Interpreting the Evolution of the Size-Luminosity Relation for Disks, From z=1 to the Present

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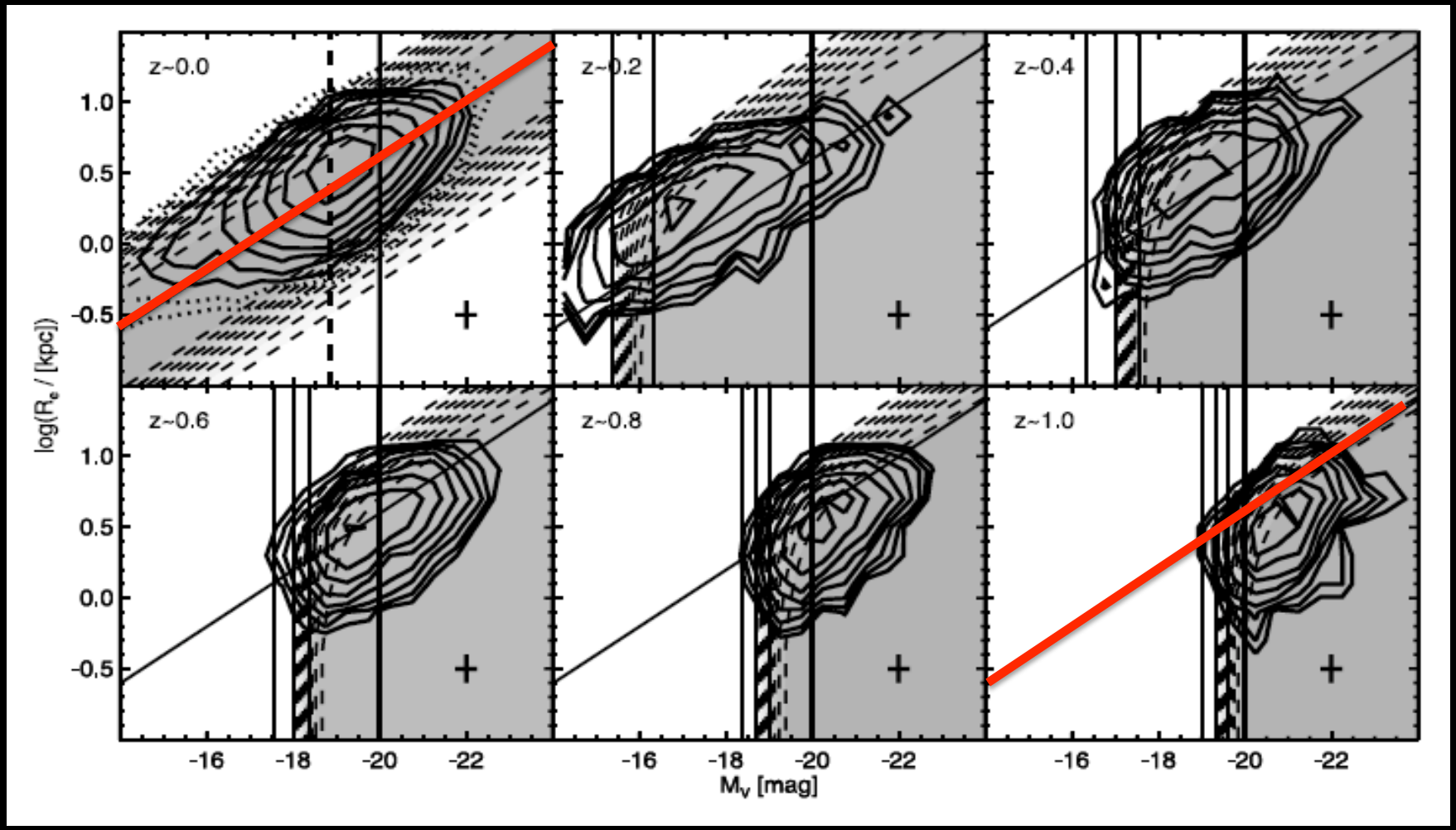
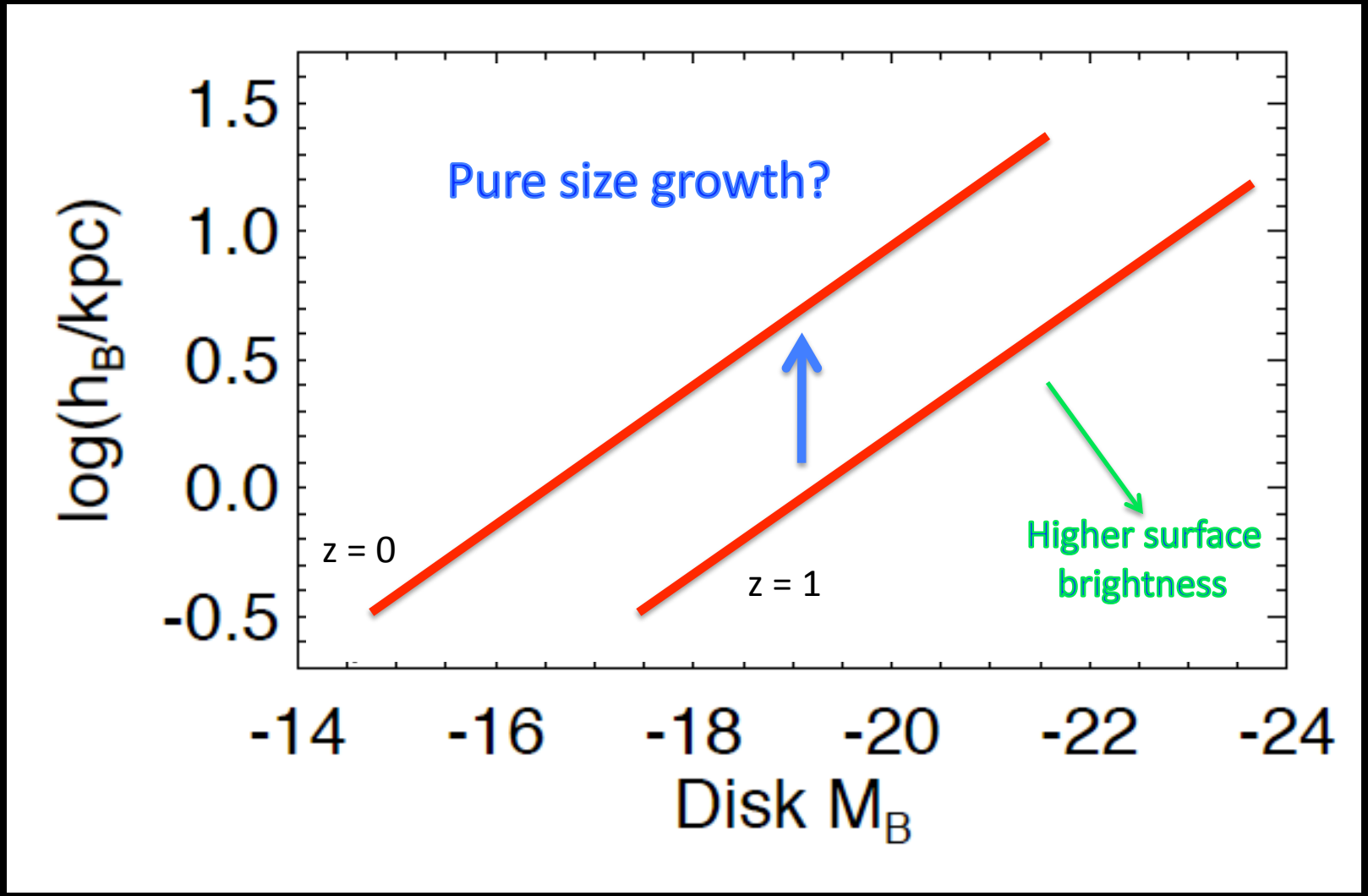
Observed Evolution in the Size-Magnitude Plane



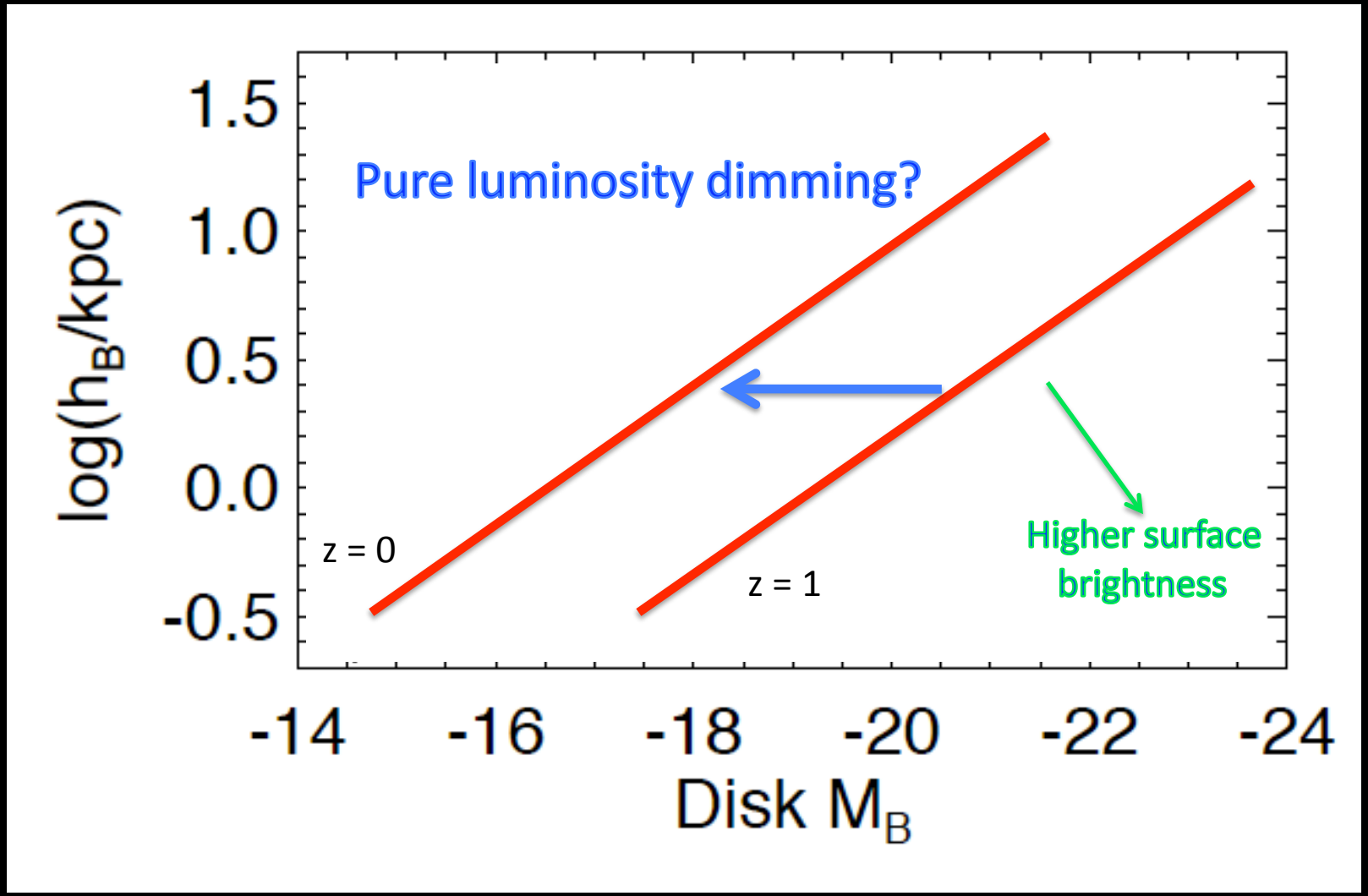
Barden et al. (2005)

Also: Schade et al. 1996; Roche et al. 1998; Lilly et al. 1998; Bouwens & Silk 2002; Ravindranath et al. 2004; Trujillo & Pohlen 2005; Melbourne et al. 2007; Kanwar et al. 2008

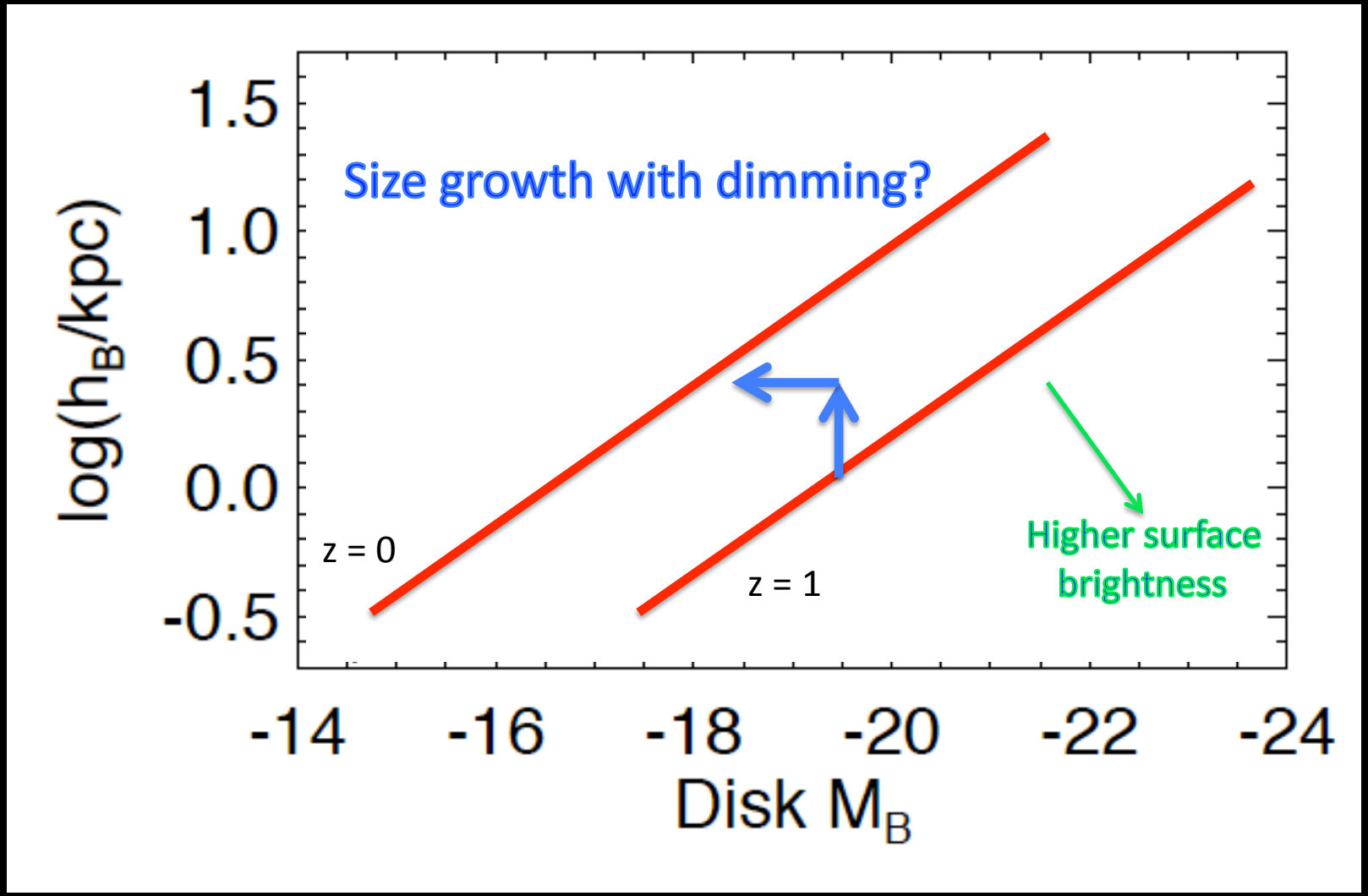
Degeneracy Makes Interpretation Difficult



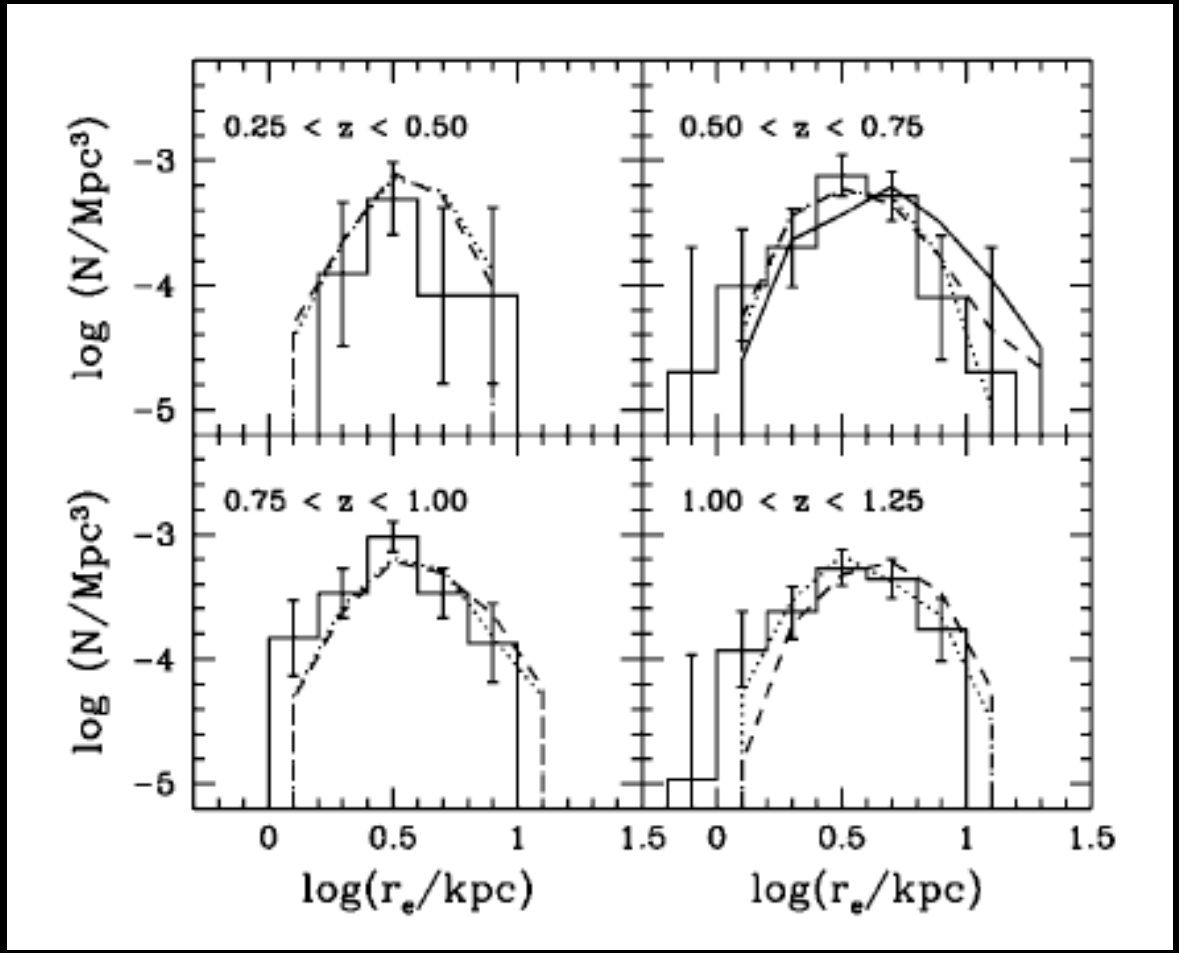
Degeneracy Makes Interpretation Difficult



Degeneracy Makes Interpretation Difficult

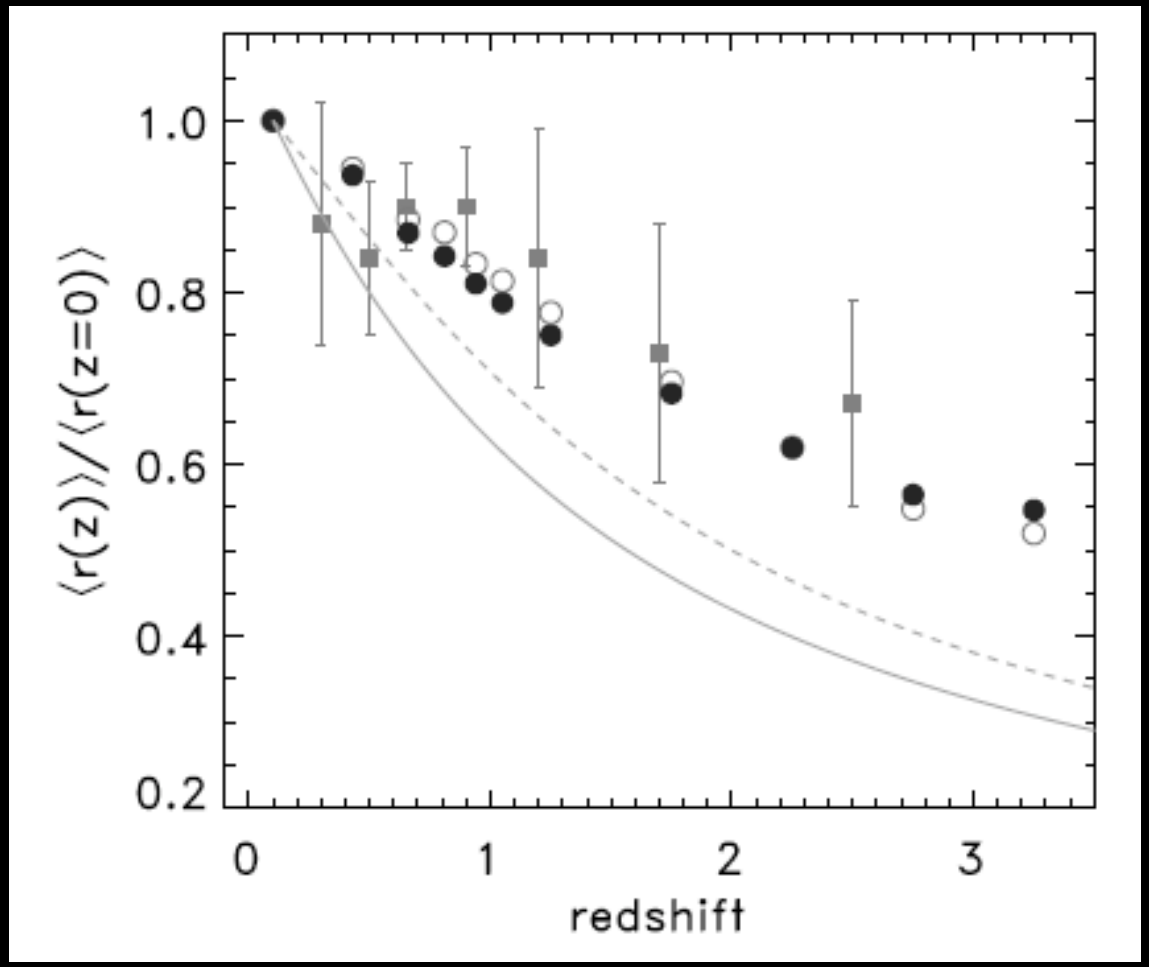


Size Function of Disks Shows No Evolution



Ravindanath et al. (2004)
Kanwar et al. (2008)

Theory: Disks Should Nearly Double in Size Since z=1?

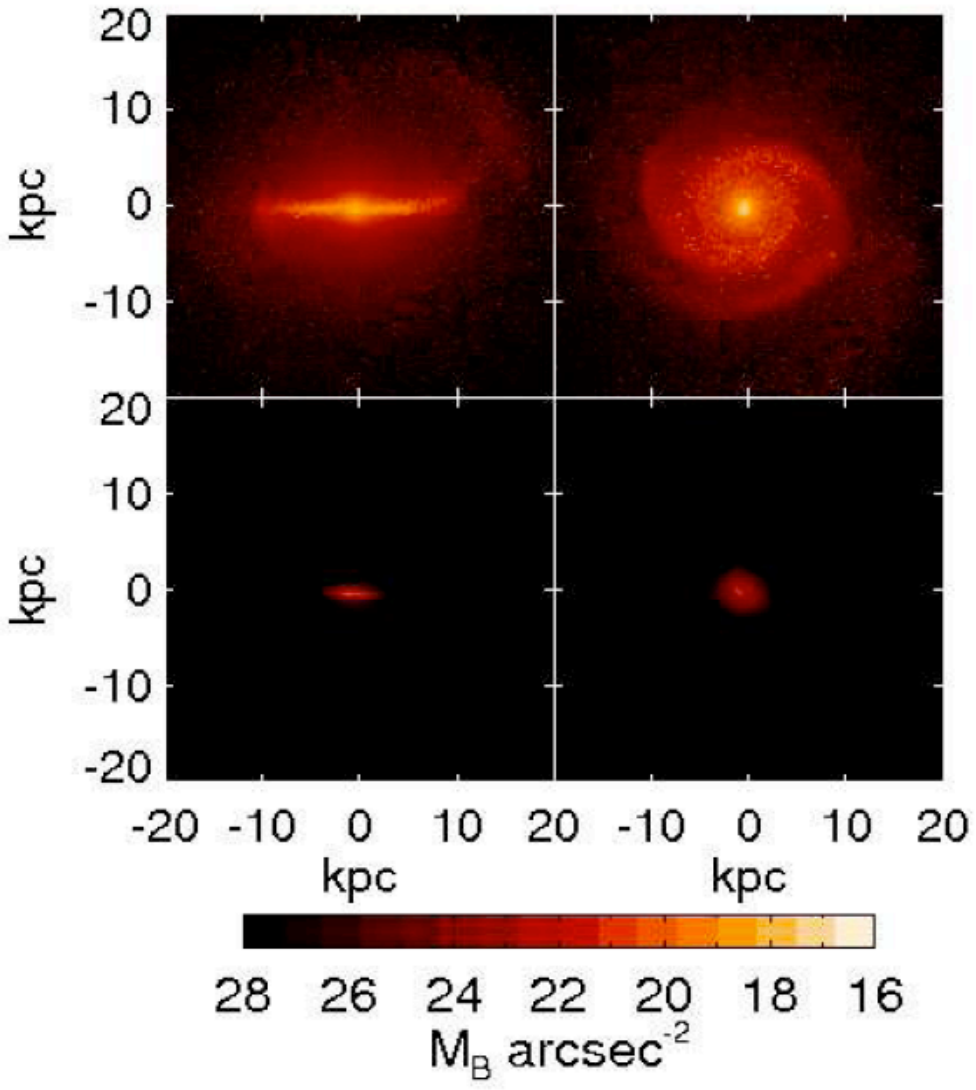


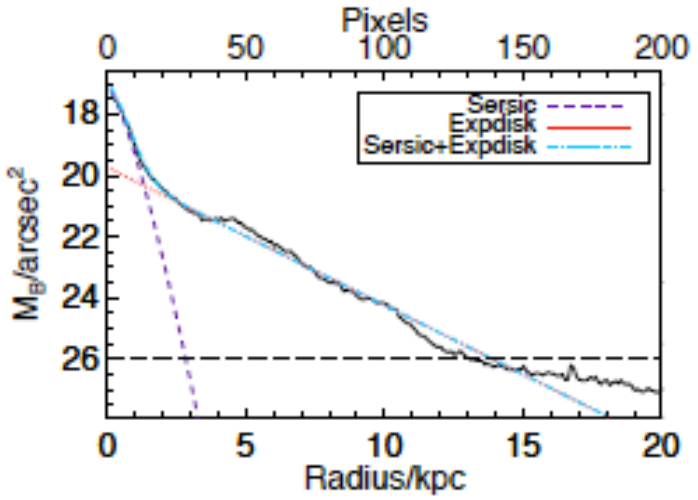
Somerville et al. (2008)

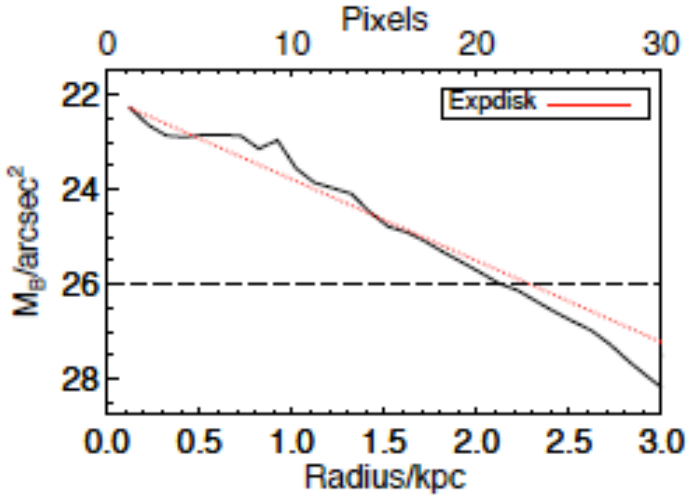
Goal:

Investigate the evolution of galaxies in the size-magnitude plane and disentangle the evolution of individual galaxies from the population as a whole

Measure sizes as Observers do!

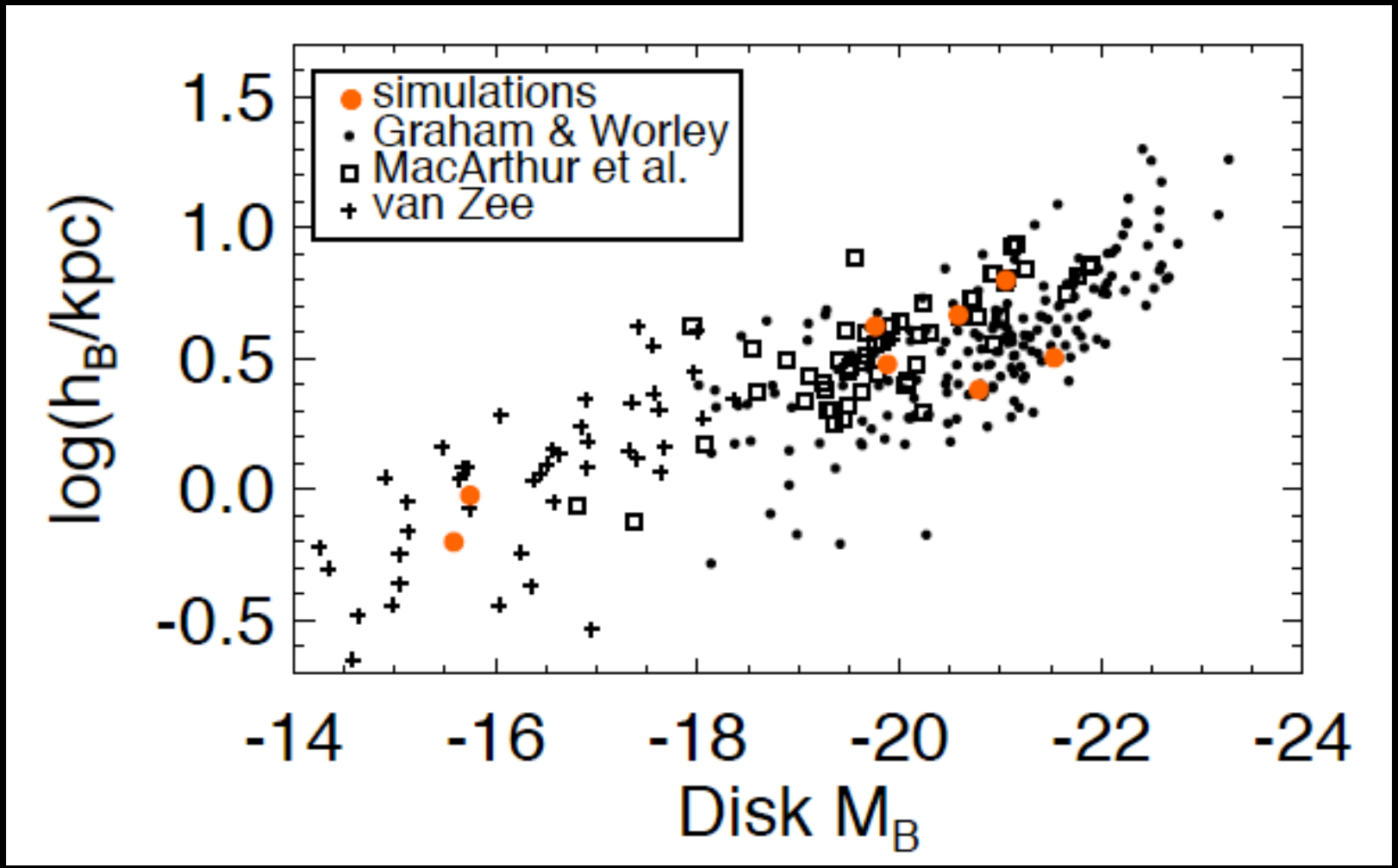




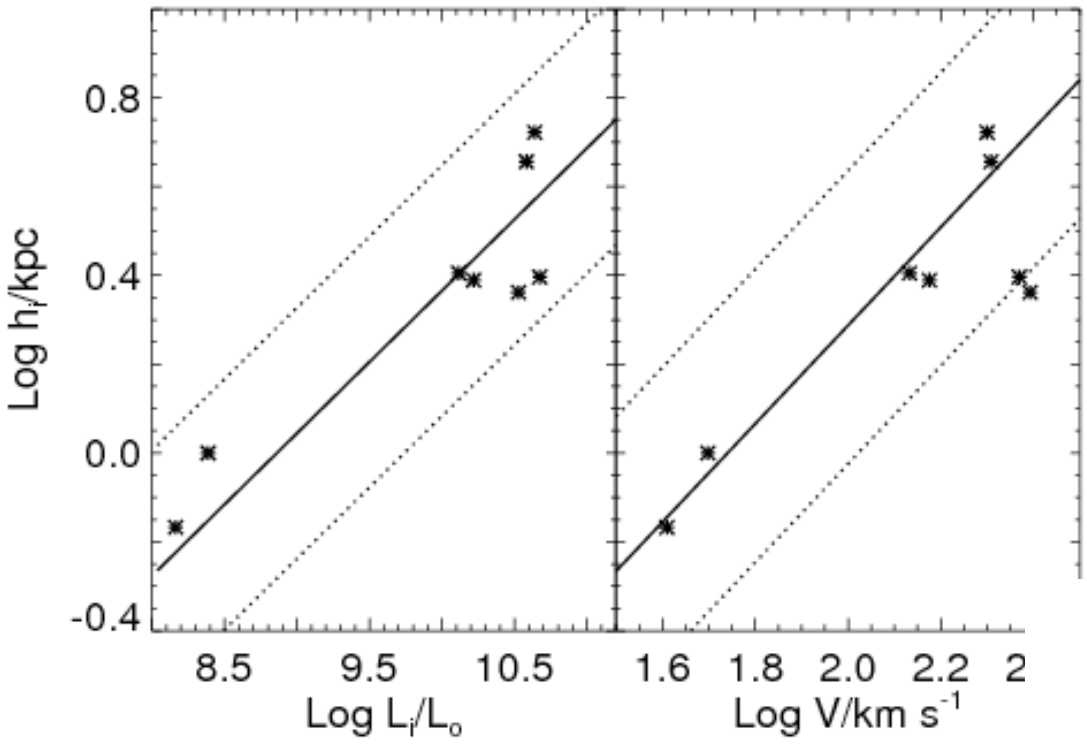


Jonsson (2006), Jonsson et al. (2010)

The Size – Magnitude Relation at z=0



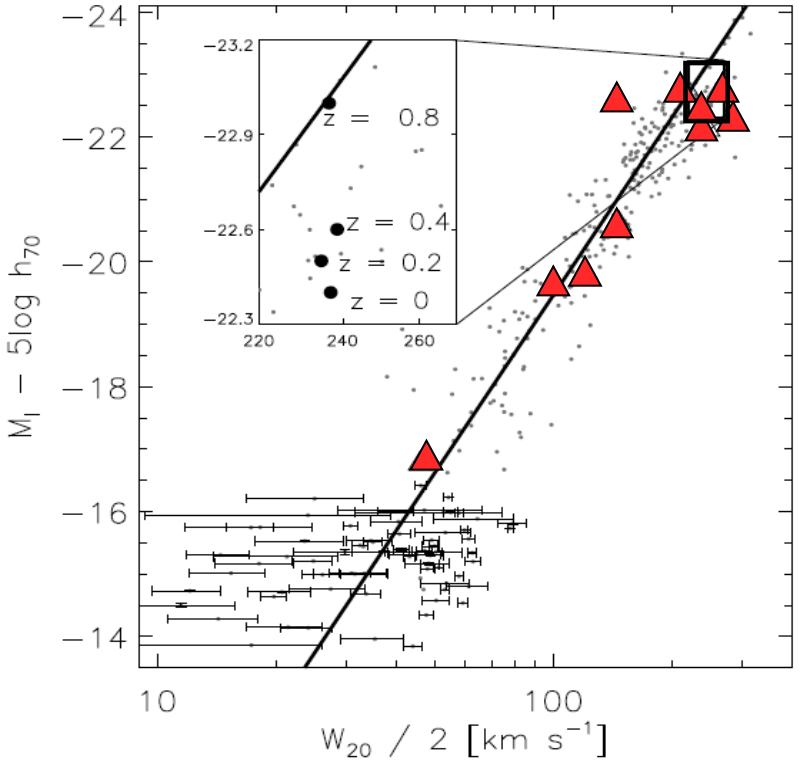
Brooks et al. (2010), submitted

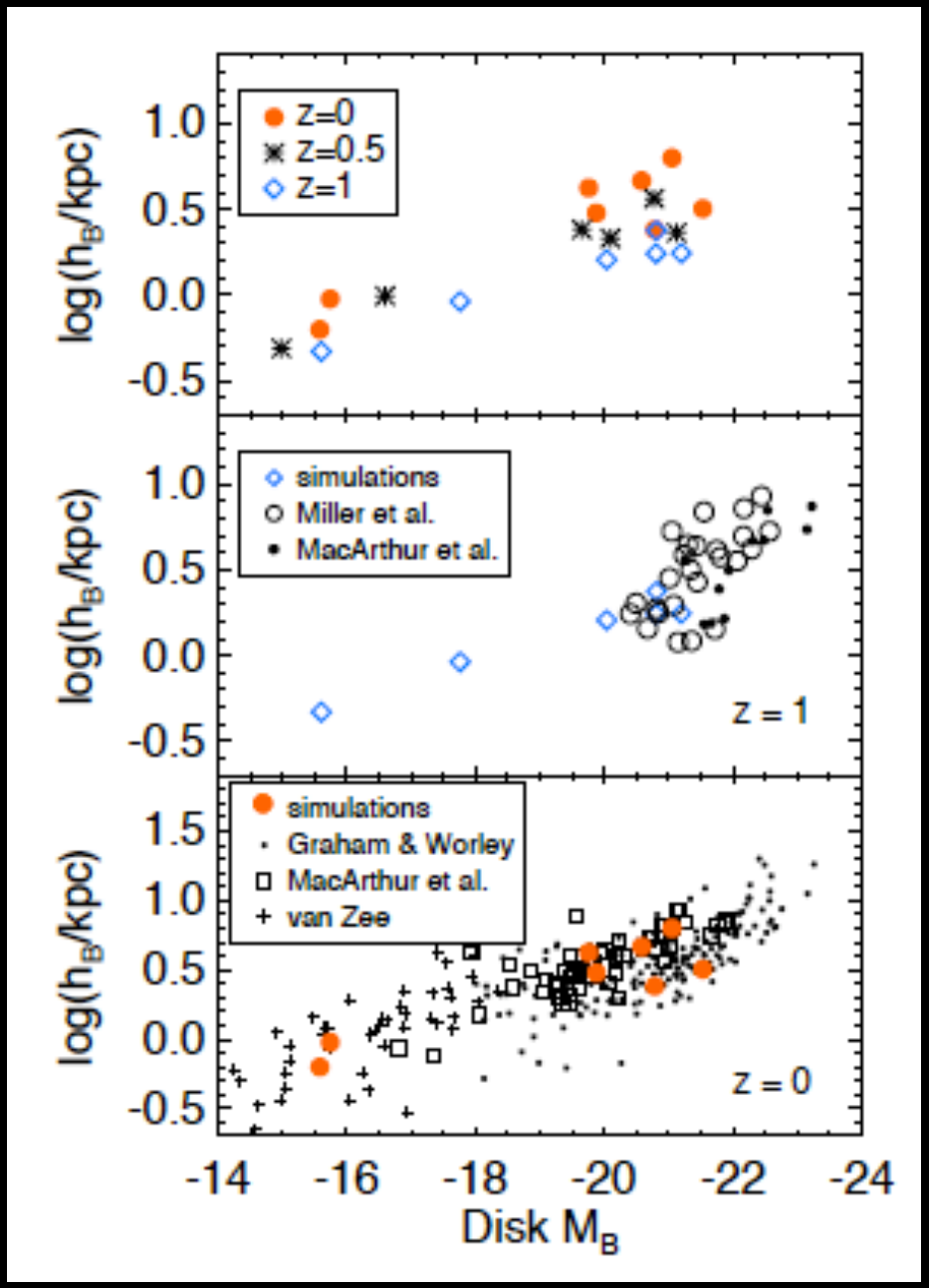


Courteau et al. (2007)

Size – Luminosity
Size – Velocity
Luminosity – Velocity

Governato et al. (2009),
Geha et al. (2006)



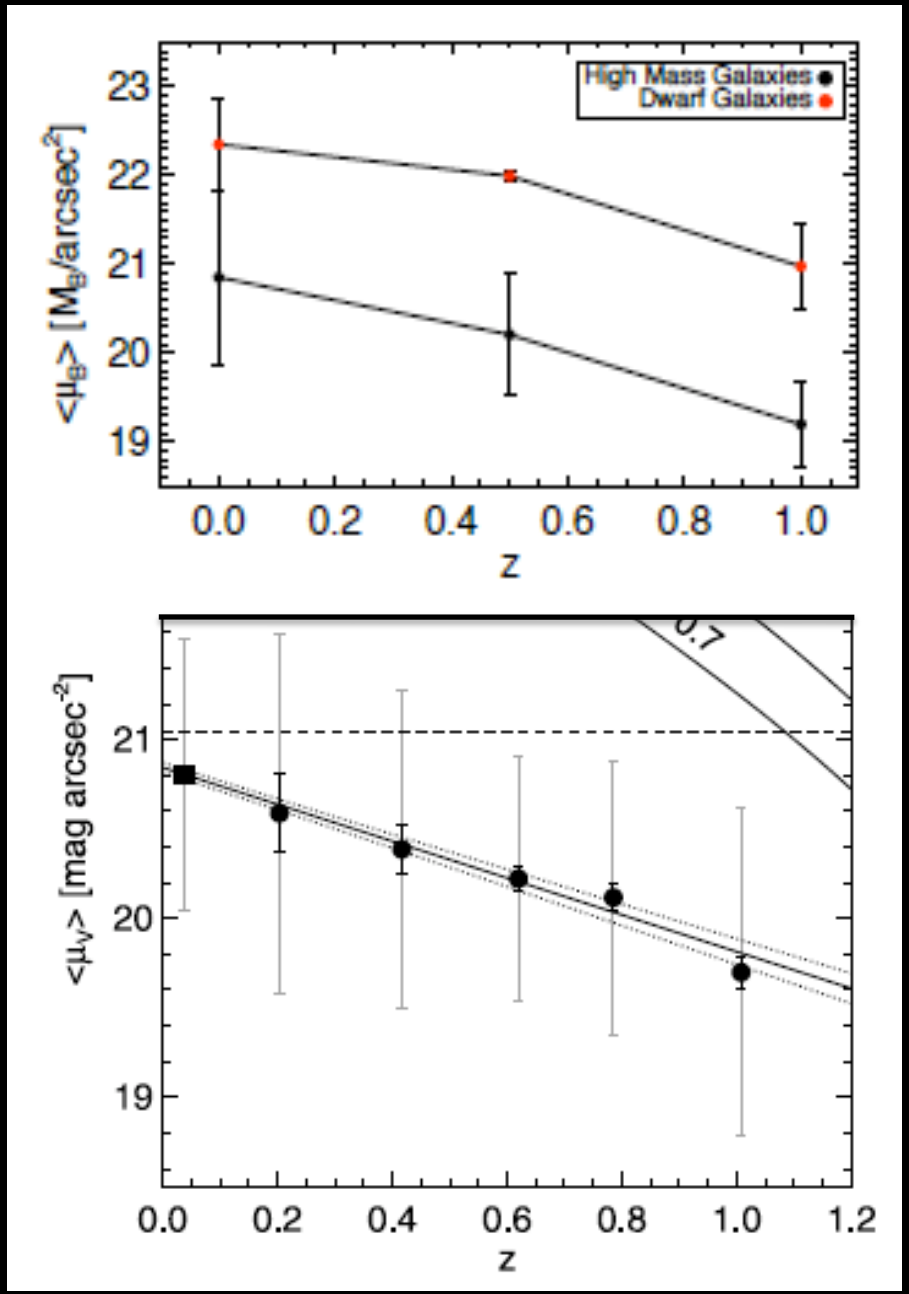


The Evolution of the Size – Magnitude Relation at z=0

Brooks et al. (2010), submitted

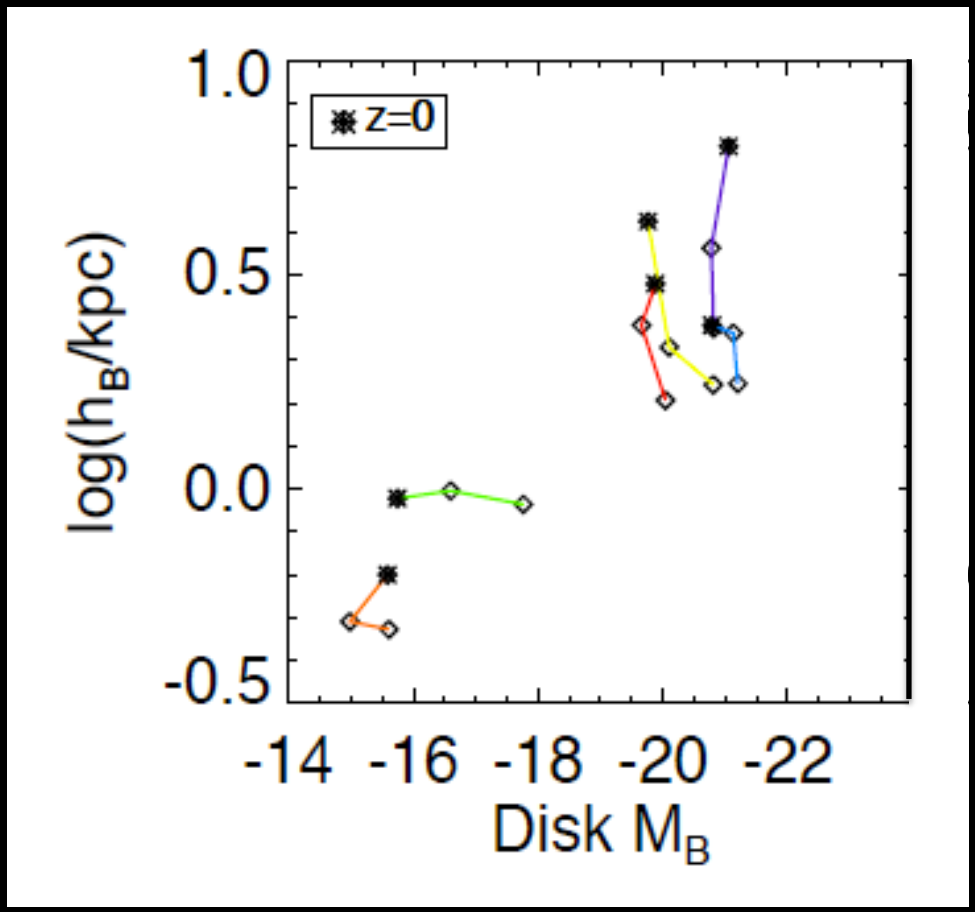
~1.5 magnitudes of surface brightness evolution since z=1

Sims and obs in good agreement



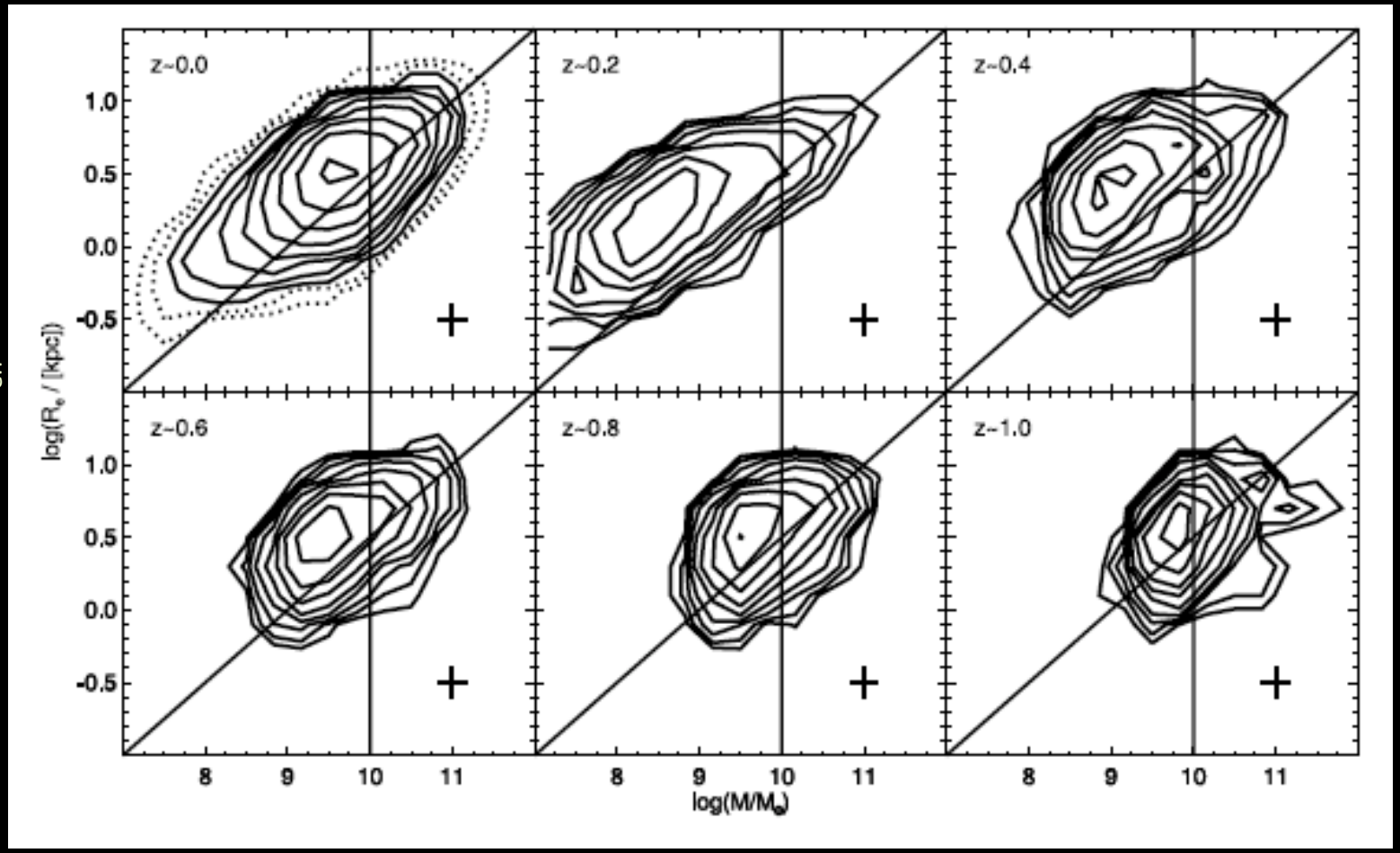
Barden et al. (2005)

Evolution of Individual Galaxies



Significant evolution in size!

Size – Stellar Mass Relation



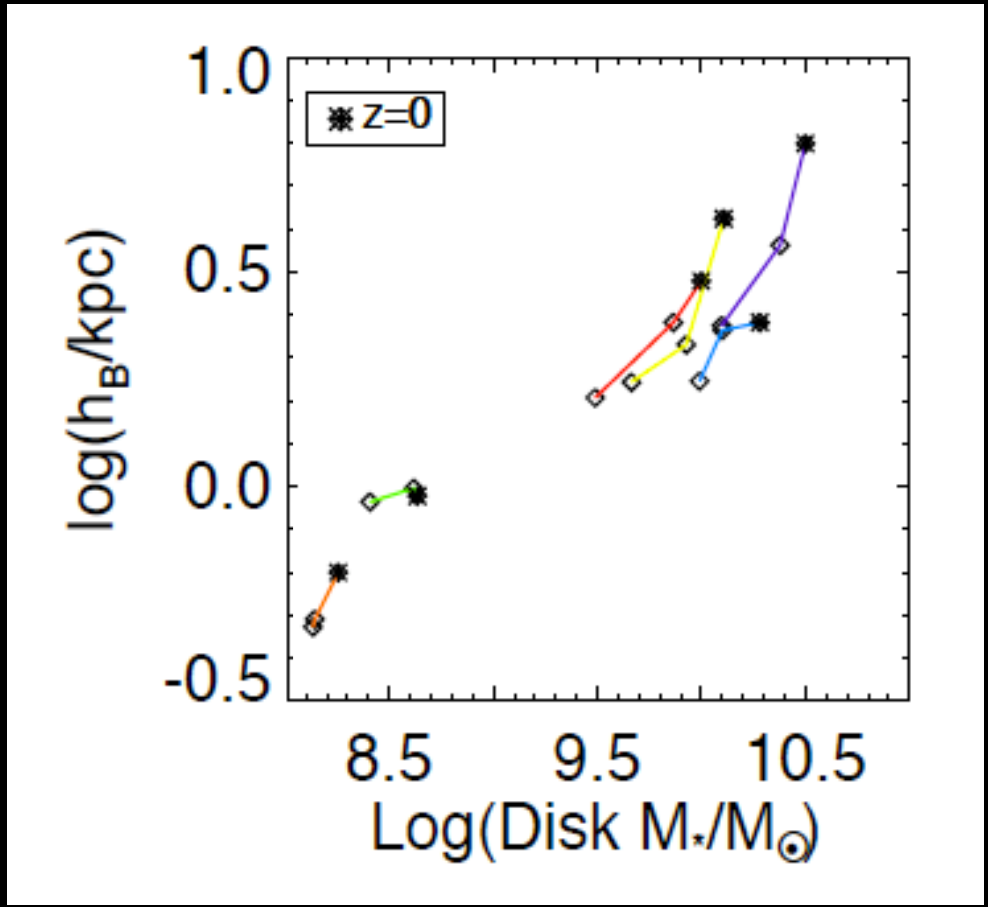
Log (R_{eff})

Log (M_*)

Barden et al. (2005)

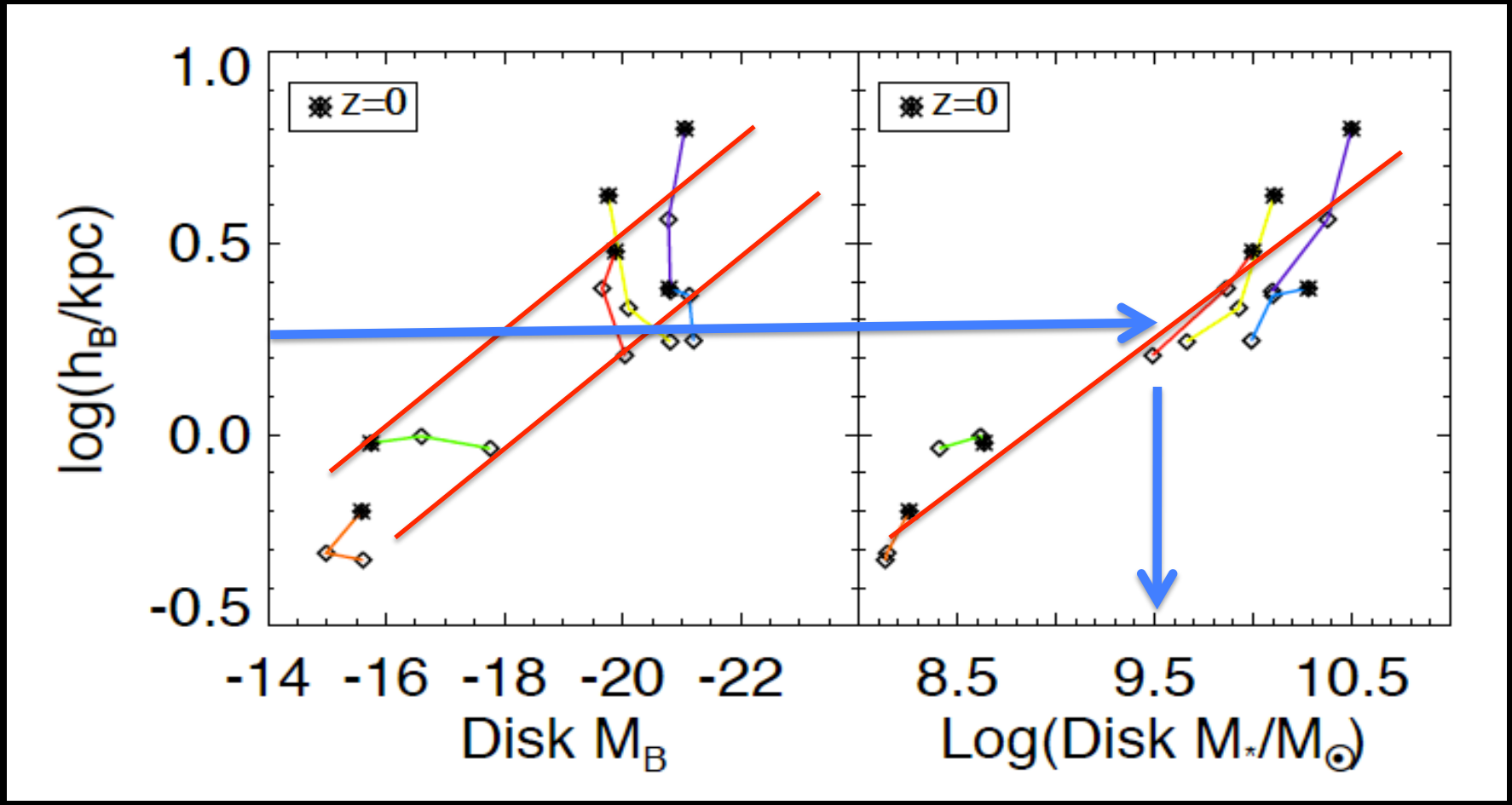
Evolution of Individual Galaxies

Galaxies grow along the size – stellar mass relation



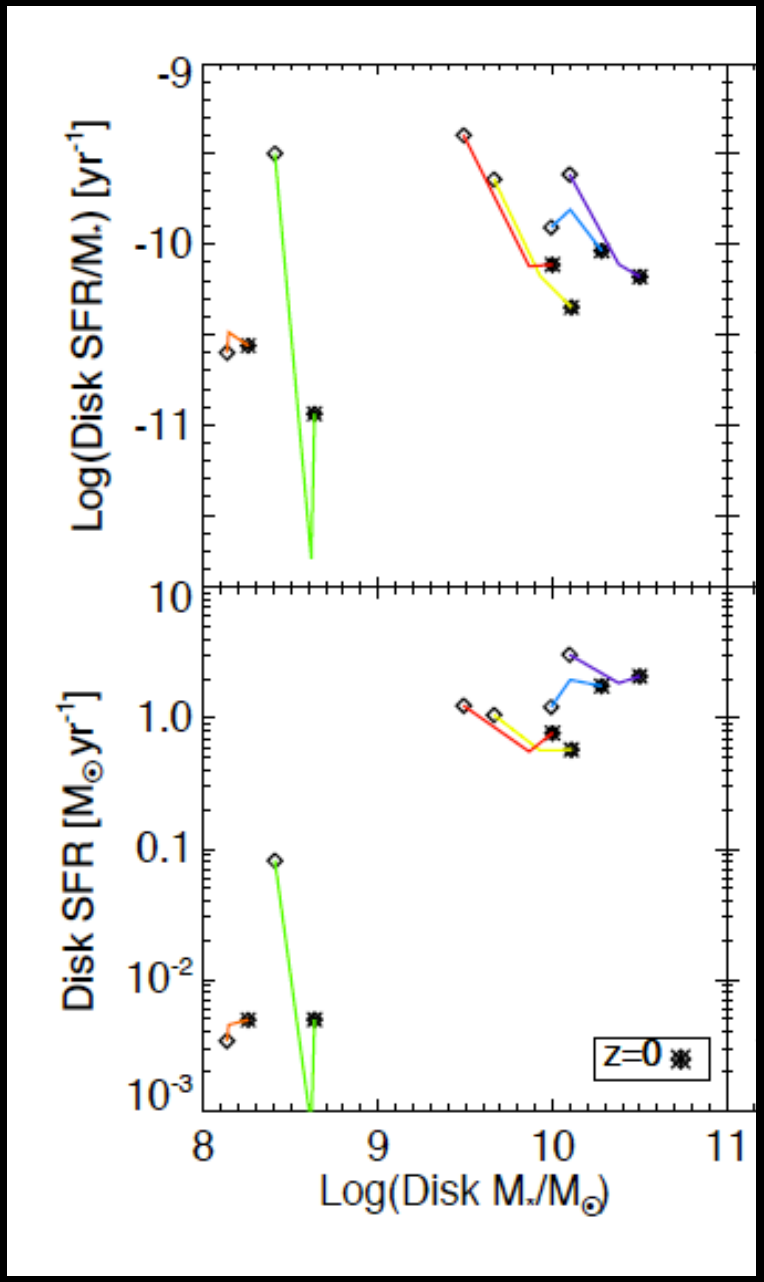
Somerville et al. (2008),
Firmani & Avila-Reese (2009), Dutton et al. (2010)

Interpreting the Evolution of the Size – Magnitude Relation



Galaxies at a fixed size/stellar mass were brighter at z=1.

Why?

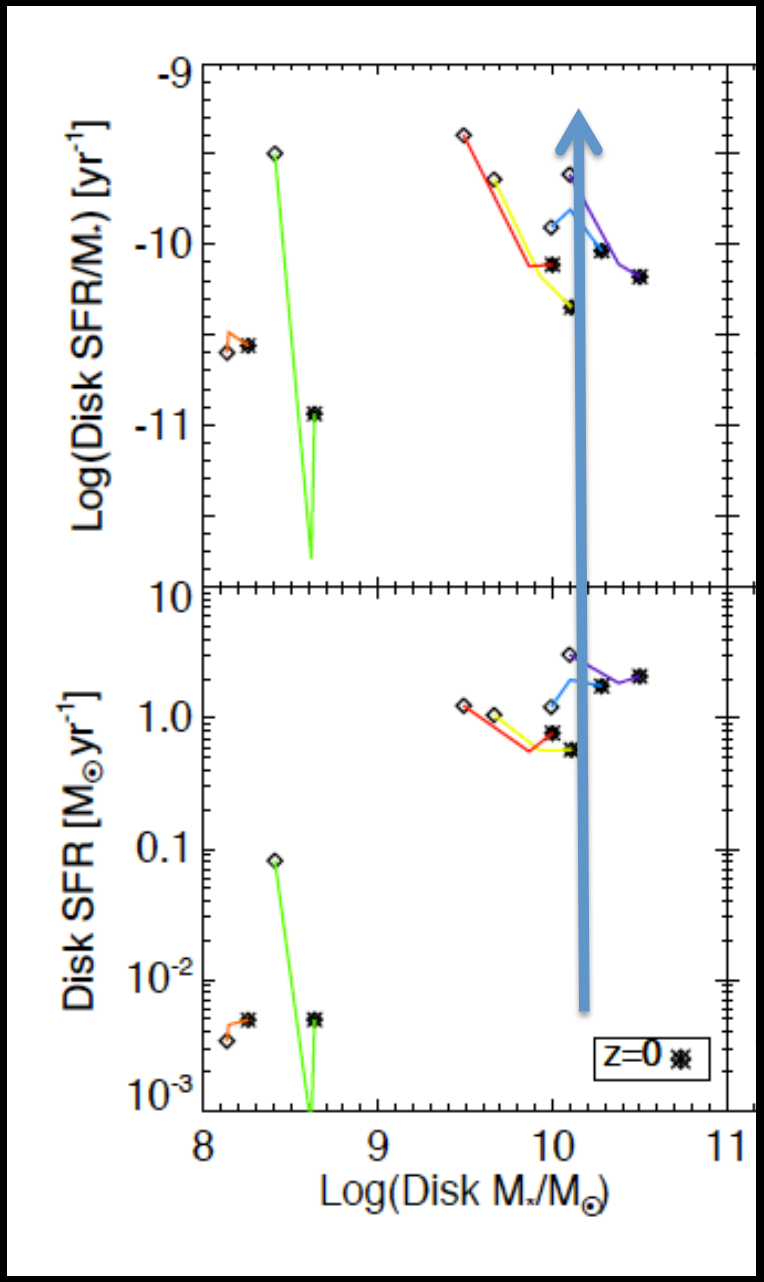


SFR/sSFR – Stellar Mass Relations

SFR and sSFR of *individual* galaxies decline

SFR and sSFR of *population* declines

Gavazzi & Scodeggio 1996; Boselli et al. 2001; Kauffmann et al. 2003; Brinchmann et al. 2004; Feulner et al. 2005; Erb et al. 2006; Salim et al. 2007; Noeske et al. 2007b,a; Elbaz et al. 2007; Daddi et al. 2007; Schiminovich et al. 2007; Cowie & Barger 2008; Pannella et al. 2009; Damen et al. 2009b,a; Dunne et al. 2009; Rodighiero et al. 2010; Oliveret al. 2010;Mannucci et al. 2010; Lara-L´opez et al. 2010

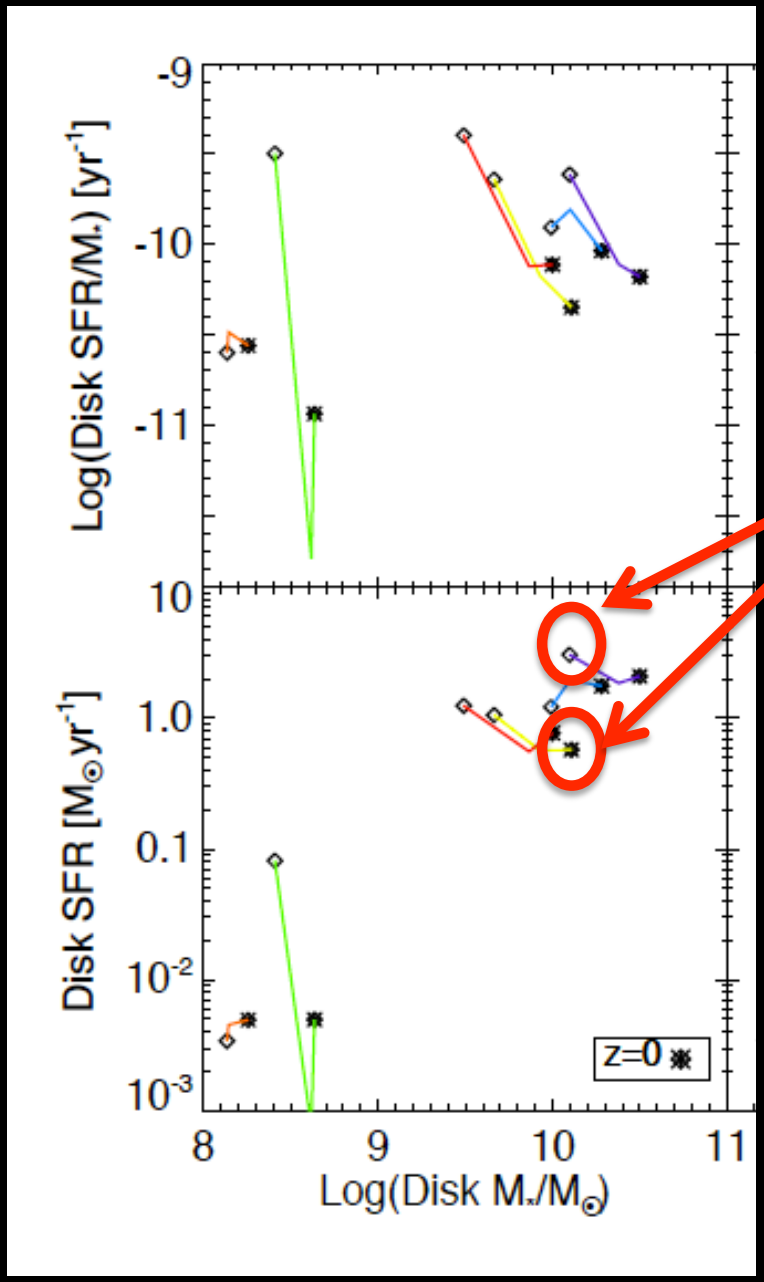


SFR/sSFR – Stellar Mass Relations

Galaxies at a fixed mass had higher SFR at z=1

Gavazzi & Scodeggio 1996; Boselli et al. 2001; Kauffmann et al. 2003; Brinchmann et al. 2004; Feulner et al. 2005; Erb et al. 2006; Salim et al. 2007; Noeske et al. 2007b,a; Elbaz et al. 2007; Daddi et al. 2007; Schiminovich et al. 2007; Cowie & Barger 2008; Pannella et al. 2009; Damen et al. 2009b,a; Dunne et al. 2009; Rodighiero et al. 2010; Oliveret al. 2010;Mannucci et al. 2010; Lara-L´opez et al. 2010

SFR/sSFR – Stellar Mass Relations



M_{vir} of z=1 galaxy is ~1.5x larger than the z=0 galaxy of same stellar mass

Larger mass = higher SFR

Gavazzi & Scodeggio 1996; Boselli et al. 2001; Kauffmann et al. 2003; Brinchmann et al. 2004; Feulner et al. 2005; Erb et al. 2006; Salim et al. 2007; Noeske et al. 2007b,a; Elbaz et al. 2007; Daddi et al. 2007; Schiminovich et al. 2007; Cowie & Barger 2008; Pannella et al. 2009; Damen et al. 2009b,a; Dunne et al. 2009; Rodighiero et al. 2010; Oliveret al. 2010;Mannucci et al. 2010; Lara-L´opez et al. 2010

Conclusions

• Artificial surface brightness images are used to decompose disk/bulge and fit the exponential disk scale lengths

• Galaxies are a good match to the evolving size-magnitude relation

• Unlike most observational conclusions, our disks are substantially growing with time

• Galaxies grow *along* the size – stellar mass relation

• A galaxy at fixed size/stellar mass at z=1 has a higher SFR than its z=0 counterpart due to a deeper potential well