The minimum mass of (thin) disc galaxies (astro-ph/1005.4688)

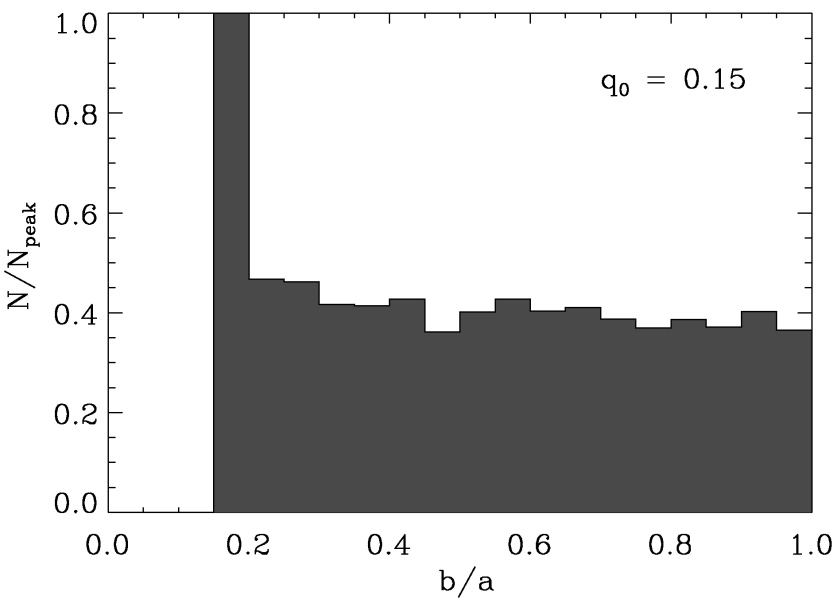
Rubén Sánchez-Janssen (ESO Chile)
J. Méndez-Abreu (IAC)
J.A.L. Aguerri (IAC)

Dynamics and Evolution of Disc Galaxies
Moscow, May 31, 2010

Galaxy discs in context

- Contain 60% of stellar mass in the local Universe (Driver et al. 2006).
- Main sites of current star formation activity (Kennicutt 1998).
- Their prominence and appearance form the basis of the Hubble morphological sequence.
- However, understanding their formation is extremely challenging (angular momentum catastrophe, feedback effects, etc...)
- **Which is the role of galaxy mass?**

Our approach

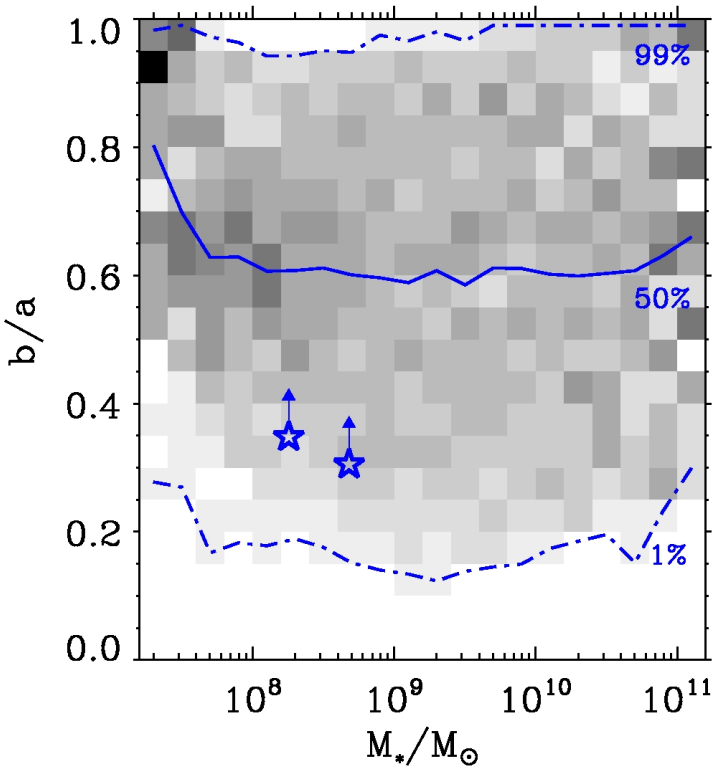


- Find the range of masses where (thin) discs live.
- How? By studying the probability distribution of axis ratios of nearby galaxies as a function of their mass.

Samples

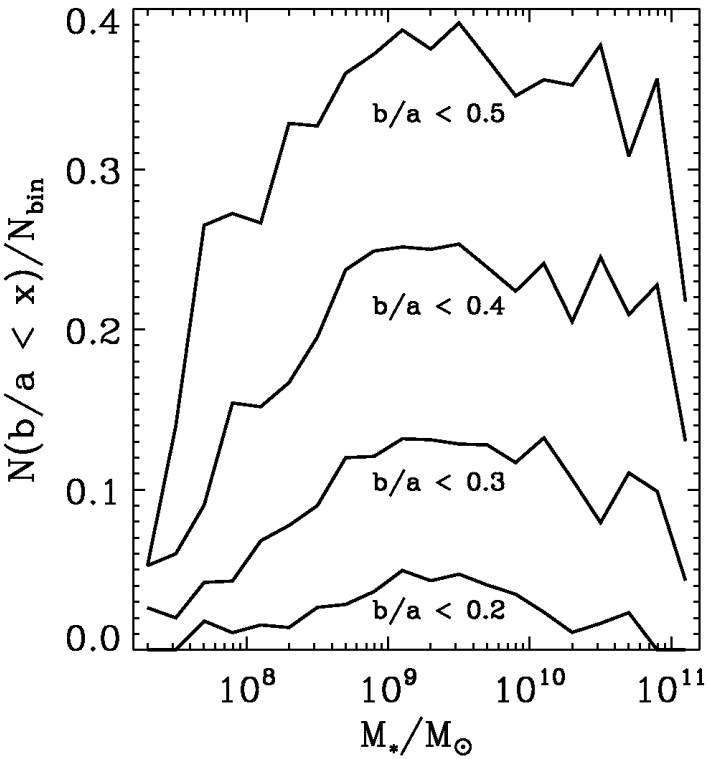
1. SDSS-DR7, 9245 galaxies:
   - $2000 < cz < 6000$ km s^{-1}
   - $-22.5 < M_i < -14.5$, volume-limited down to $M_i = -16.5$
   - median of gri 25 mag arcsec^{-2} $(b/a) \rightarrow$ robust measurement of apparent shape in outer regions, where the effects of bulges and dust should be minimized
   - Bell et al. (2003) M/L with Kroupa (2001) IMF.
2. Karachentsev et al. (2004), 445 galaxies:
   - Local Universe (D <10 Mpc) down to $M_B = -8$.

SDSS (stellar masses)



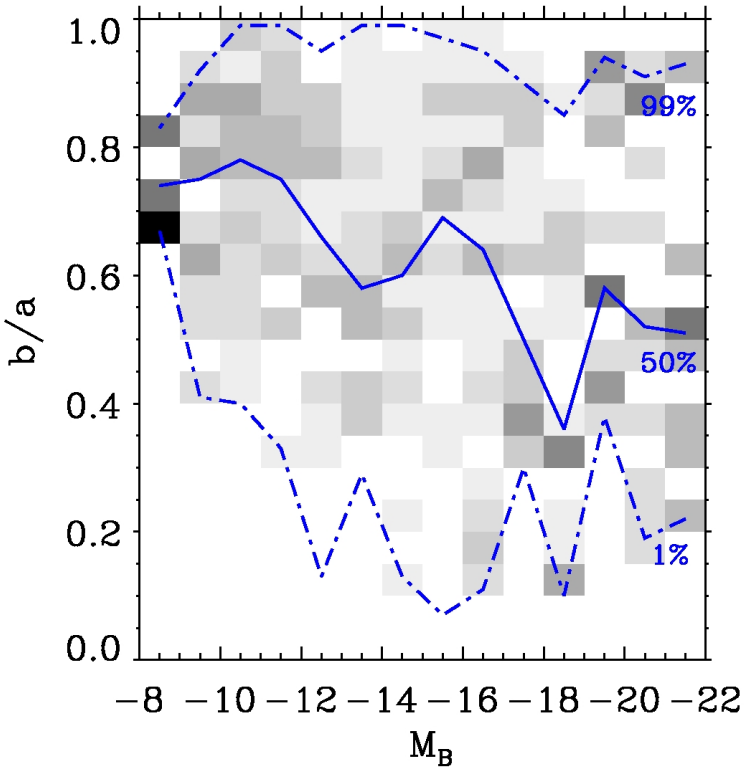
- U-shaped distribution
- Upper quartile: discs are likely slightly triaxial (Ryden 2004).
- Lower quartile: minimum occurs at canonical $b/a \approx 0.15$

SDSS (stellar masses)



- Strong function of M_*
- $M_* \approx 2 \times 10^9$ $M_\odot$ can be identified as minimum mass of thin discs.

Local Volume (luminosities)

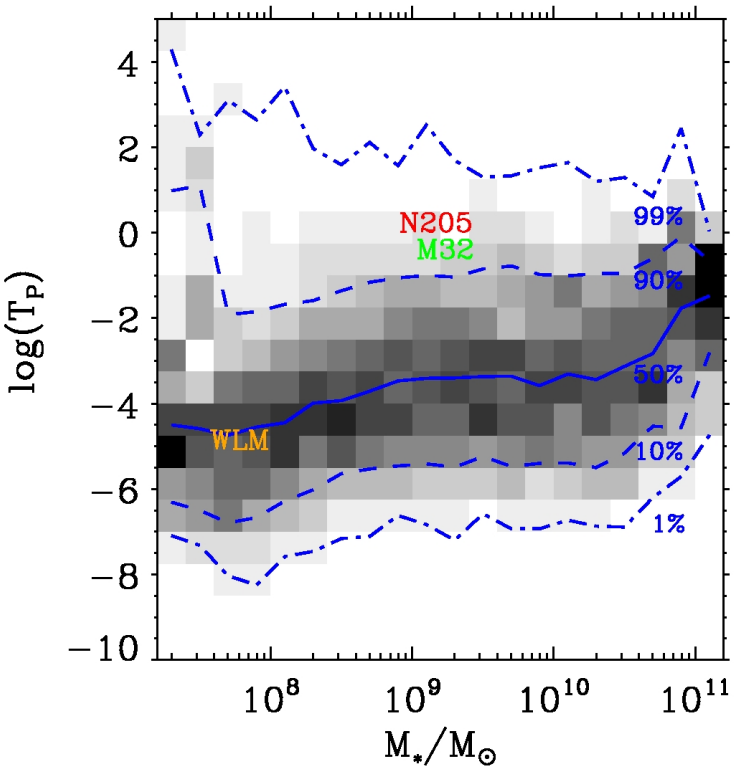


- Tendency still evident and enhanced at fainter magnitudes
- Low-luminosity dwarfs are extremely spheroidal

Discussion

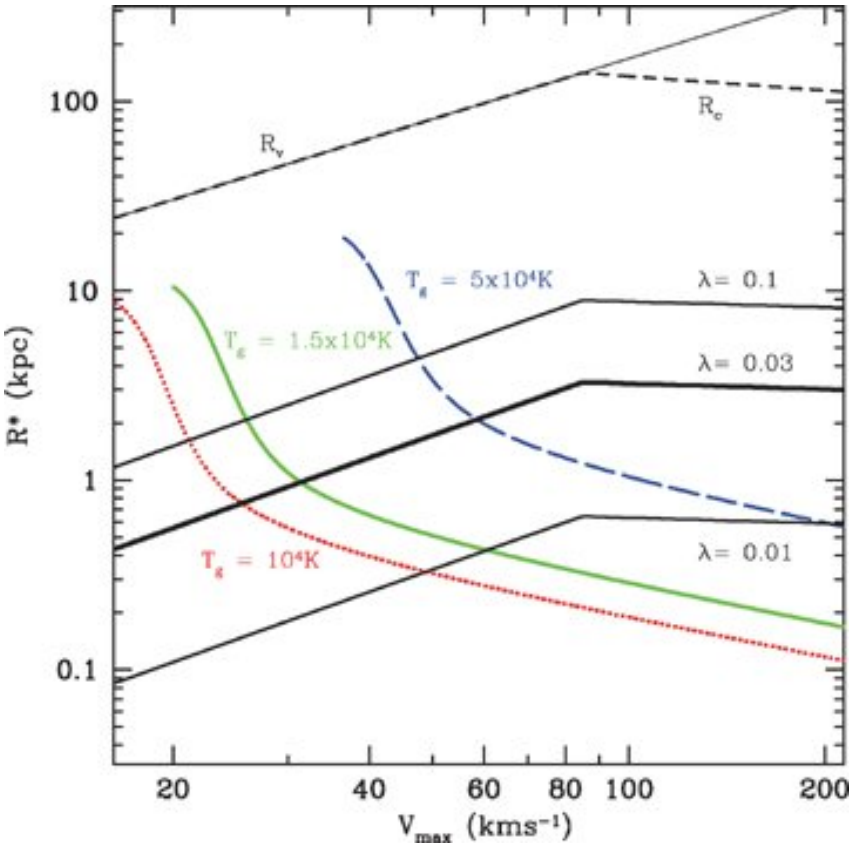
- There is a range of masses (luminosities) for the existence of thin discs.
- Massive galaxies contain more mass in spheroidal components.
- Low-mass galaxies are thicker as they are fainter...why??
- Two options: **external** or **internal** mechanisms

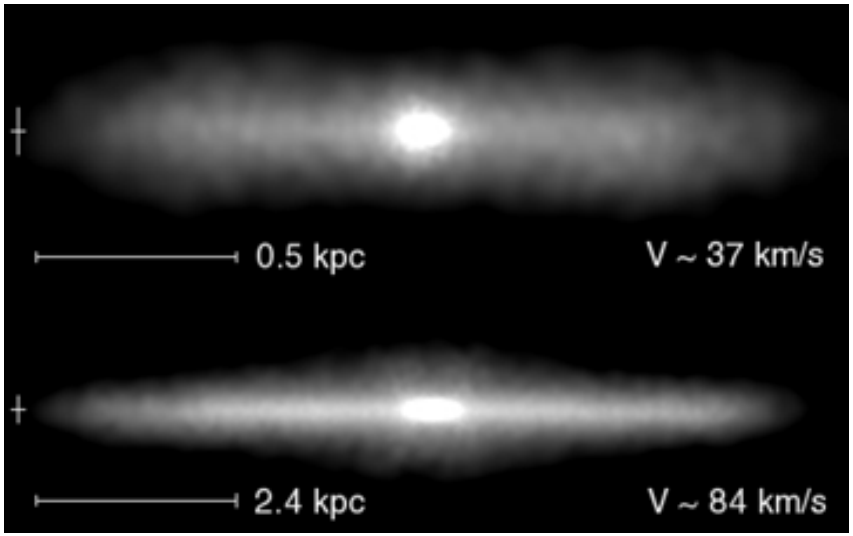
Ruling out environmental effects



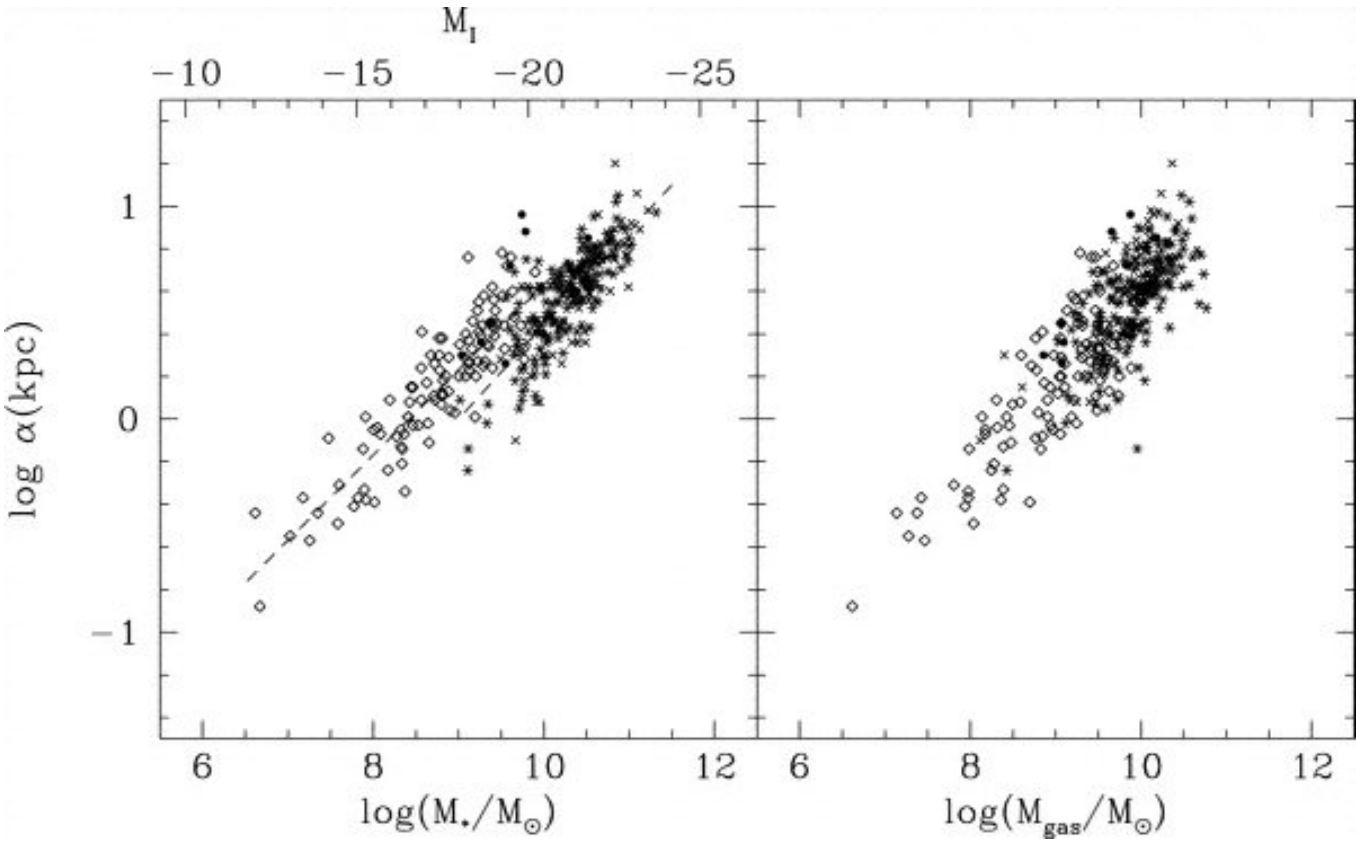
- No clusters, but what about group-scale interactions (as in LG)?
- Neighbours with $M_i < -16.5$ and $|\Delta \mathrm{v}| < 1000$ km s^{-1}
- $\mathrm{T}_P = \max[\left(\frac{\mathrm{M}_{*,P}}{\mathrm{M}_{*,i}}\right)\left(\frac{\mathrm{A}_{25}}{\mathrm{D}_P}\right)^3]$
- Dwarfs are generally *less* tidally affected than more massive galaxies (lower clustering, most are *centrals*).

The importance of feedback (e.g., Kaufmann et al. 2007)

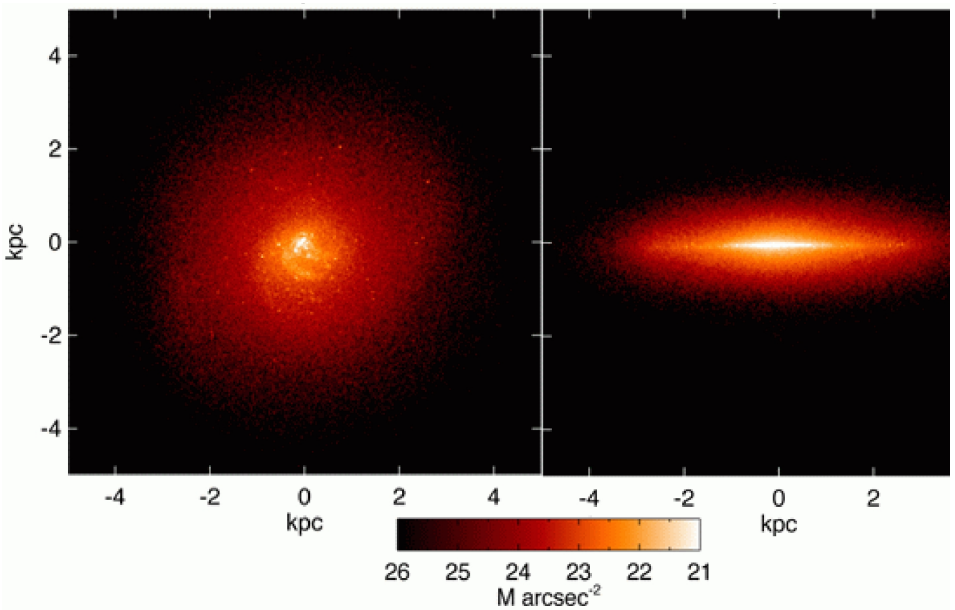


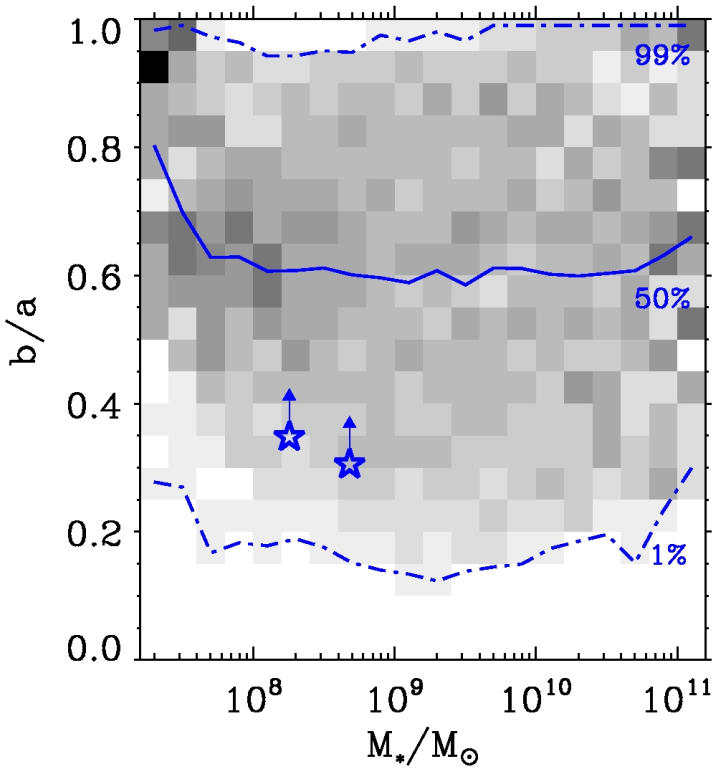


Discs and dwarfs (Schombert 2006)



Comparison with hydro simulations (Governato et al. 2010)





Implications

- No bars in dwarf galaxies? Bars only exist in the narrow 10^9-10^{11} $M_\odot$ mass range (Méndez-Abreu et al. 2010).
- Care when deprojecting velocity widths using a fixed q_0! (see also Roychowdhury et al. 2010).
- Dwarfs are more prone to suffer environmental effects than most simulations predict (e.g., Mastropietro et al. 2004)

Evidences of increasing importance of turbulent motions

- Large thickness of neutral gas component in dwarfs (FIGGS, Roychowdhury et al. 2010).
- Lack of double-horned HI profiles in dwarf samples (e.g., Geha et al. 2006)