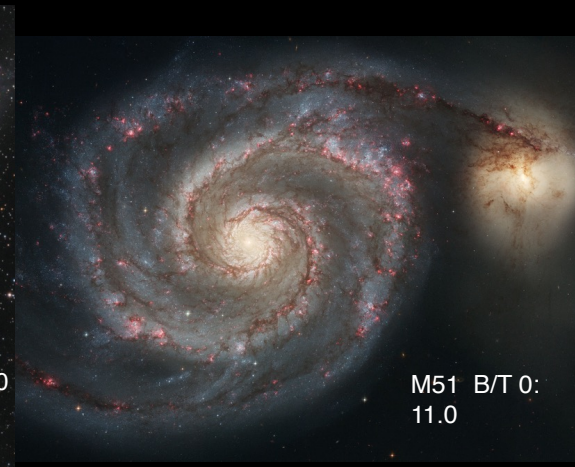
M 101 B/T 0
10.8



IC 342 B/T 0
10.7



N 4945 B/T 0
10.6



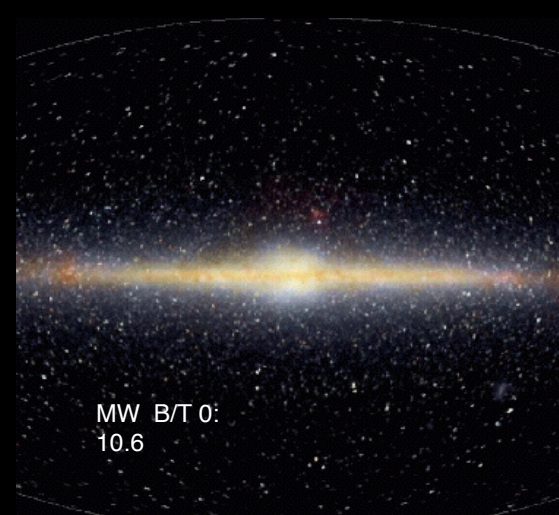
M 51 B/T 0
11.0



M 83 B/T 0
10.9



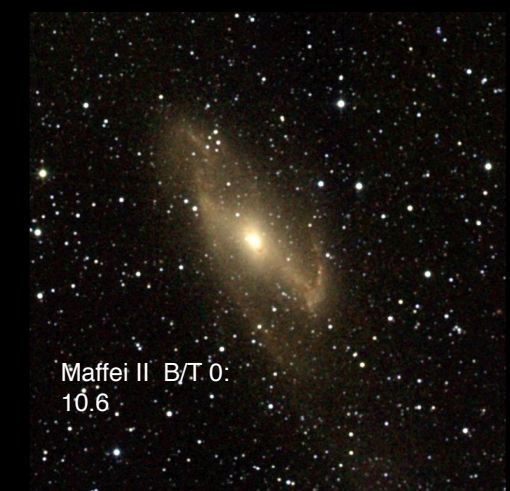
N 253 B/T 0
10.9



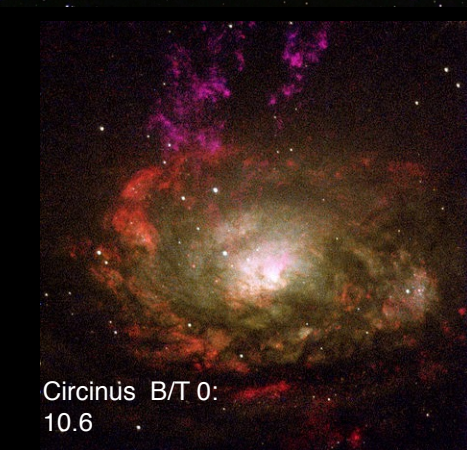
MW B/T 0
10.6



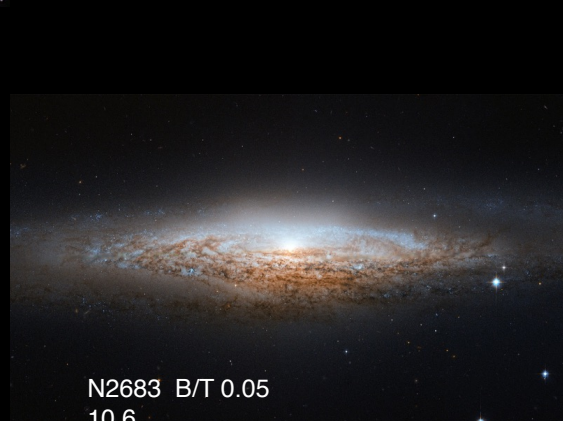
M 94 B/T 0
10.6



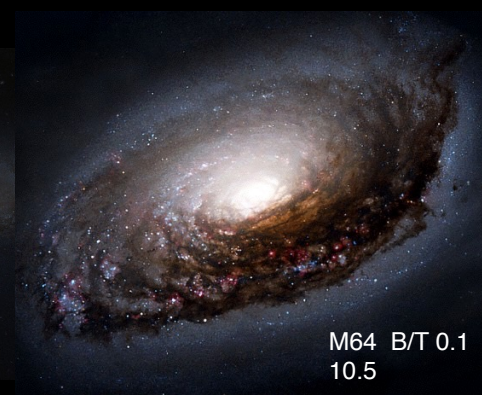
Maffei II B/T 0
10.6



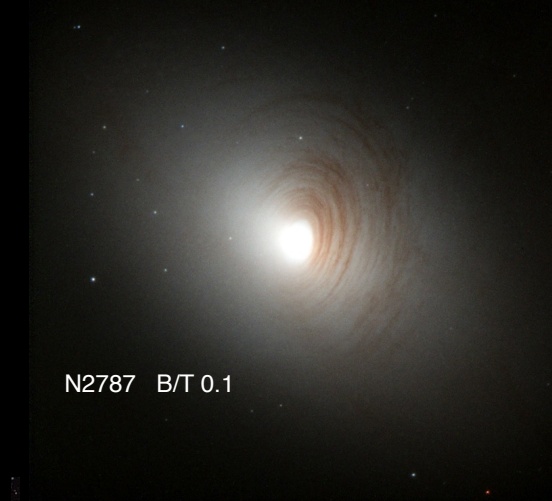
Circinus B/T 0
10.6



N 2683 B/T 0.05
10.6



M 64 B/T 0.1
10.5



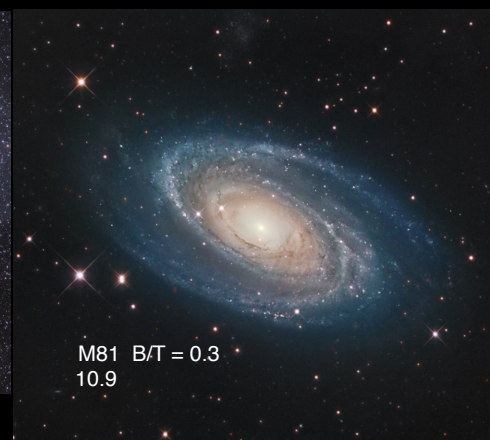
N 2787 B/T 0.1



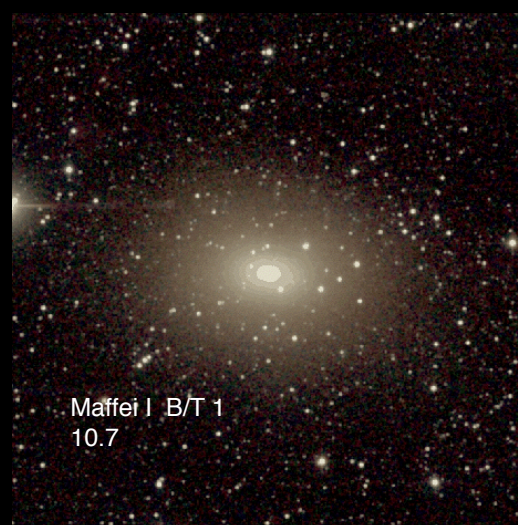
M 106 B/T 0.1
10.9



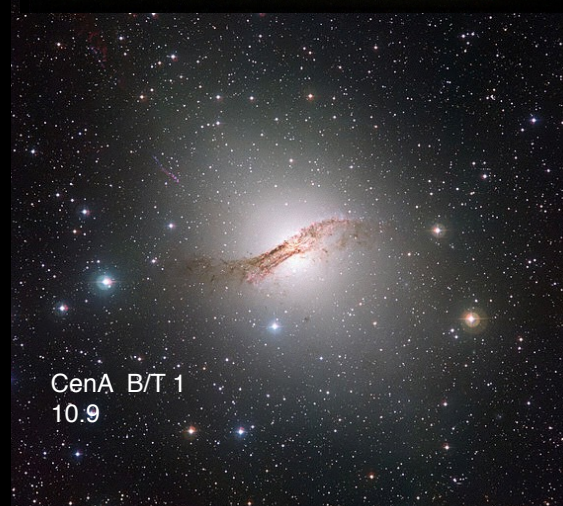
M 31 B/T 0.3
10.7



M 81 B/T = 0.3
10.9



Maffei I B/T 1
10.7



Cen A B/T 1
10.9

The 19 galaxies with
Kormendy et al. B/T,
 $D < 10$ Mpc,
 $L_K > 10^{10.5}$.



N4559 B/T 0



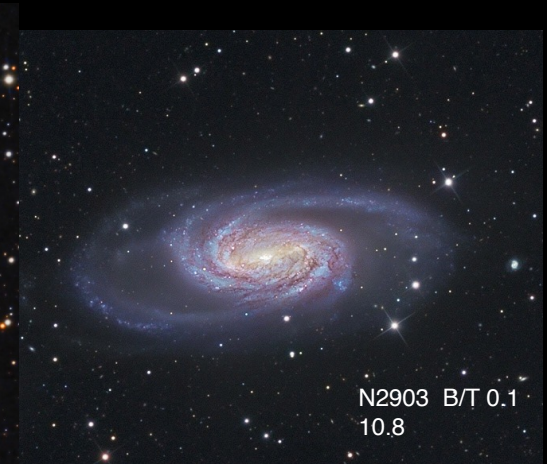
N463
10.4



M82 B/T 0
10.6



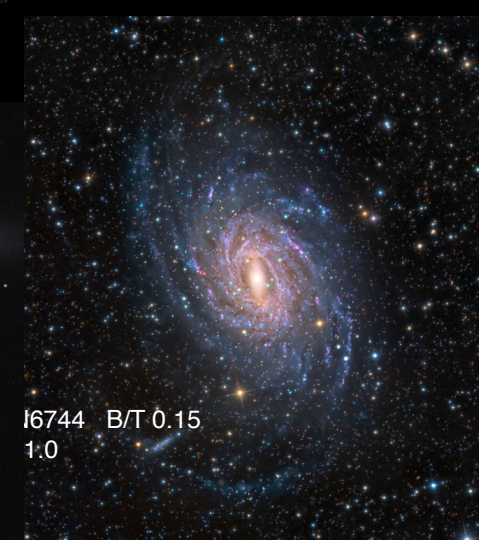
N925 B/T 0.1
10.1



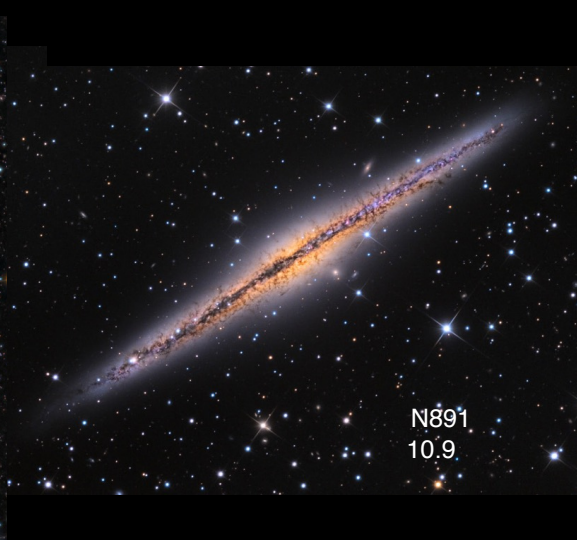
N2903 B/T 0.1
10.8



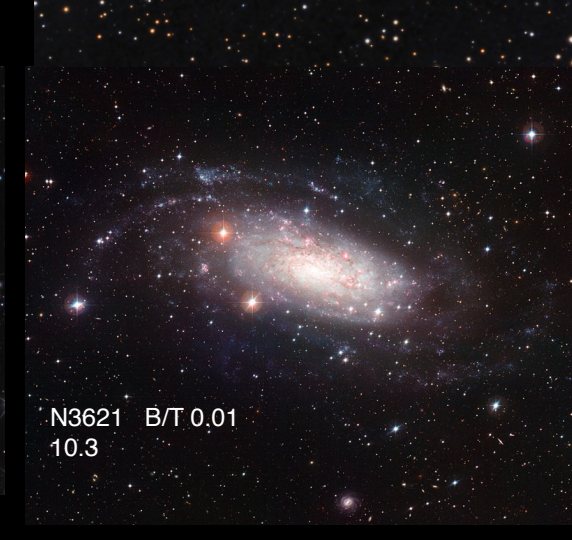
N4517
10.2



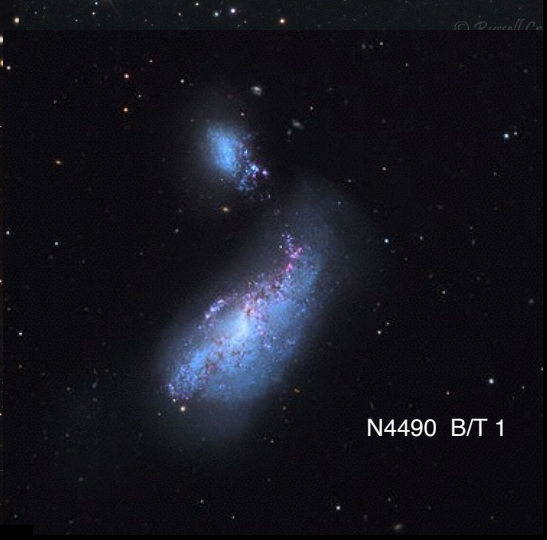
I6744 B/T 0.15
1.0



N891
10.9



N3621 B/T 0.01
10.3



N4490 B/T 1



N3344 B/T 0.1
10.3



M66 B/T 0.1



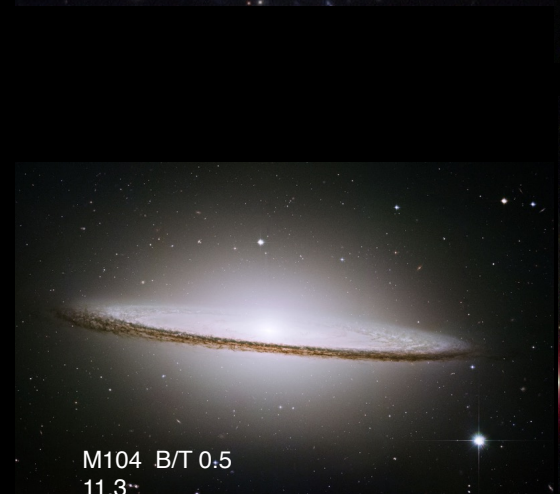
M63 B/T = 0.2
10.9



M108 B/T 0.2



M96 B/D 0.3



M104 B/T 0.5
11.3



N2784
10.8



N2640
10.9



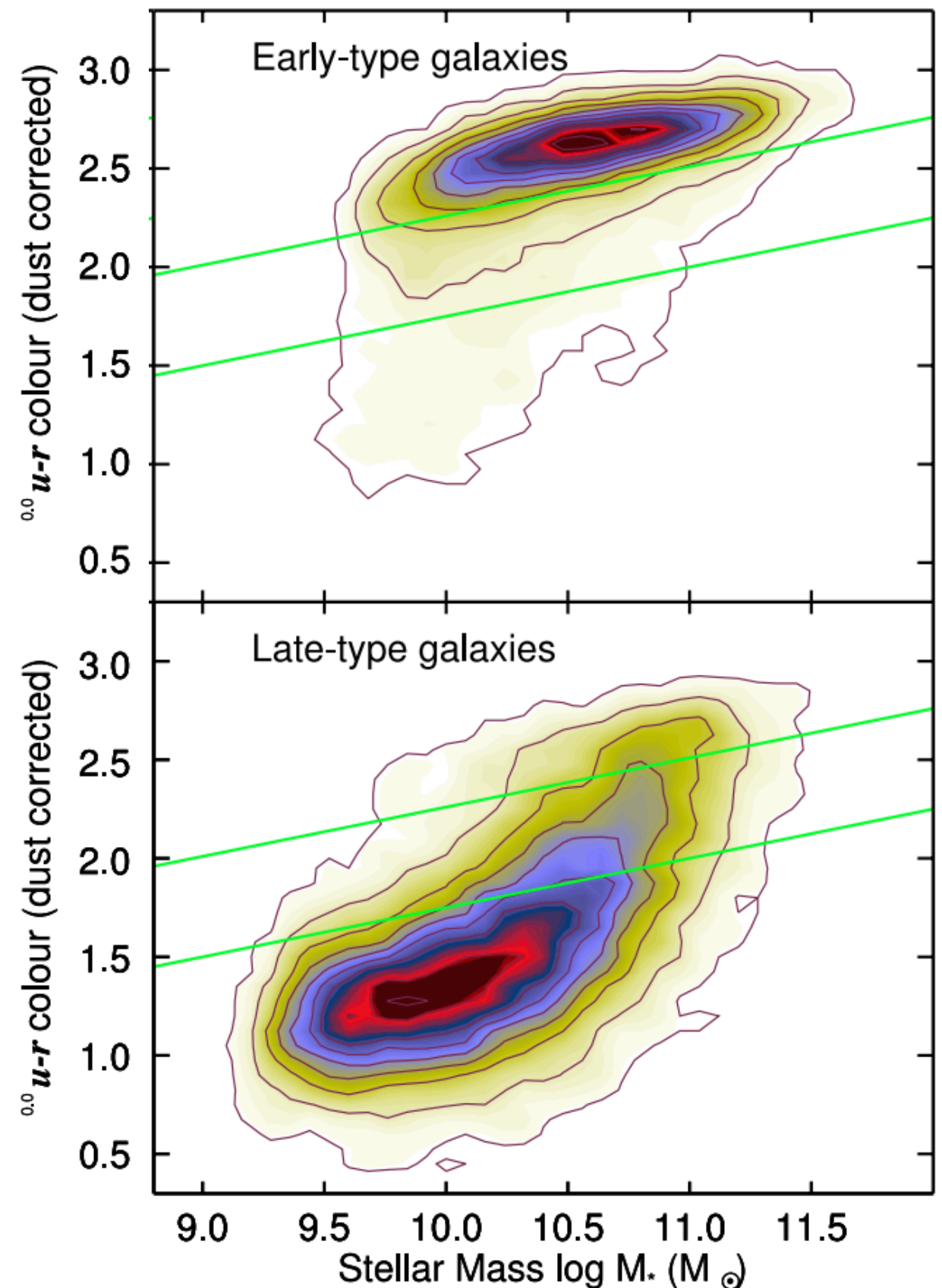
M105 B/T 1
11.3

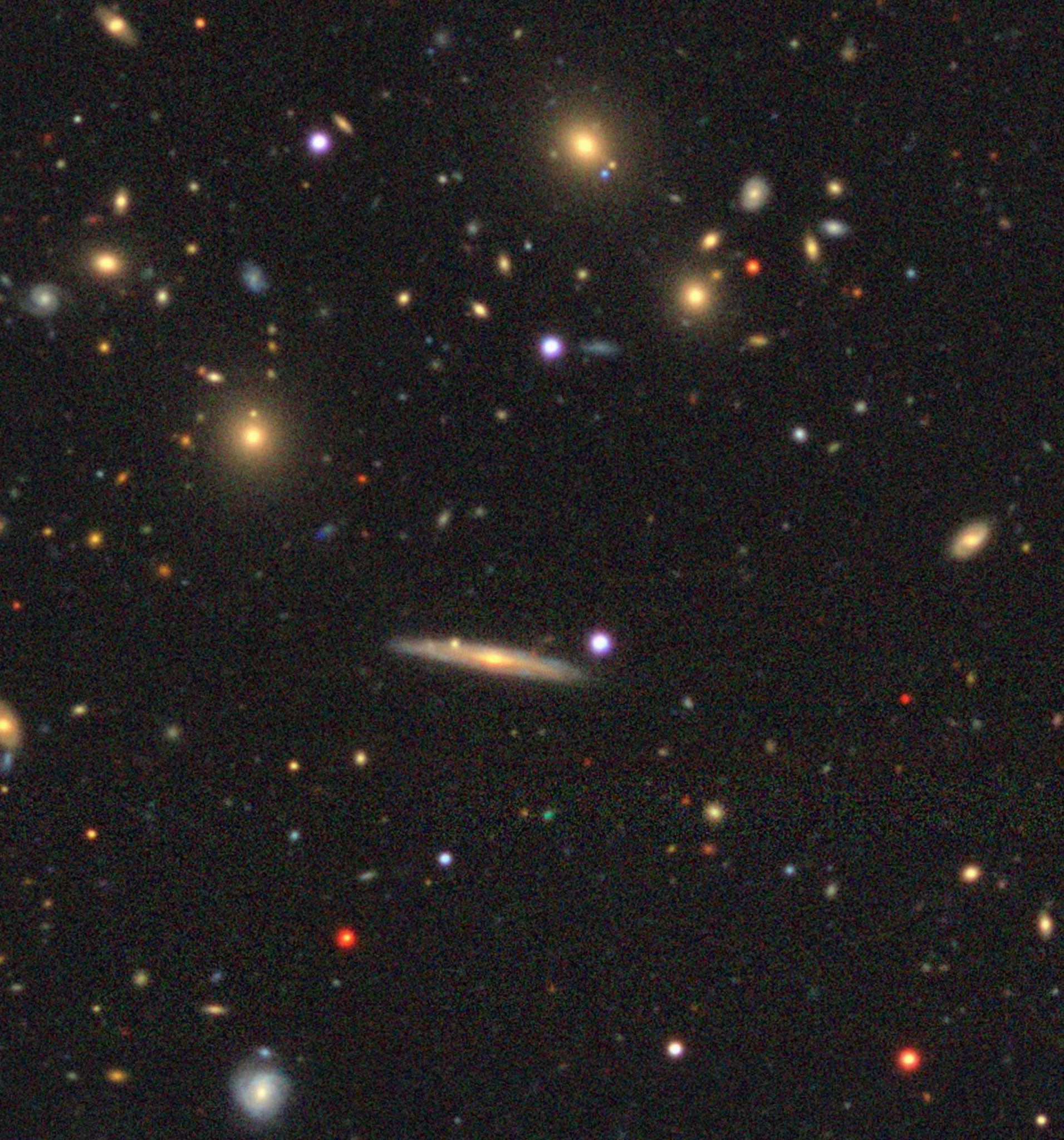
19 more galaxies at
 $D < 10$ Mpc,
 $L_K > 10^{10}$,
some with Fisher and
Drory B/T

Megan Urry

and colleagues used the Galaxy Zoo citizen science project “which assigns a morphology to a galaxy when 80 per cent or more of Galaxy Zoo users agreed on the classification.” They find that, for their sample of some one million galaxies, “18 per cent are early types, 34 per cent are late types and 45 per cent are indeterminate types. The remaining 3 per cent are mergers.” Urry tells me that most of the indeterminate ones are spirals with prominent bulges of stars; later types.

So what is the separatrix?





Mass does not seem to be the separatrix.

There are spirals with stellar masses comparable to giant ellipticals, as in this image. There are ellipticals and spirals with masses a tenth of the Milky Way.

Legacy Sky Survey
image, data, and advice
courtesy of Patrick Ogle,
Space Telescope
Science Institute.

redshift $z = 0.15$

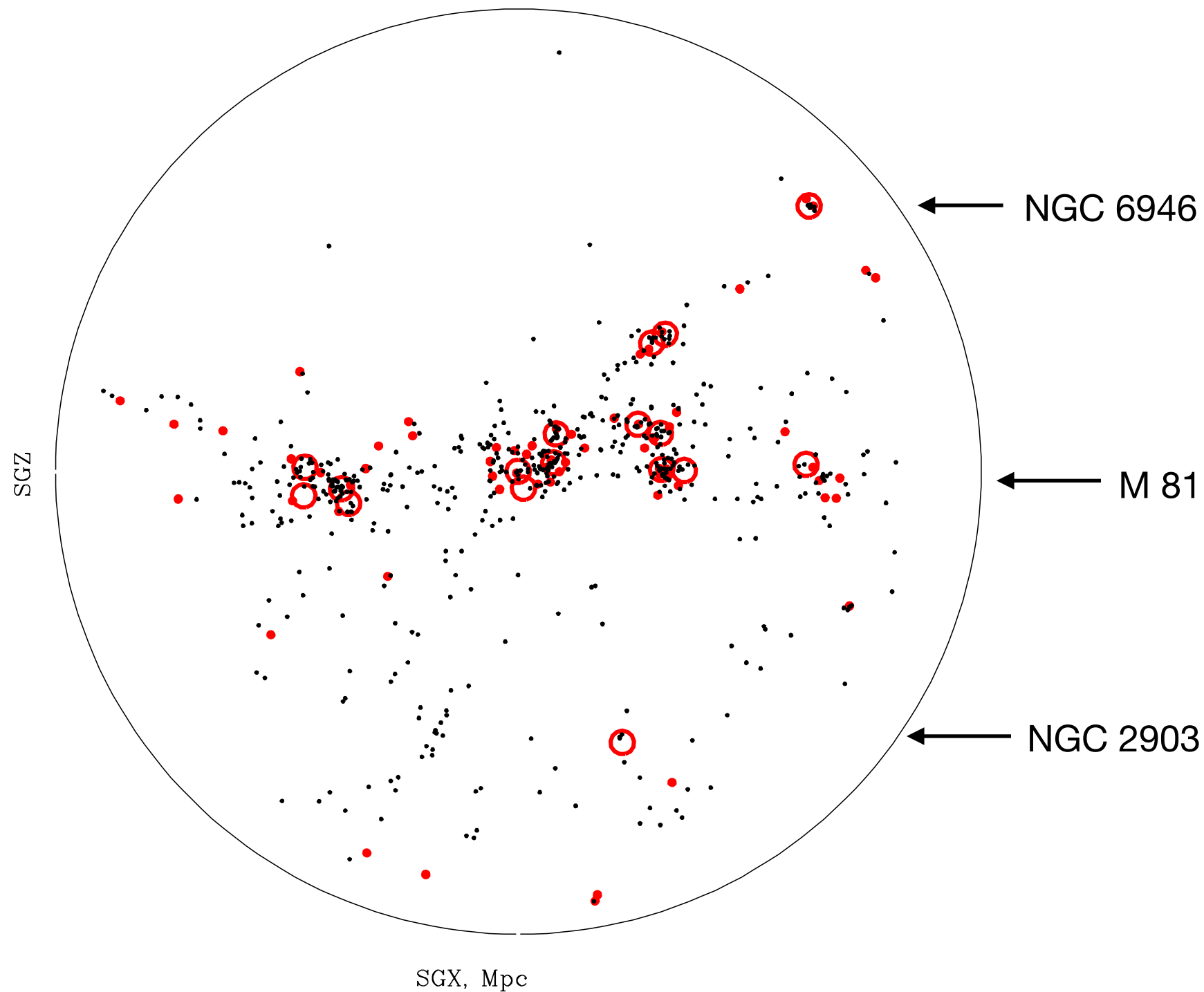
$R_{25} = 72 \text{ kpc}$

$v_{\text{rot}} = 465 \text{ km s}^{-1}$

$$\begin{aligned} M_{25} &\sim v_{\text{rot}}^2 R_{25} / G \\ &\sim 3 \times 10^{12} M_{\odot} \end{aligned}$$

Environment does not seem to be the separatrix.

Nearby spirals are in a considerable variety of environments.

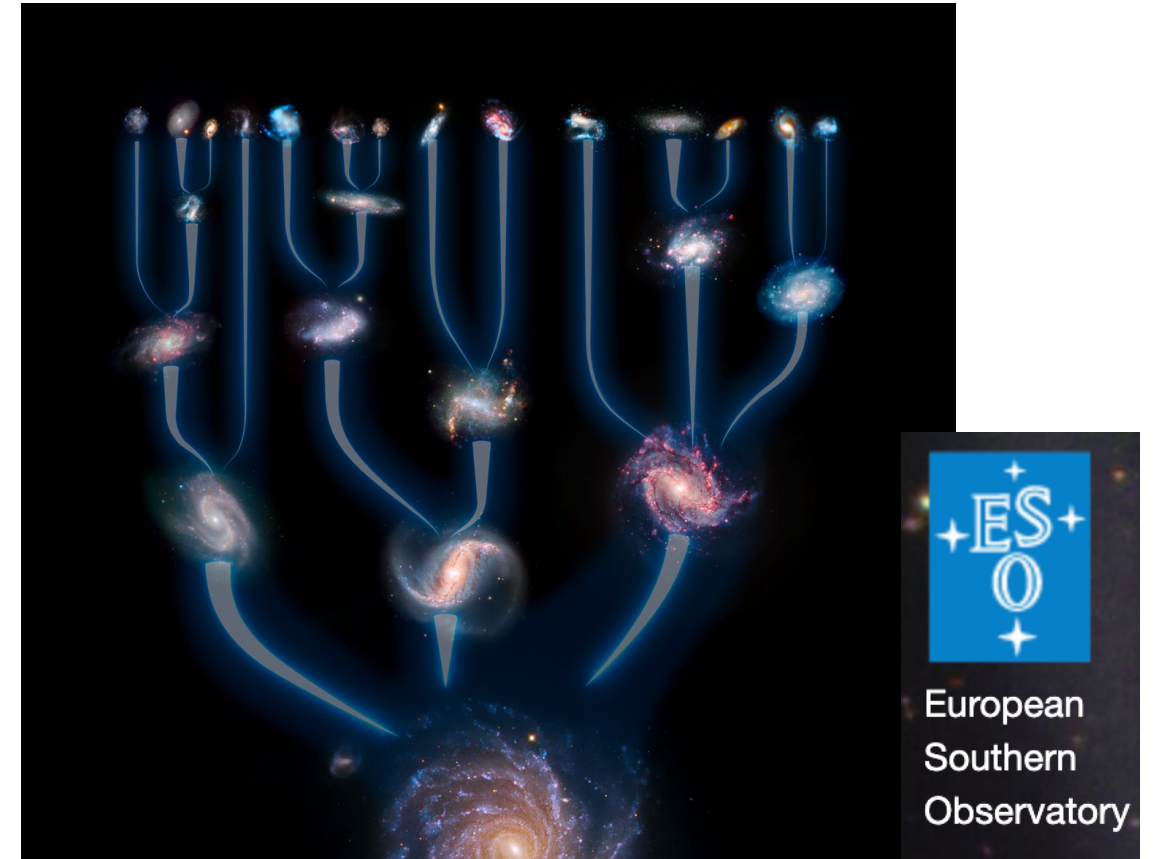
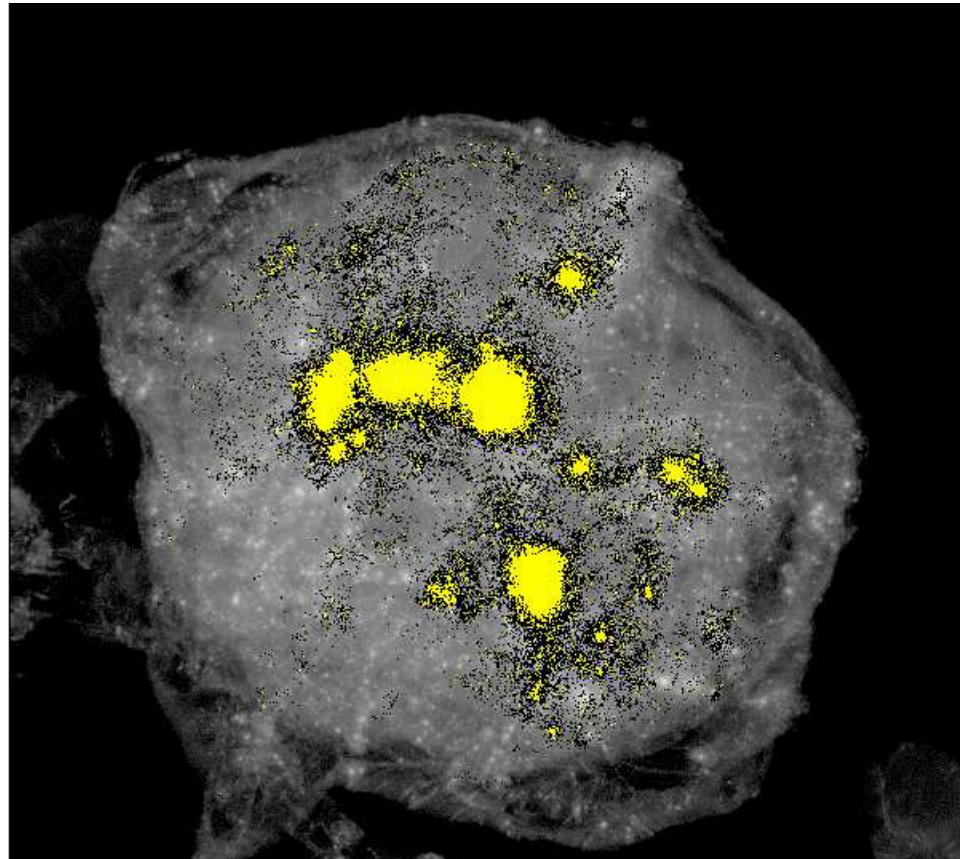


These are the known galaxies closer than 9 Mpc and more luminous than $M_B = -10$. The open red circles mark the most luminous.



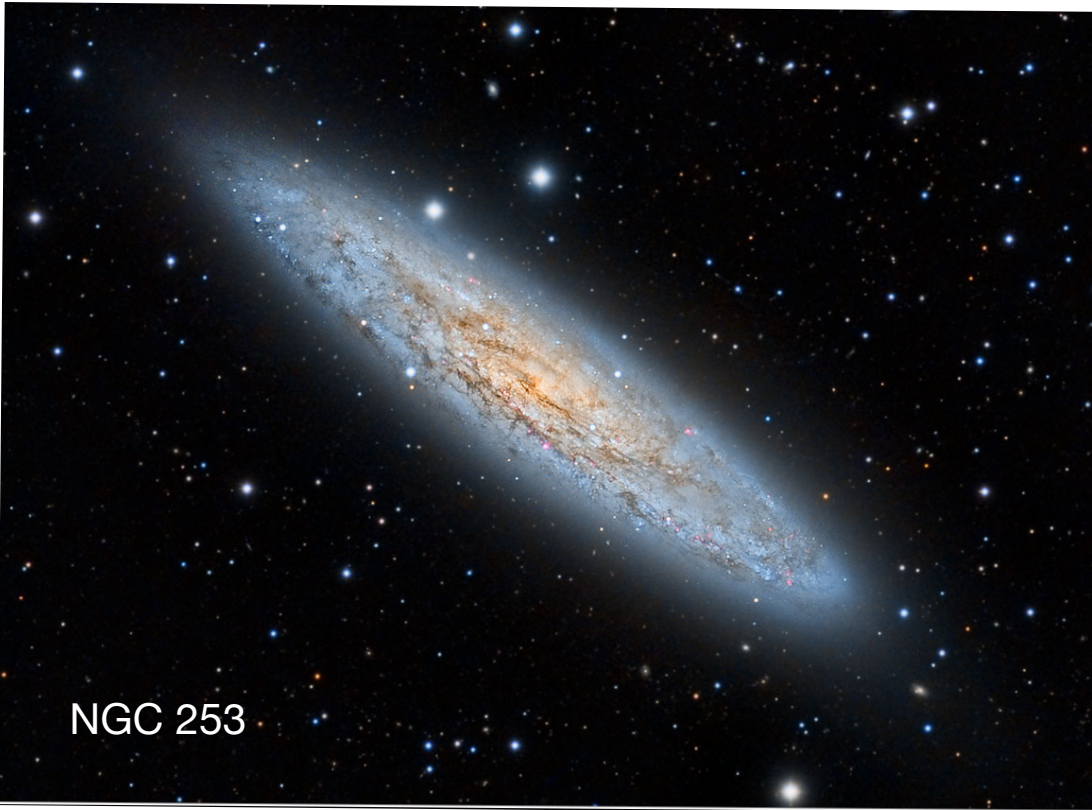
The Halo Merger Tree

$z=3.1$



Auriga simulation, image by Jie Wang

The merger tree paradigm is inspired by the standard Λ CDM theory. It is influential; ADS astronomy lists “merger tree,” with comments about galaxies, in the contents of 327 papers in 2022, 268 papers in 2021, 274 papers in 2020.

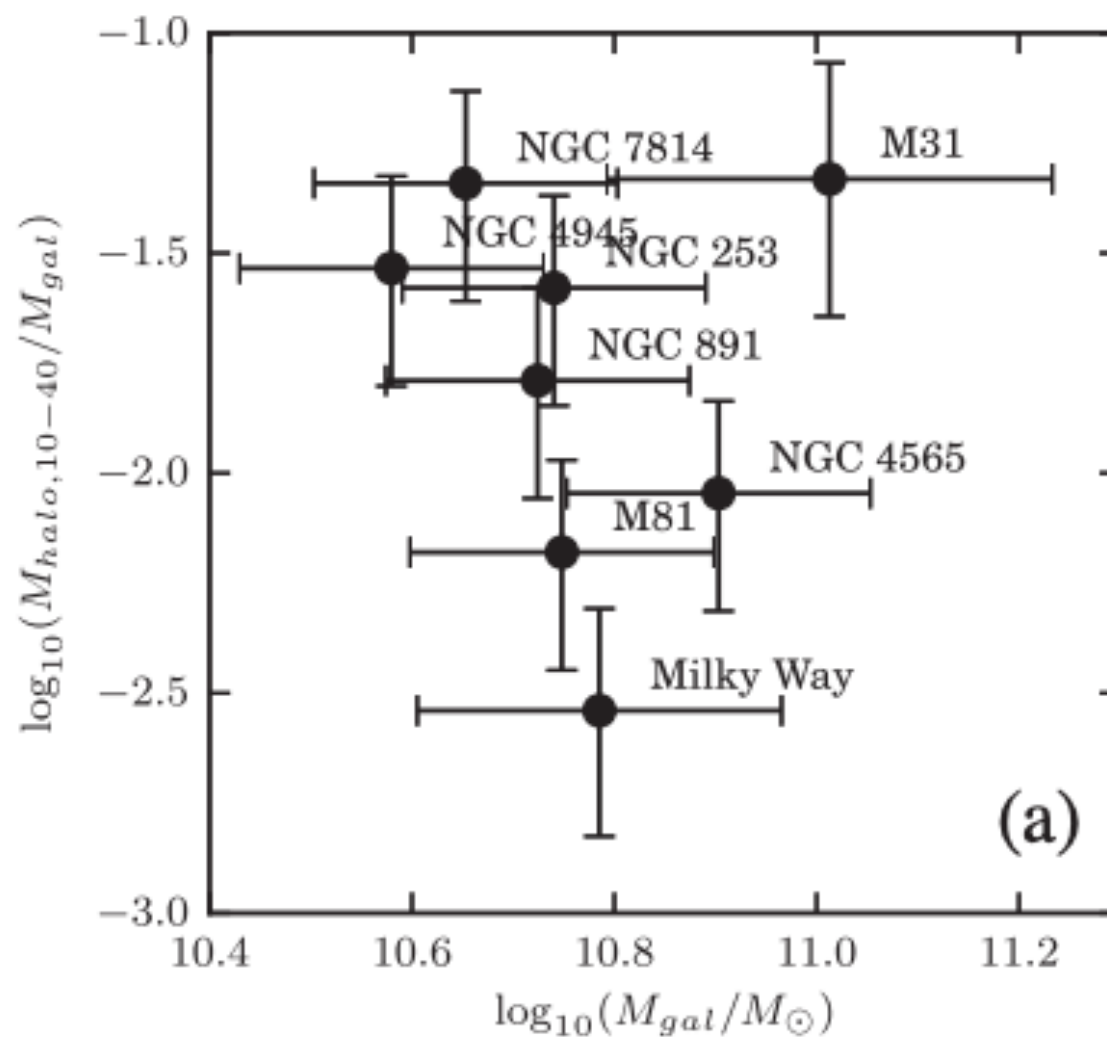


NGC 253

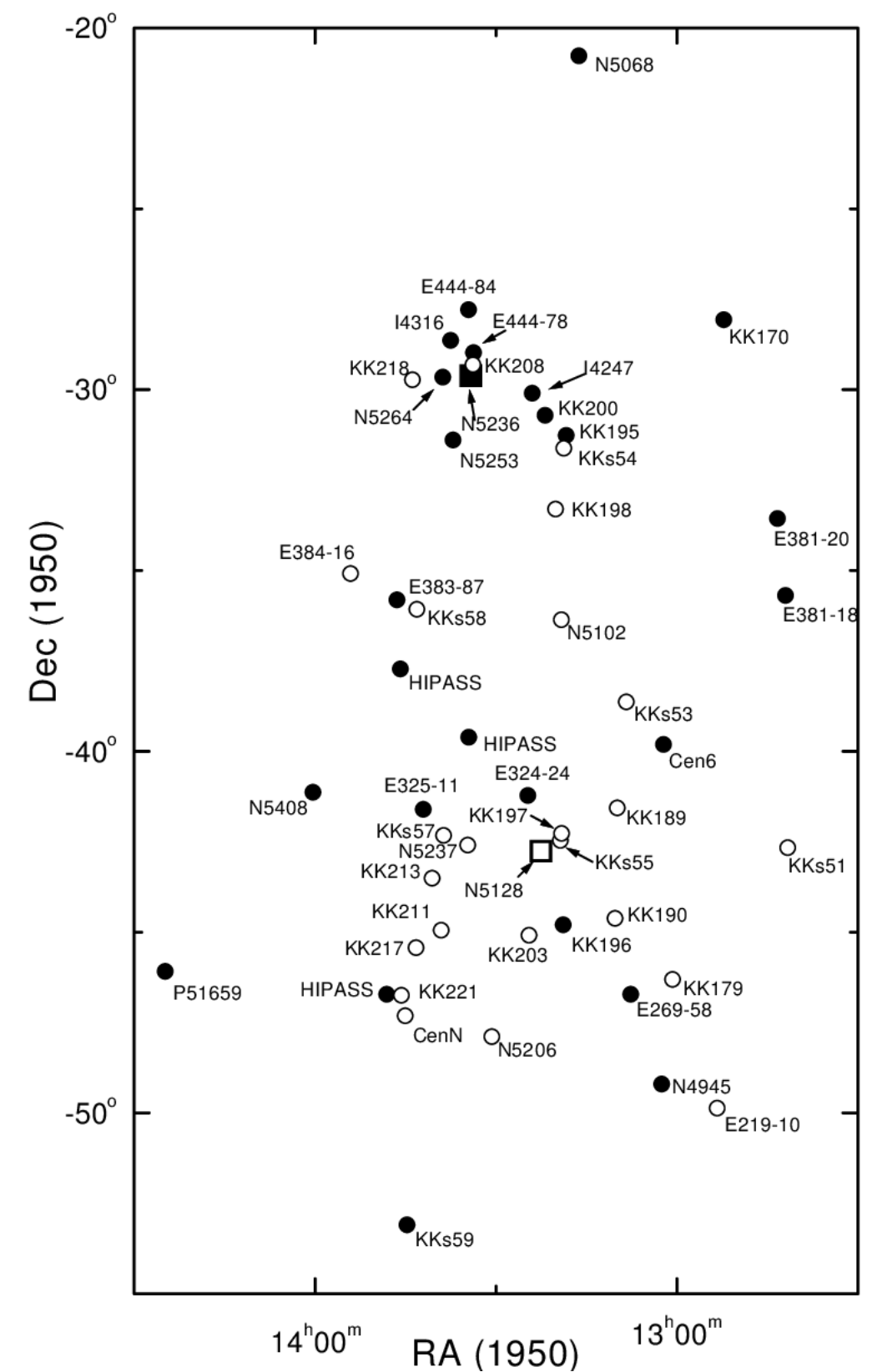


Diverse stellar haloes in nearby Milky Way mass disc galaxies

Benjamin Harmsen,^{1★} Antonela Monachesi,^{2★} Eric F. Bell,^{1★} Roelof S. de Jong,³
Jeremy Bailin,^{4,5} David J. Radburn-Smith⁶ and Benne W. Holwerda⁷



It is said that ellipticals formed by dry mergers, spirals by wet mergers



Karachentsev et al. 2002

The open and filled circles are early- and late-type galaxies.