The CDM halos of the Local Group dSphs

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Cosmological Context

- dSph are the most-dark-matter dominated objects in the Universe

  laboratories to investigate the nature of dark matter

- They play a fundamental role in the formation of galaxies

  galaxy formation

- Very old systems, the reflect properties at z>>0

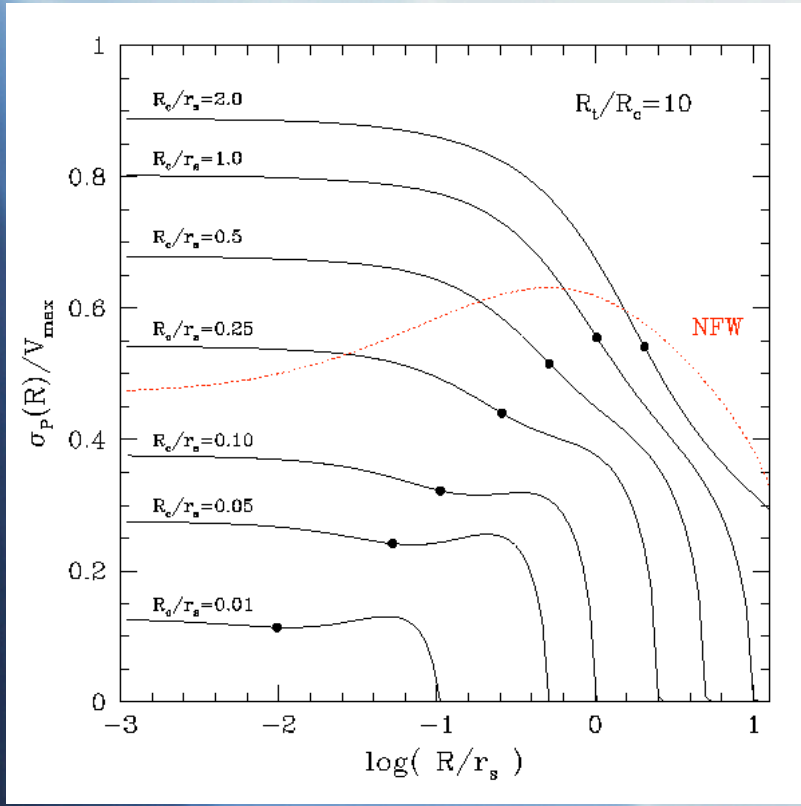
  cosmological probes

- Small, (simple) objects

  star formation, metal-enrichement processes in galaxies

The CDM halos of dSphs

- Model: King profile embedded in a NFW dark matter halo (2 free param.!)
- Constraints: $\Sigma(R)$ and $\sigma_p(R)$ ⟷ stars ⟶ tracers of DM

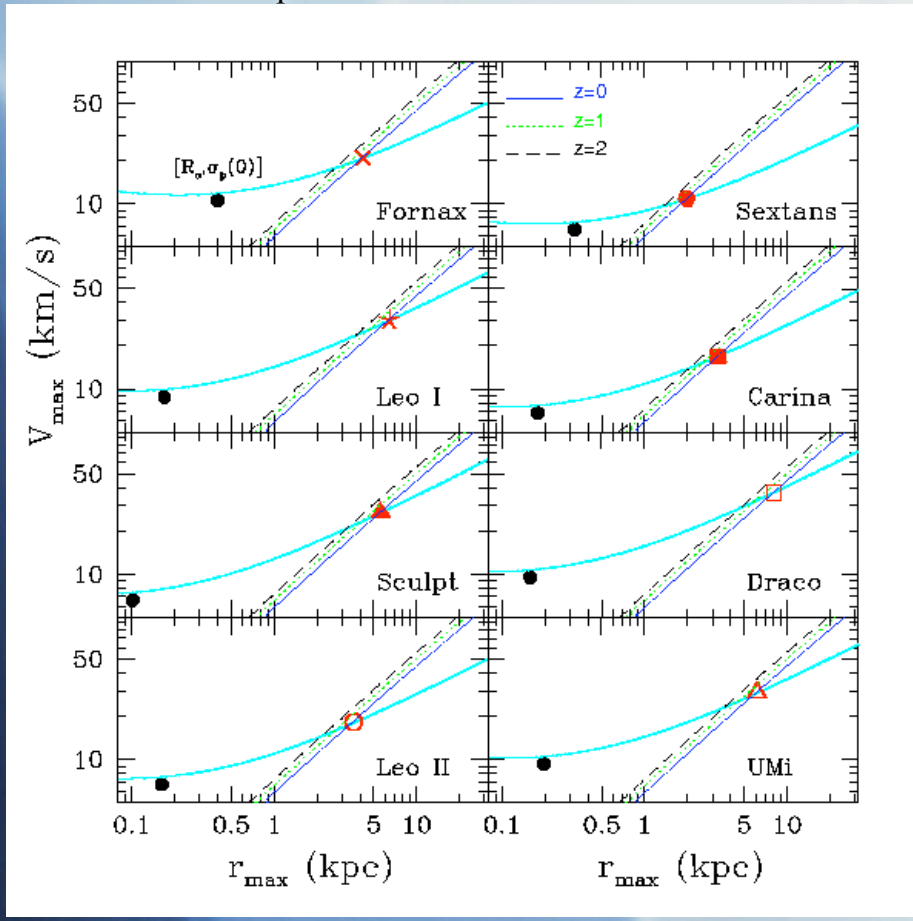


Segregation R_c/r_s determines $\sigma_p(R)$

- increasing R_c/r_s <---> increasing $\sigma_p(R)$
- decreasing R_c/r_s <---> flat $\sigma_p(R)$

Breaking the degeneracy…

- $\Sigma(R)$ and $\sigma_p(R)$ constrain one parameter of a NFW halo



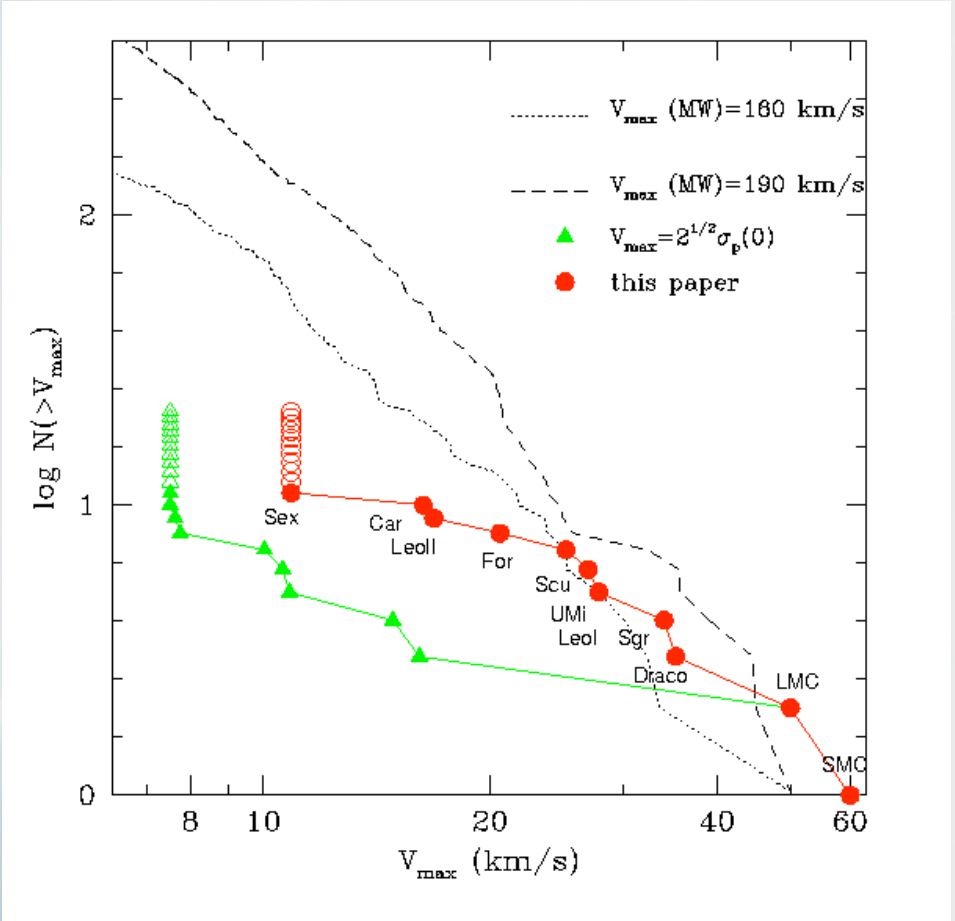
$V_c(R_c)$ strongly constraint

Cosmology: dSph similar ρ_0

$r_{max} \longleftrightarrow V_{max}$

Properties of the MW dSphs

1. Denser systems are more massive
2. Mass and light do not correlate
3. Stars deeply embedded within the dark matter halos
4. Mass-follow-light models underestimate the mass of dSphs

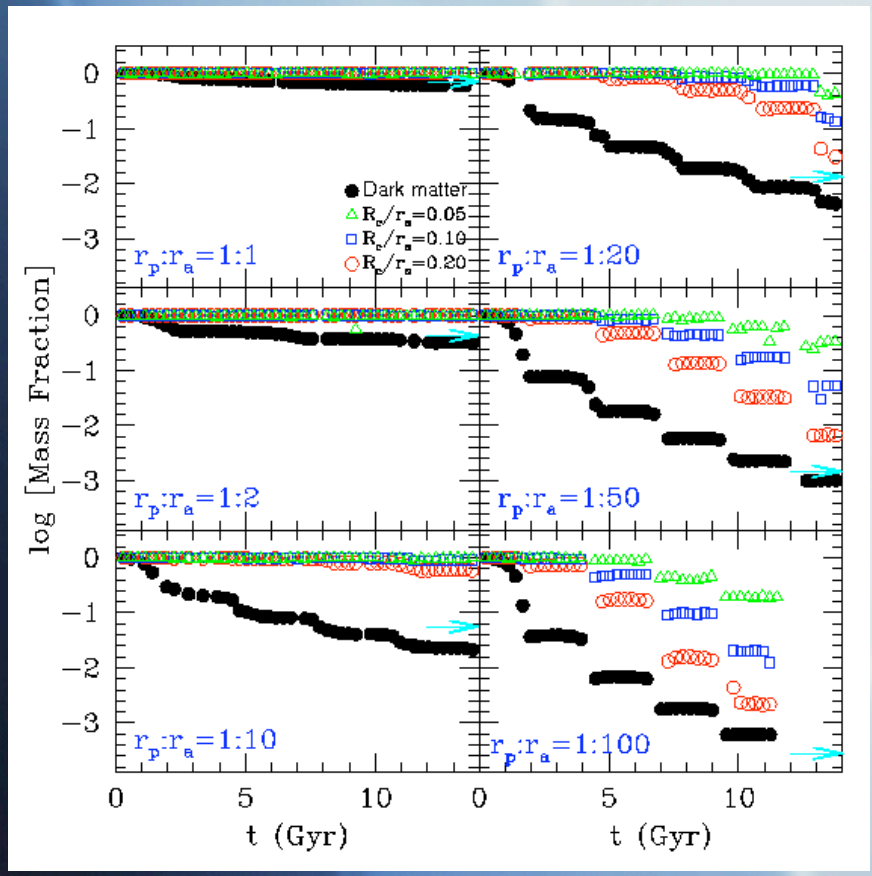


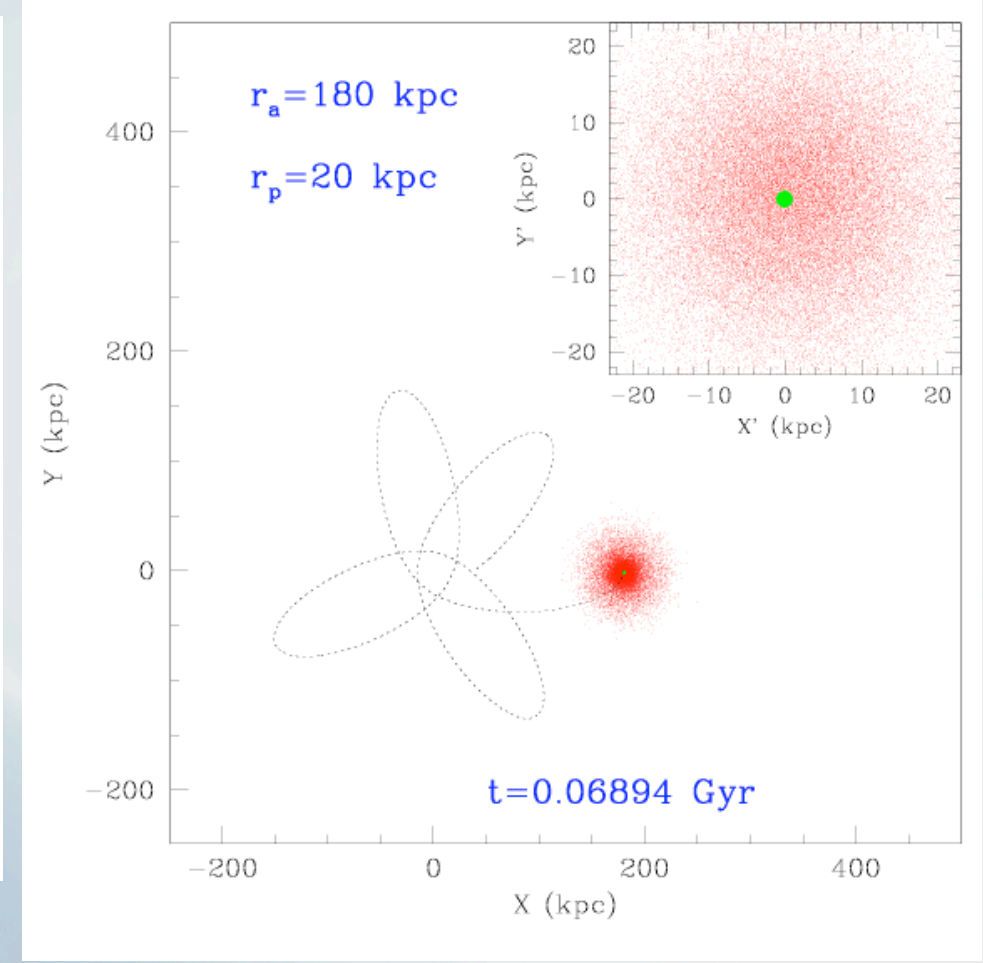
We assume dSph models in **isolation**

How does tidal mass stripping affect our estimates?

Effects of mass loss…

Peñarrubia, Navarro & McConnachie (2007, June)

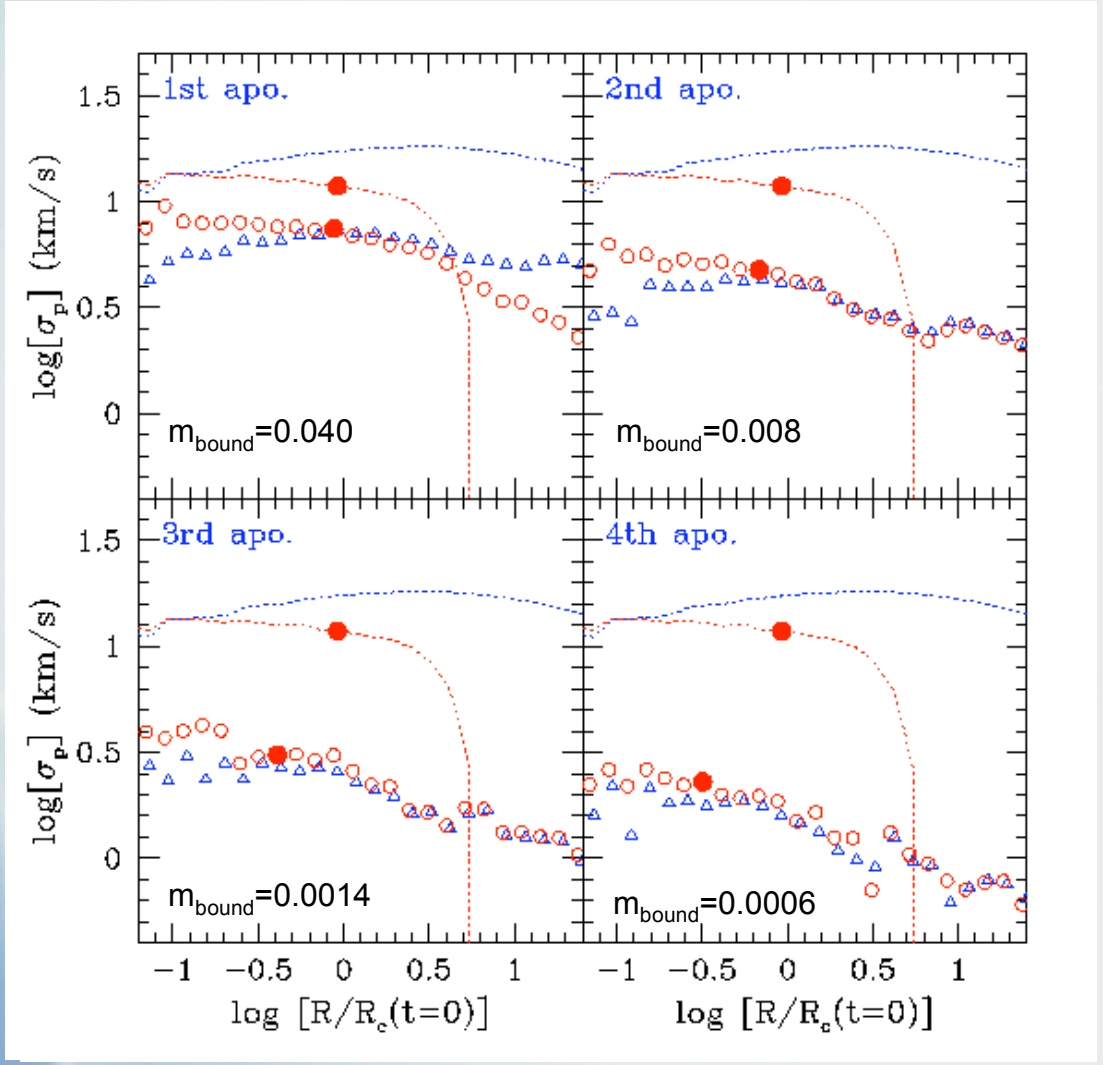




…on the luminous profiles

- Mass stripping decreases $\Sigma(R)$ and $\sigma_p(R)$ at all radii

- The remant dSph can be fitted with a King profile for extreme mass loss events



Evolution of stellar observables

- The evolution of a dSph can be characterized by a single parameter:

  $M(R_c) / M(R_c)[t=0]$

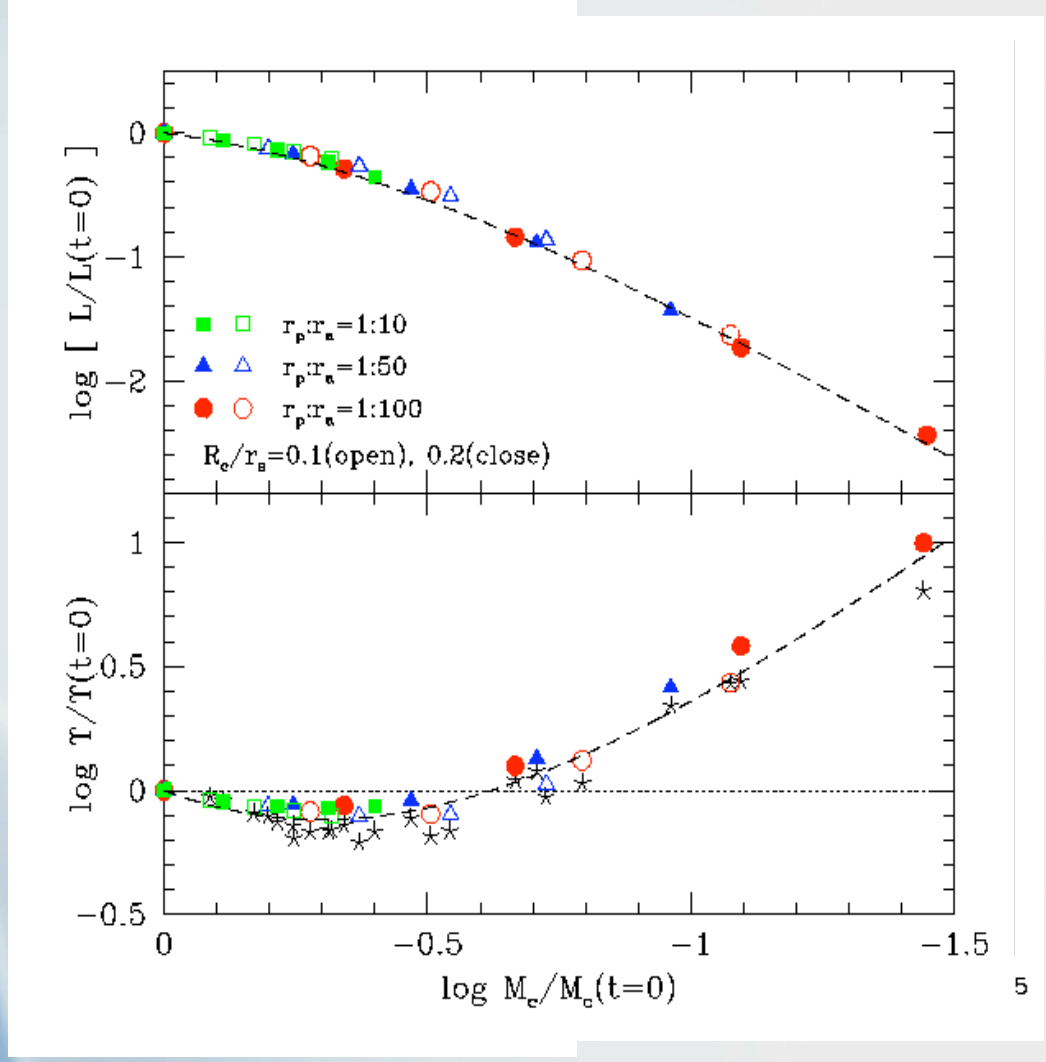
  ↓

  Evolutionary tracks

- In order to determine that parameter for a given system we need to know the rest

  (*orbit, host potential, accretion time, initial structural parameters,…,etc)*

- Study of the dSph **population**



Accuracy of analytical estimates

$\sigma_0 / V_{max} \approx$ const. along the evolution

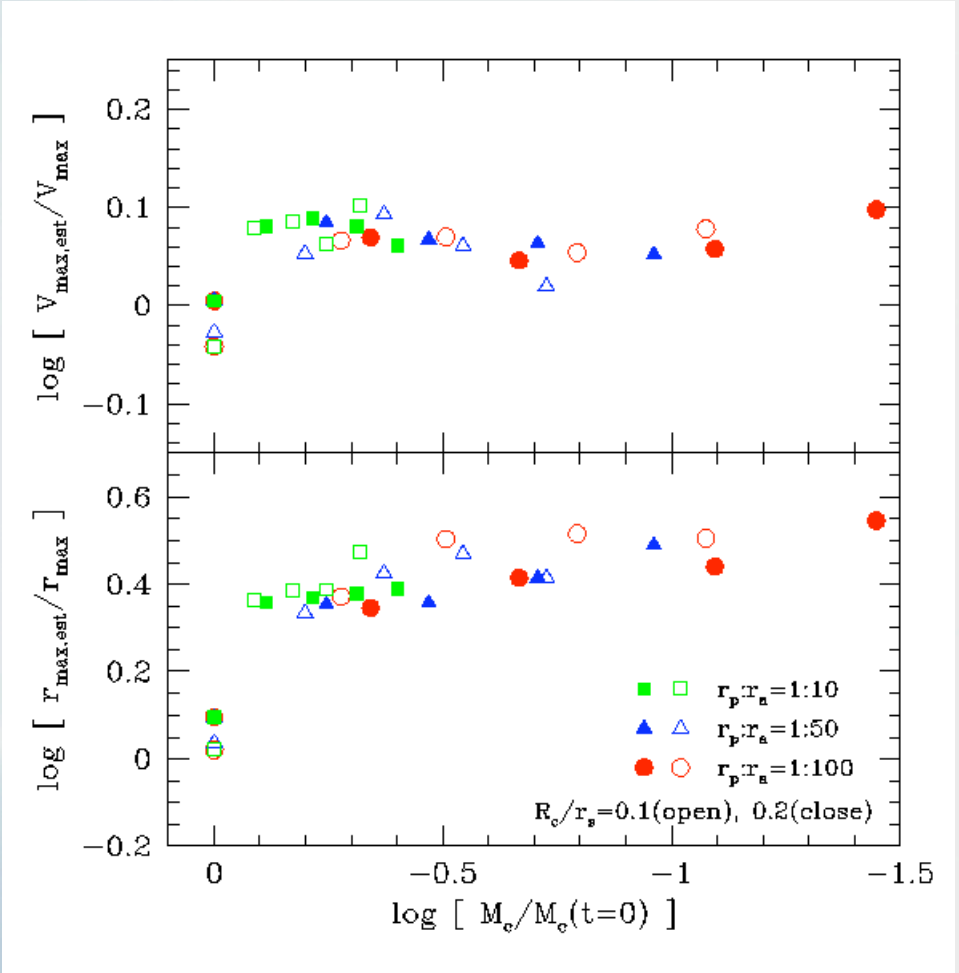
↓

V_{max} estimate accurate to 30%

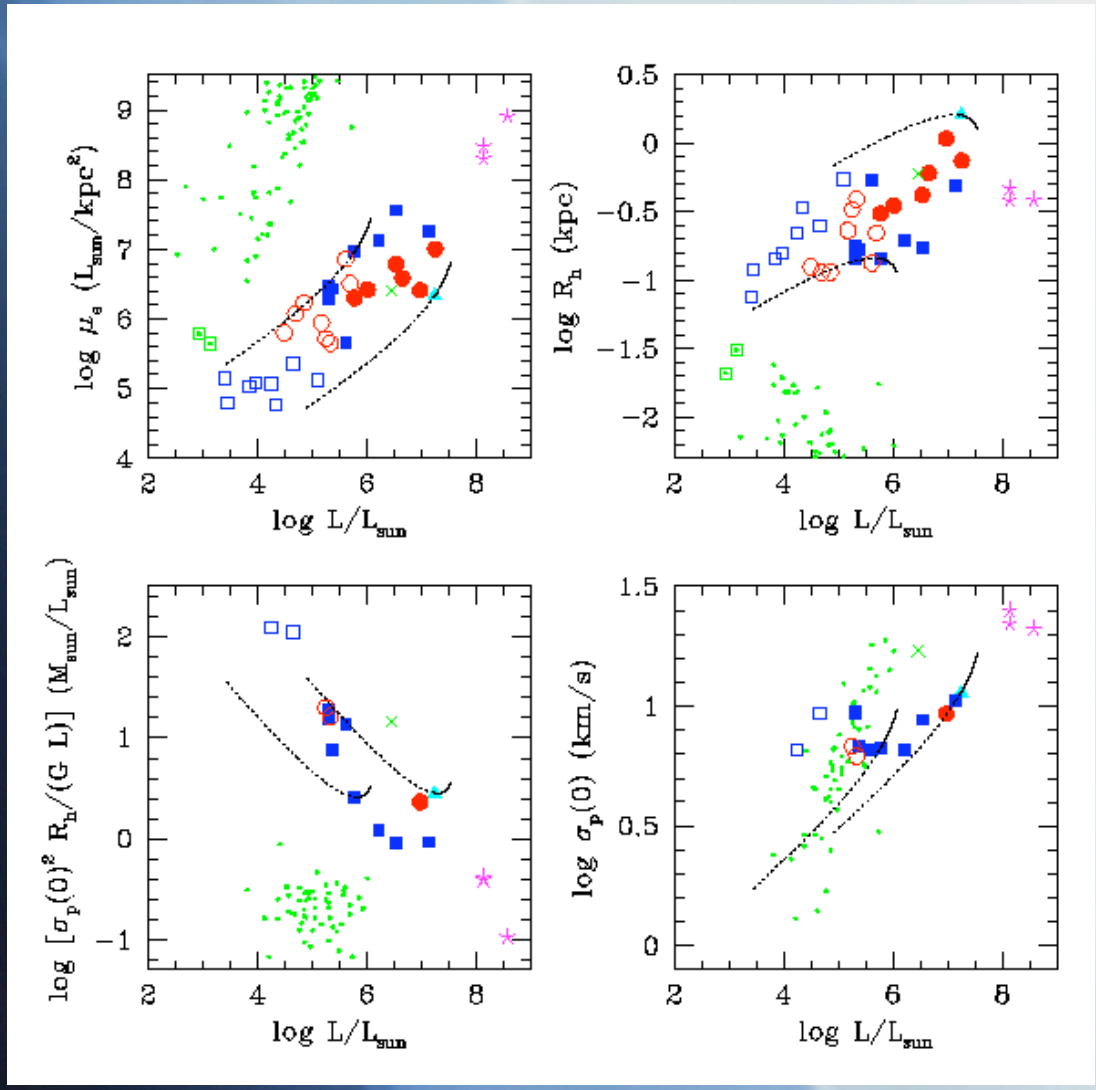
R_c / r_{max} may *increase* up to factor 10

↓

r_{max} may be overestimated up to a factor 3



Evolutionary tracks of dSphs



- Mass stripping preserves the relationship

  $\mu_e \longleftrightarrow L$

  (supernova feedback? Dekel & Woo 2003)
- Mass stripping preserves the relationship

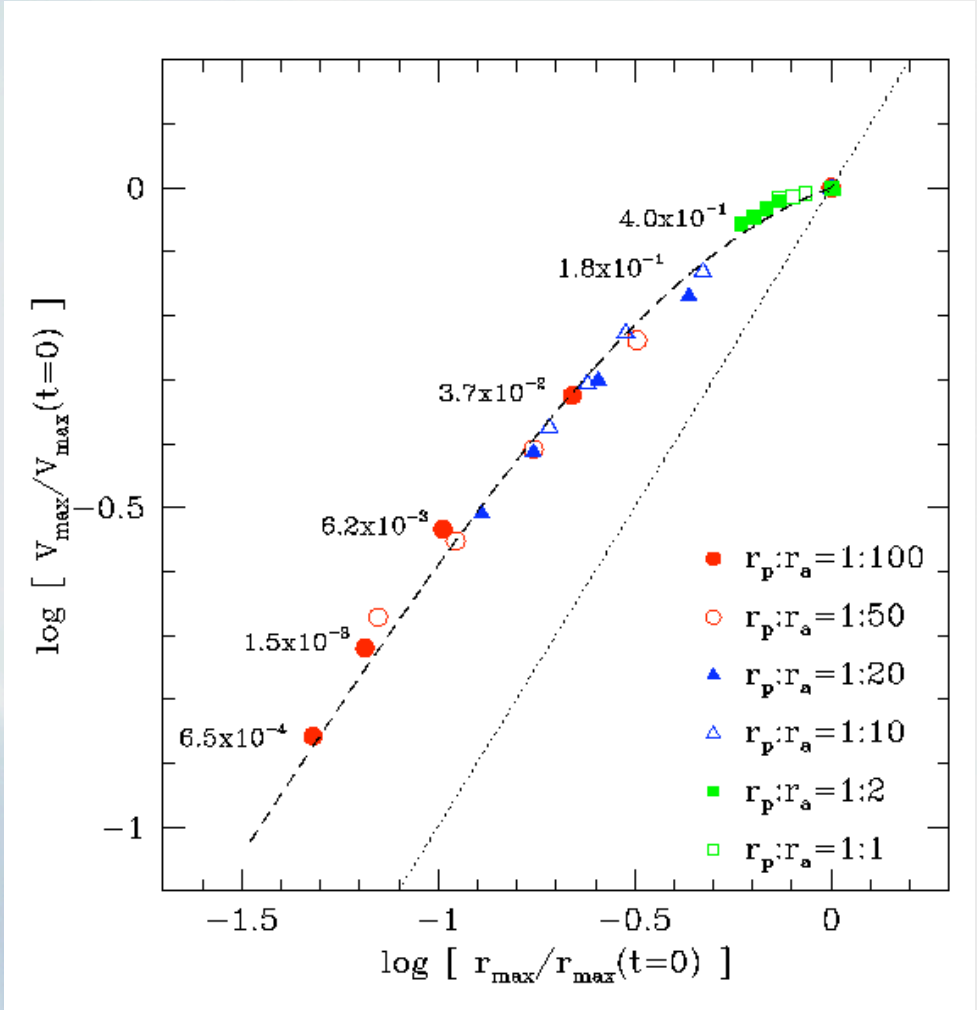
  $M/L \longleftrightarrow L^{-1}$
- Dark dSphs can be stripped versions of luminous dSphs if

  $\sigma_p \sim 1\text{--}3$ km/s

…. etc

…on the dark matter halo

- r_{max} and V_{max} both decrease under tidal mass stripping
- They follow a single evolutionary path as a function of the bound mass fraction (Hayashi et al. 2003)



Constraints on Cosmology

1. Deriving the dark matter distribution from the luminous component

   Dark matter profile compatible with CDM expectations??

   Wilkinson et al. (2002, 2006), Lokas et al. (2002, 2005), Kormendy & Freeman (2004), Gilmore (2006)

2. Deriving the CDM halo properties from the luminous component

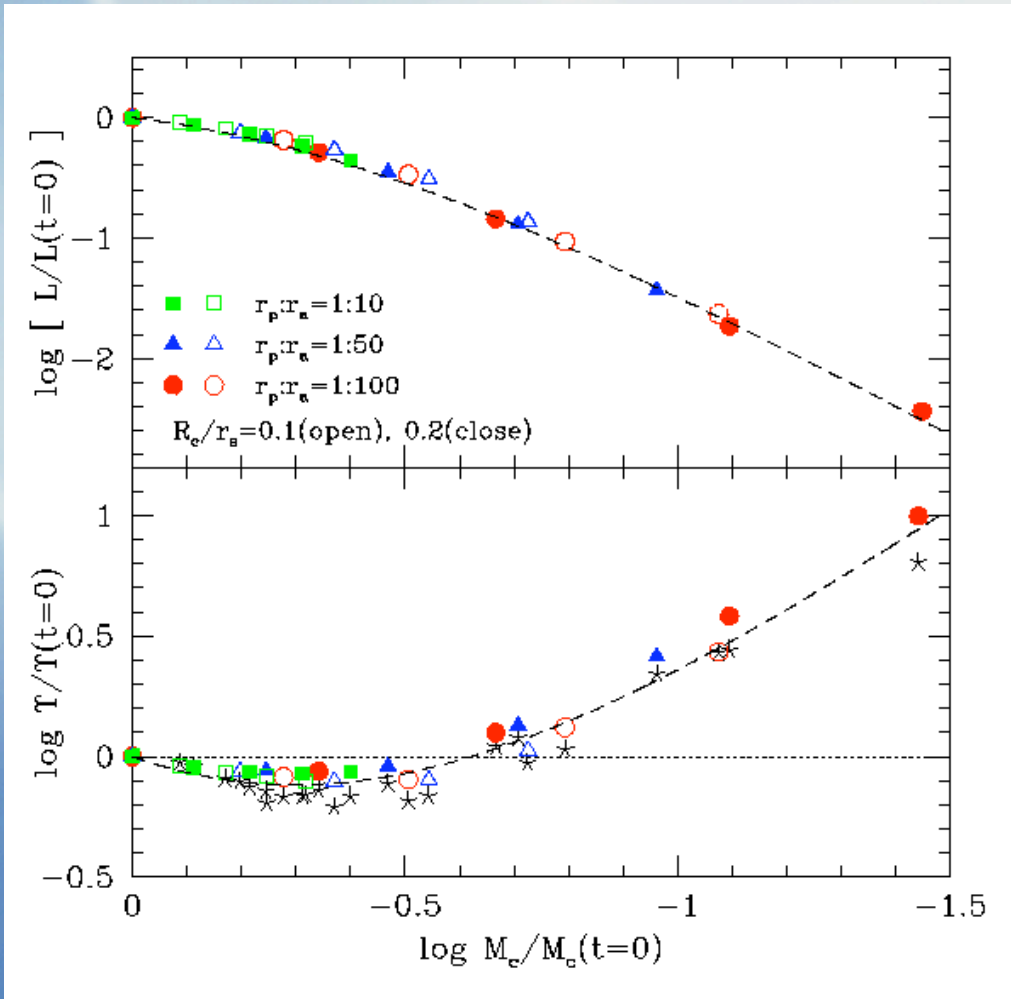
   dSph halo parameters compatible with CDM expectations ??

   (we use what we have learnt from CDM simulations…)

   Strigari et al. (2006, 2007), Peñarrubia et al. (2007)

3. Alternative scenarios

   dSph with no dark matter (Pavel's talk)


log [L/L(t=0)]
0
−1
−2
r_p:r_a=1:10
r_p:r_a=1:50
r_p:r_a=1:100
R_c/r_a=0.1(open), 0.2(close)
log T/T(t=0)
1
0.5
0
−0.5
0
−0.5
−1
−1.5
log M_c/M_c(t=0)