Evidence for the concurrent growth of thick discs and central mass concentrations from S^{4}G imaging

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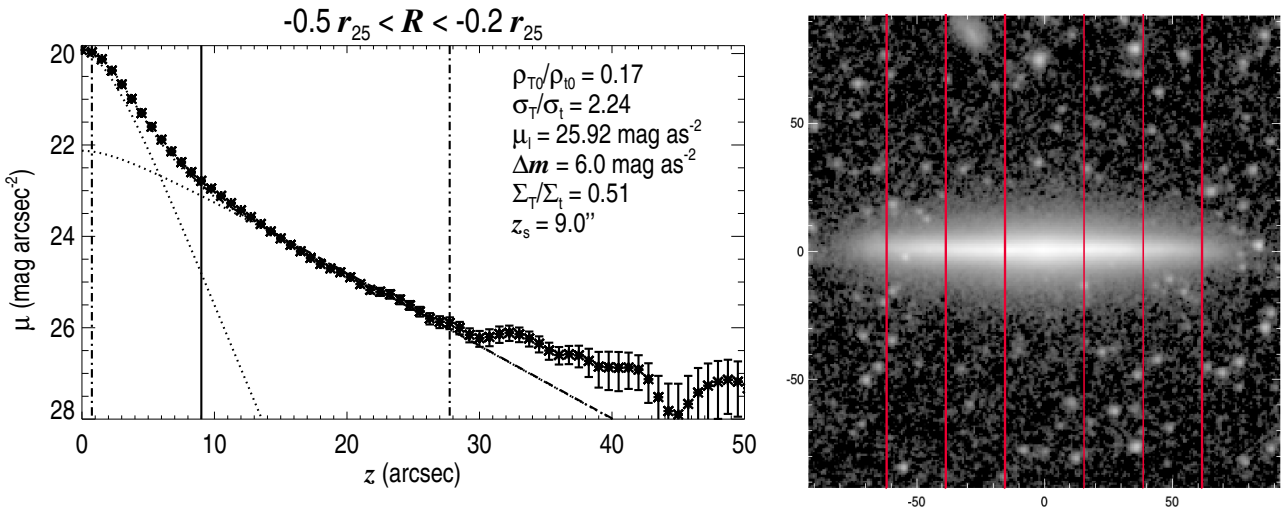
Thick discs

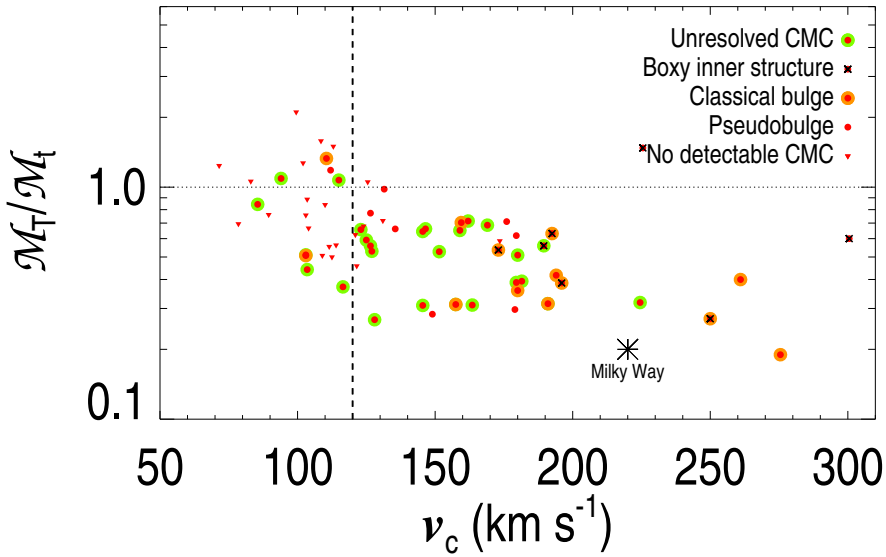
- Exponential excesses of light above the canonical thin disc.
- Controversial origin:
  - Internal/External?
  - Fast/Secular?



Comerón et al. (2012, ApJ, 758, 98)

Thick to thin disc mass ratios ($\mathcal{M}_T/\mathcal{M}_t$)

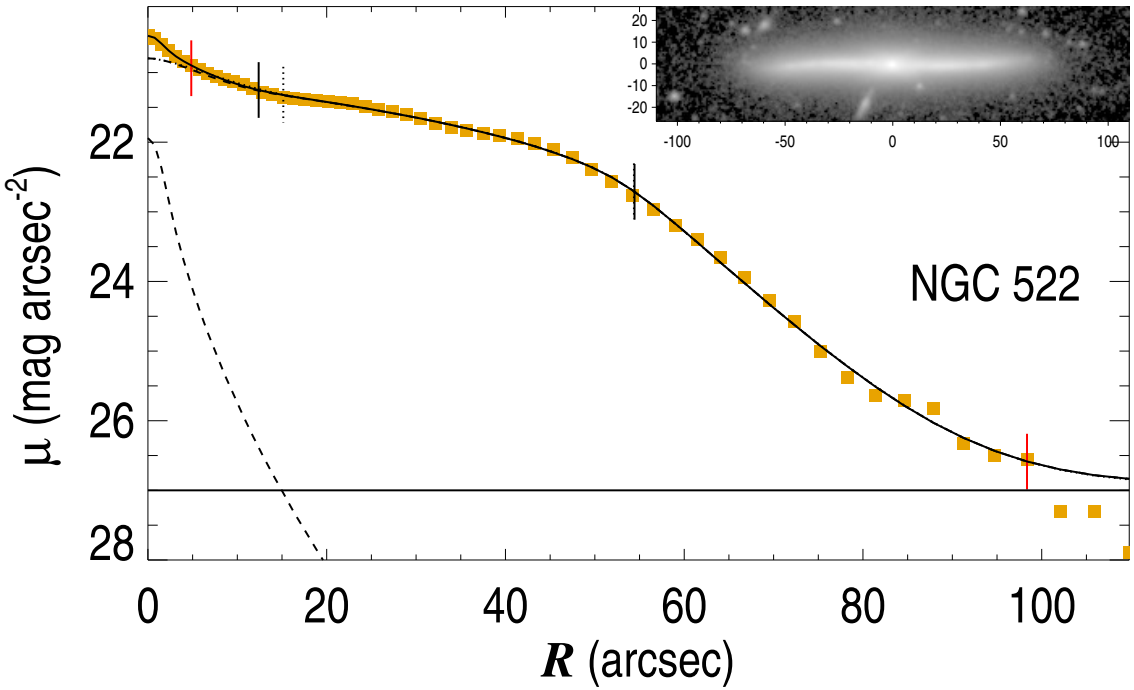
- We studied a sample of 69 edge-on galaxies in the S^{4}G.
- $\mathcal{M}_T/\mathcal{M}_t$ is roughly constant and similar to that in the Milky Way for $v_c \gtrsim 120\,\mathrm{km\,s^{-1}}$.
- $\mathcal{M}_T/\mathcal{M}_t$ is much larger than in the Milky Way for $v_c \lesssim 120\,\mathrm{km\,s^{-1}}$.



Comerón et al. (2014, accepted in A&A)

The mass of Central Mass Concentrations ($\mathcal{M}_{\rm CMC}$)

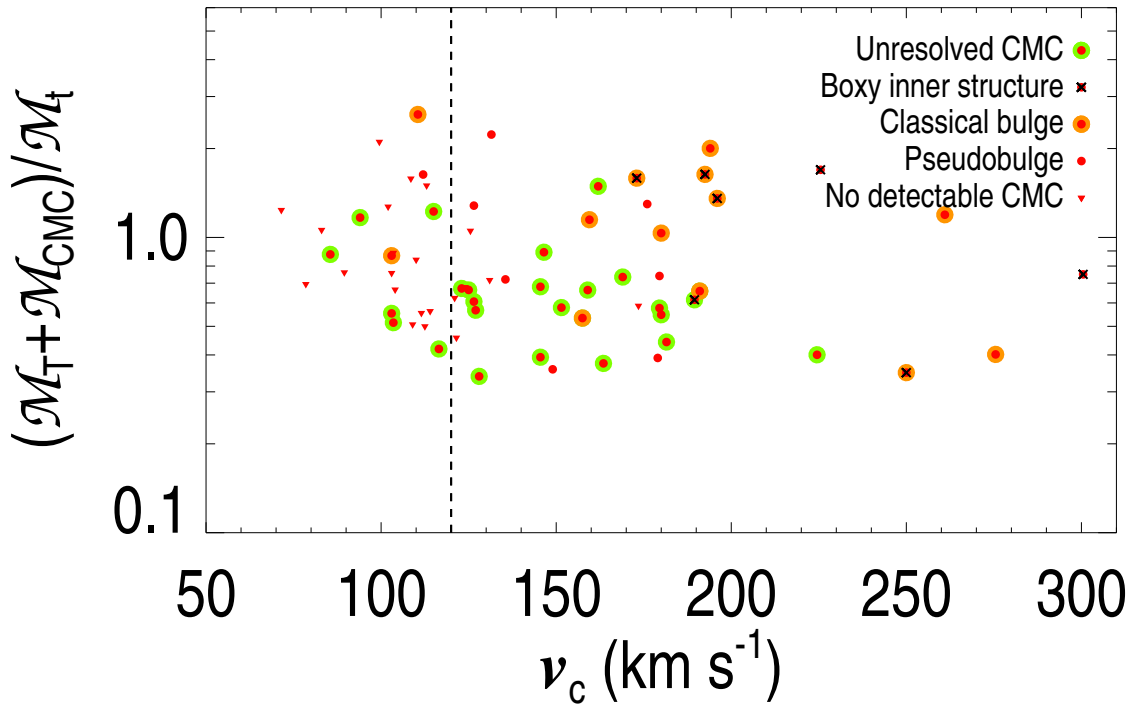
- We can measure the mass of CMCs by fitting a superposition of an exponential disc and a Sérsic function.



Comerón et al. (2014, accepted in A&A)

Mass ratio between hot and cold components

- Dynamically cold components are the thin discs.
- Dynamically hot components are the thick discs and the CMCs.



Comerón et al. (2014, accepted in A&A)

Scale-height of discs as a function of their SF intensity

In a single disc:

$$\dot{\Sigma}_\star \approx \frac{\epsilon_{\rm orb}}{t_{\rm orb}} \frac{2(\beta+1)\Omega^2}{\pi G Q^2} z_0$$

$$z_0 \propto \dot{\Sigma}_\star$$

From Krumholz et al. (2012, ApJ, 745, 69) SF model

Evidence that discs at high redshift were thick

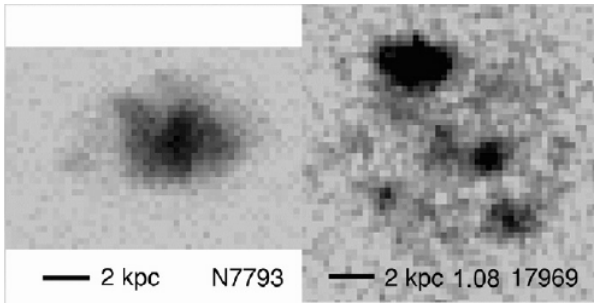
The thickness of a single-component disc is:

$$z_0 = \sigma_z^2/(\pi G \Sigma).$$

The size of the Jeans' wavenumber in a disc is:

$$\lambda_J = \sigma^2/(\pi G \Sigma).$$

The most massive clumps sink because of dynamical friction and form the CMC?



Elmegreen et al. (2009, ApJ, 701, 306)

The scale-height of the SF layer varies with time

- According to the toy model by Dekel et al. (2013, MNRAS, 435, 999), the mass accretion of galaxies evolves like

$$\dot{\mathcal{M}}(z) \propto \mathrm{e}^{-0.79z}(1+z)^{5/2}$$

so at redshift $z \sim 1$ the accretion rate was ~ 2.5 times larger than it is now.

- In an equilibrium situation the SF intensity is proportional to the accretion rate,

$$\dot{\Sigma}_\star \propto \dot{\mathcal{M}}$$

and because

$$z_0 \propto \dot{\Sigma}_\star$$

the scale height of the newly formed disc was larger than the SF layer nowadays.

Conclusions

- We propose that thick discs and CMCs form simultaneously in the early disc galaxies stages in a turbulent and clumpy disc with a large SFR and σ.
- In our model the main cause for the thickness of thick discs is not that they have been secularly thickened. They appear thick because the thin disc is born from a dynamically colder ISM.