The effect of

on the Sculptor dSph*

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*Based on **Iorio+19:** http://adsabs.harvard.edu/doi/10.1093/mnras/stz1342

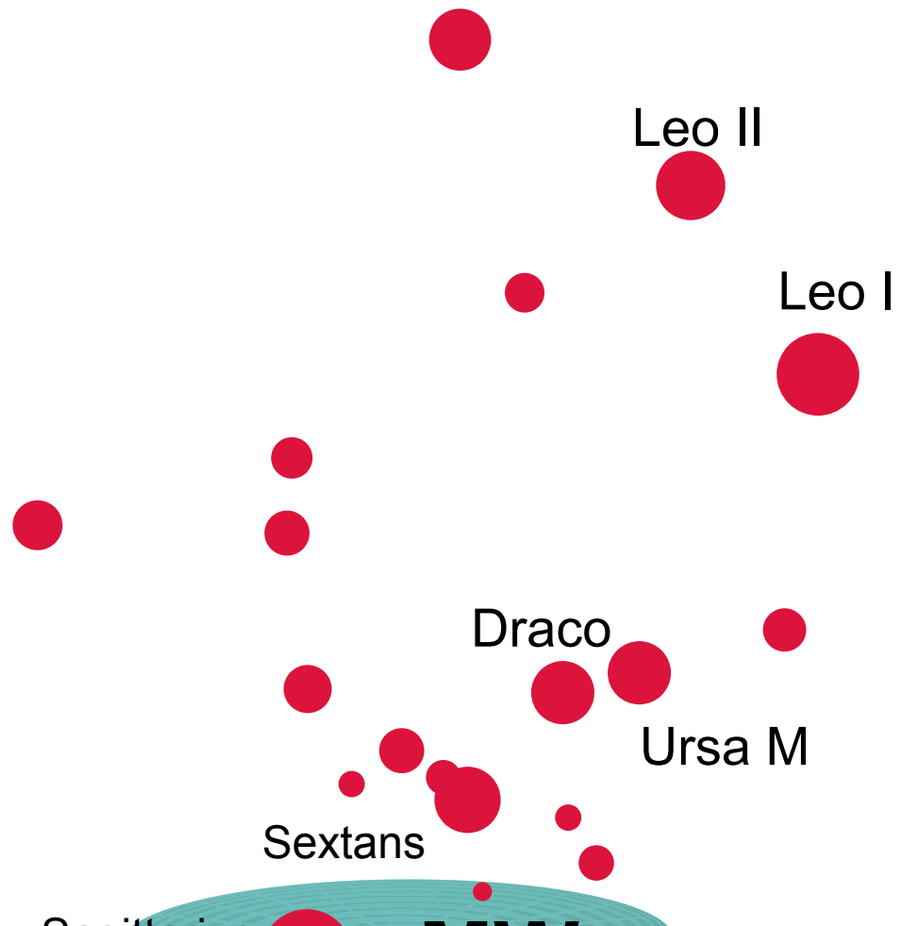
Collaborators

C. Nipoti, G. Battaglia, A. Sollima

Background

MW dSph satellites

live in tidal fields

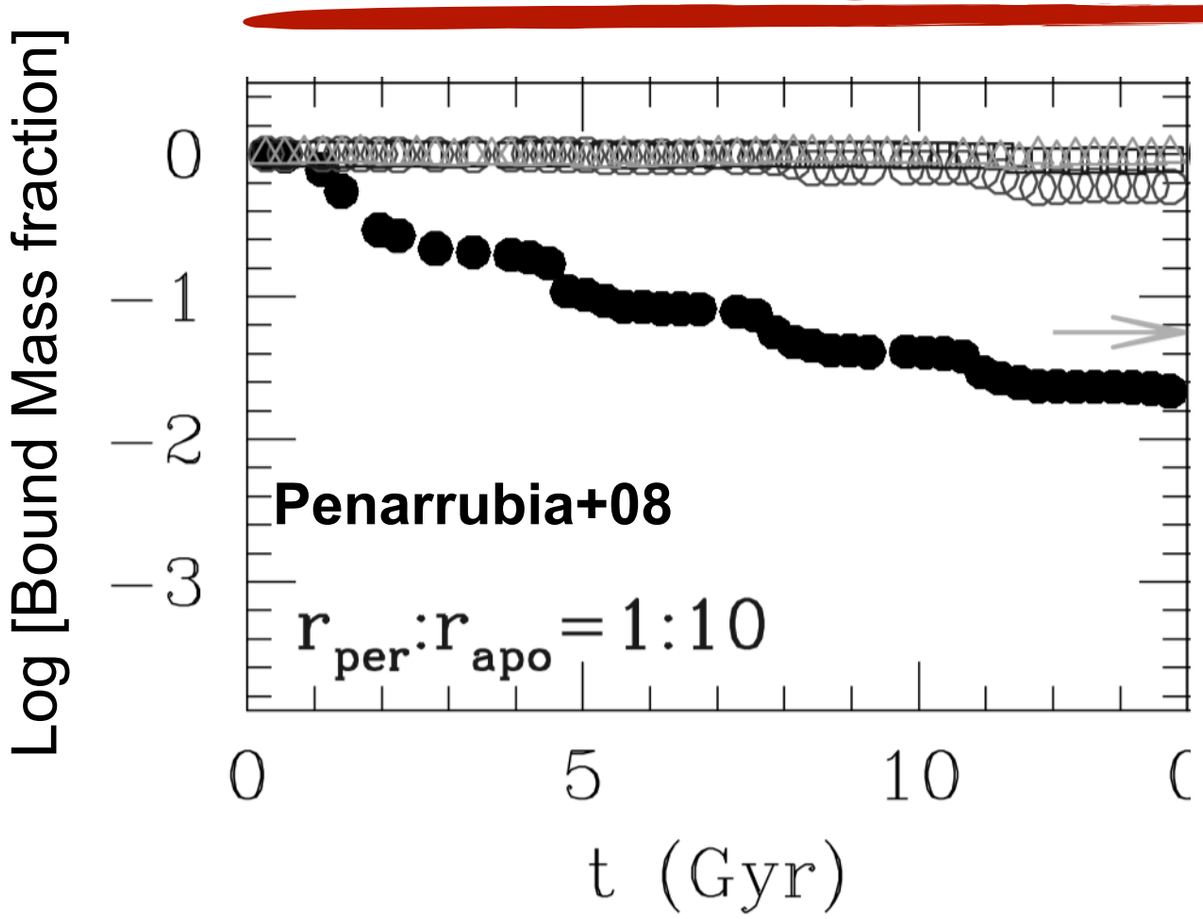


Carina dSph, Monelli+13

Fornax dSph, HST

Background

Seven sisters, near Brighton, tides are removing 60 cm/yr of cliff material.



Tidal evolution **Properties of galaxies changed by tidal effects**

(e.g. Read+06, Penarrubia+08,09; Fatthai+18)

Kinematic bias **Unbound stars can bias the los kinematics**

Overestimate the M/L ratio

(e.g. Klimentowski+19, Hammer+18)

Are stars in dSphs good dynamical tracers?
Can we assume dSphs in equilibrium?

Aim & Method

Study the **tidal evolution** of a single object with ***N*-body** simulations tuned to reproduce **observations** (see Battaglia+15)

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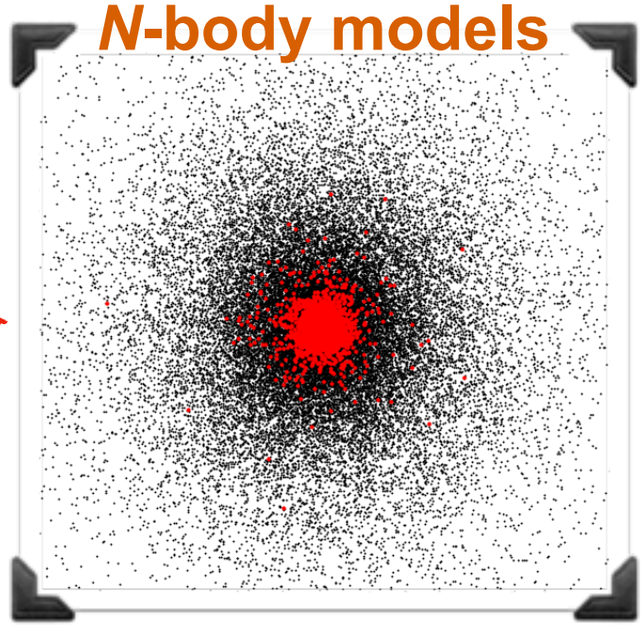
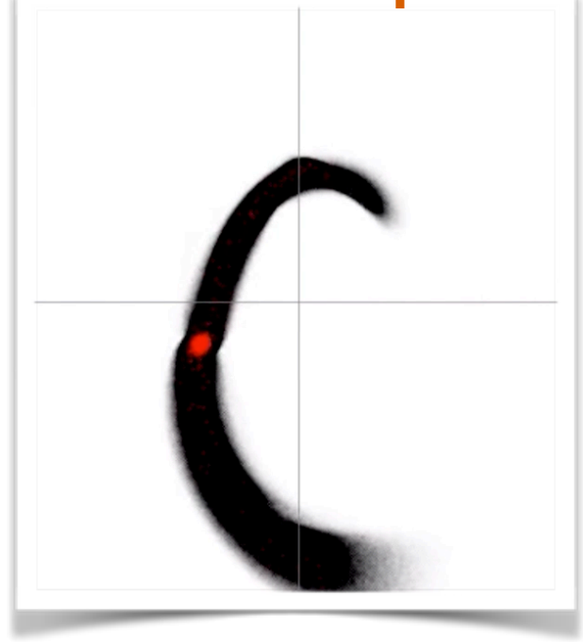
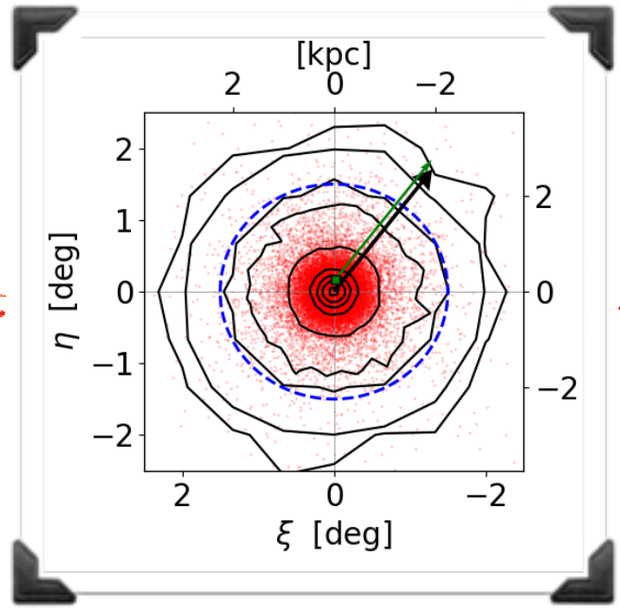
N-body models



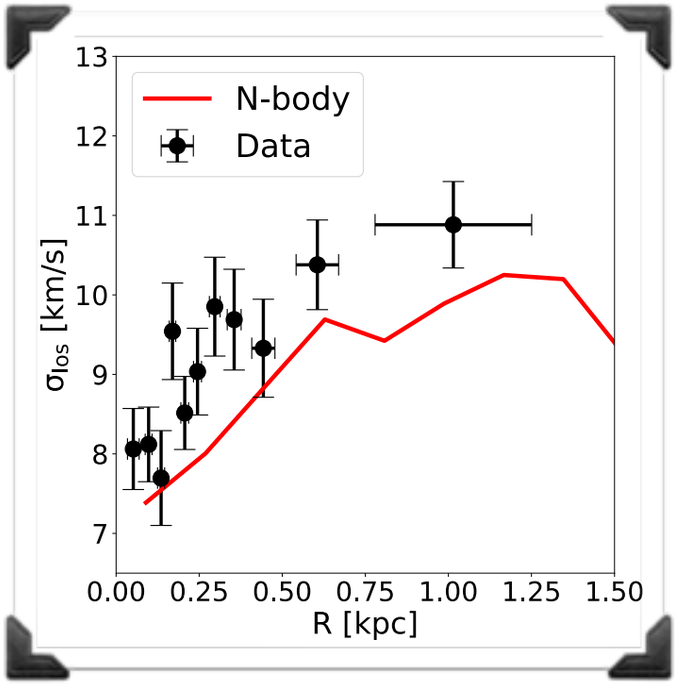
Evolve in MW potential



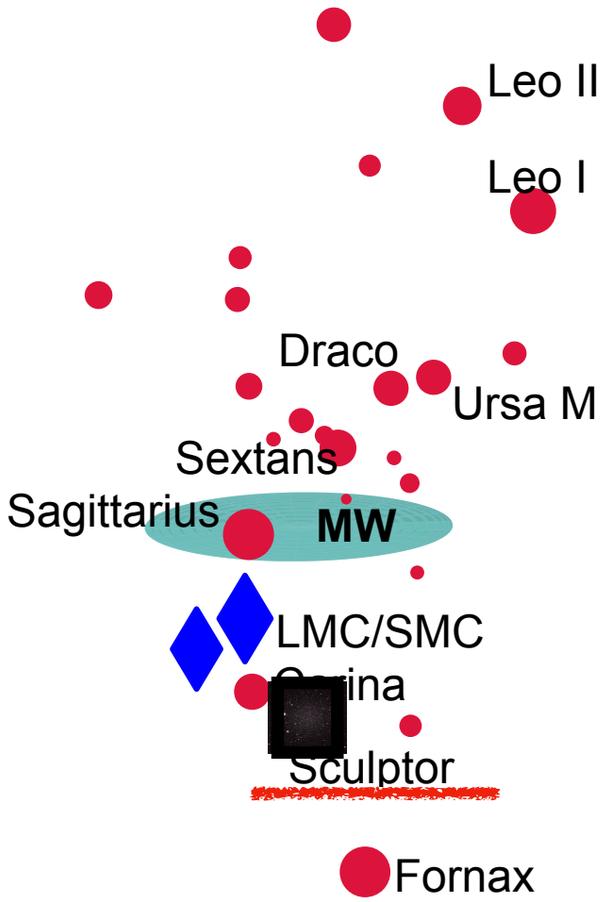
“Observe” last-snapshot



Compare with observations



Sculptor dSph



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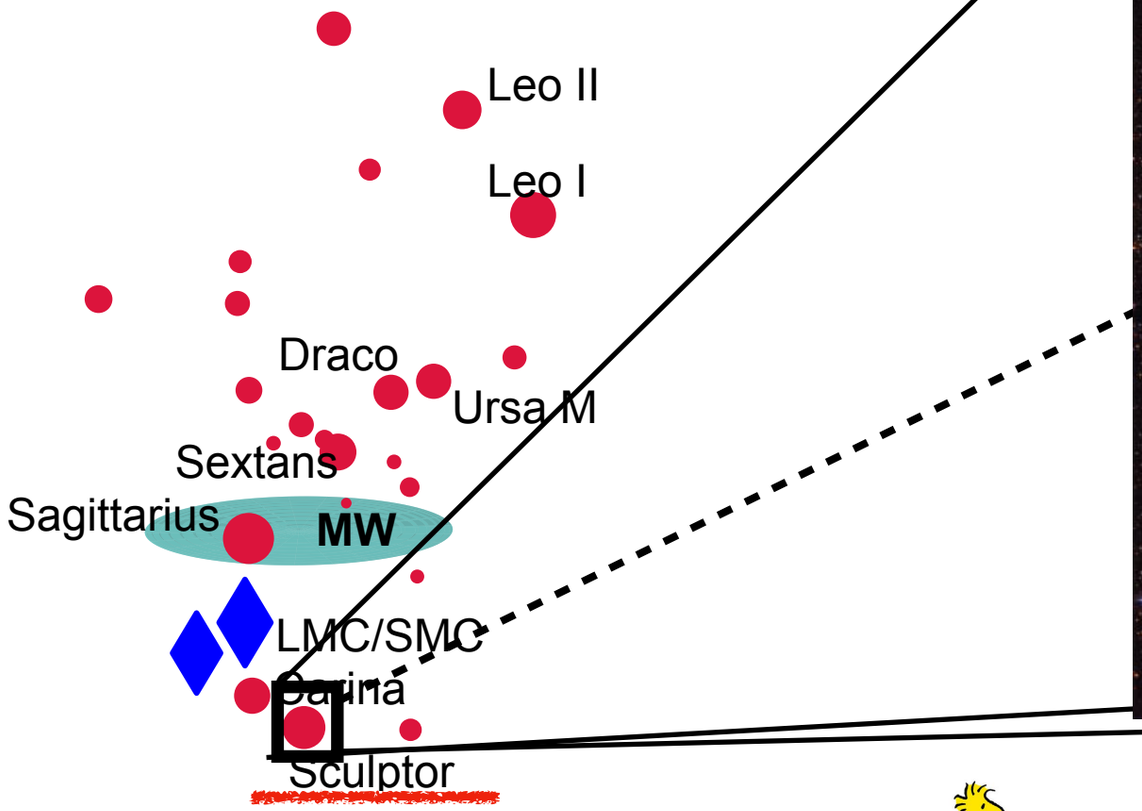



Image credit: ESO.

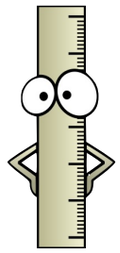
$D = 86$ kpc

$L_* = 2.3 \times 10^6$ $L_\odot$

$M_* \approx 4.5 \times 10^6$ $M_\odot$

$\sigma_{los} \approx 9$ km/s

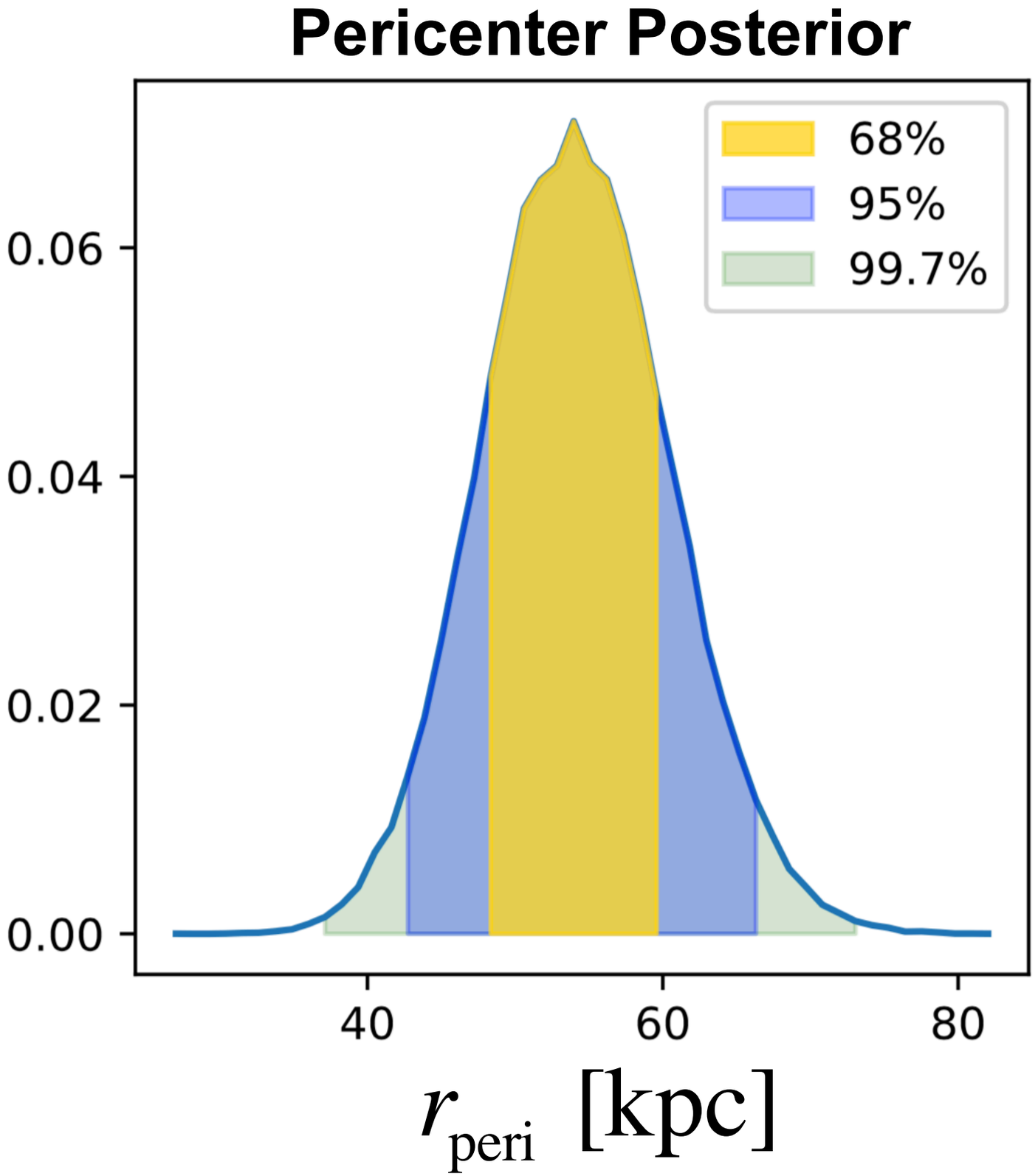
$M/L > 10$



$R_h \simeq 283$ pc

Mateo98 Pietrzynski+08 McConnachie12

Sculptor - Orbit



Sculptor Proper Motion:

Helmi+18 (GAIA DR2)

MW Potential:

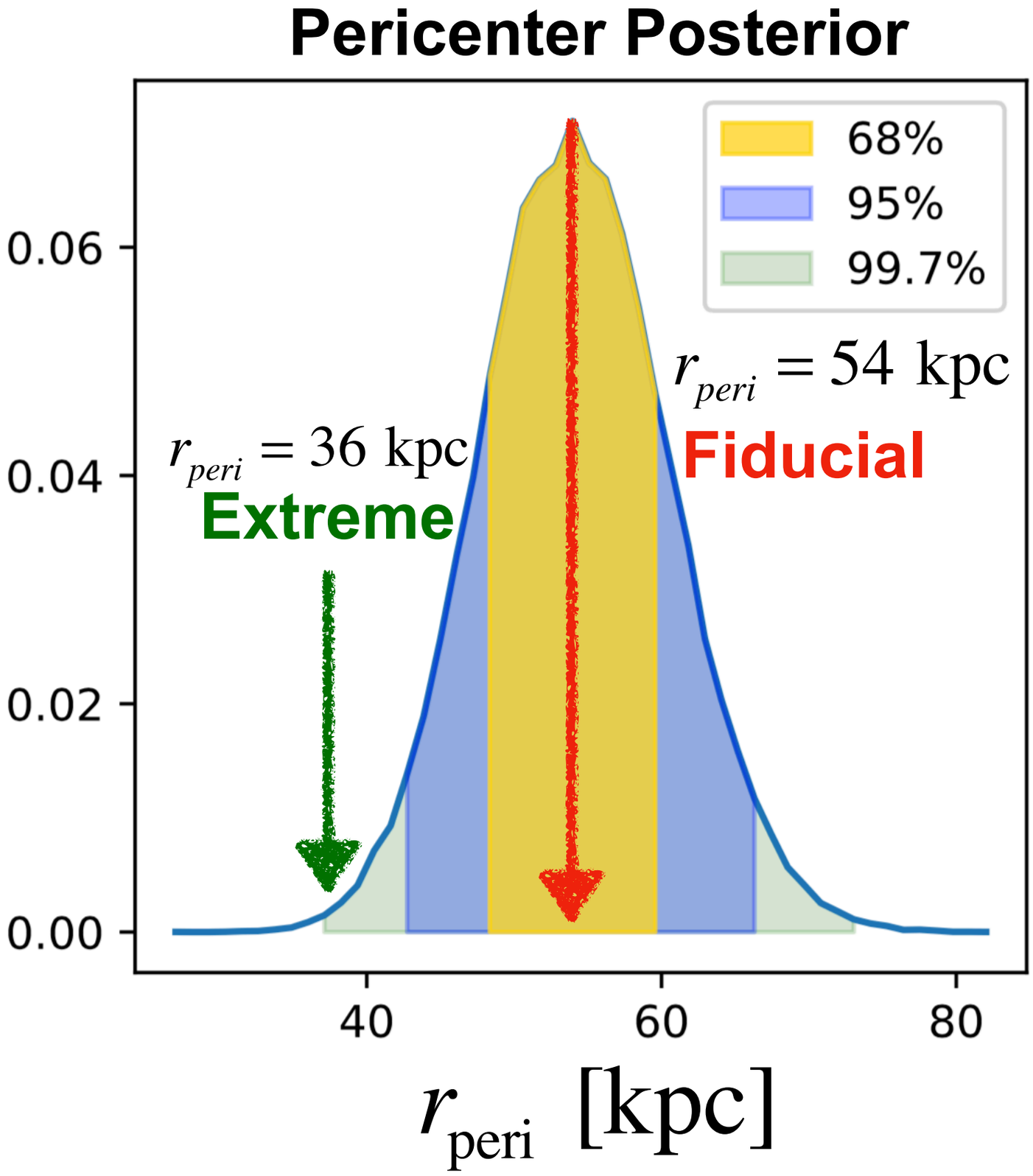
Johnston+95

$M_{\rm MW,\ 200} \approx 2 \times 10^{12}\ {\rm M}_{\odot}$

(see T. Fritz and Z. Li posters)

Heavy MW: Enhance tides

Sculptor - Orbit



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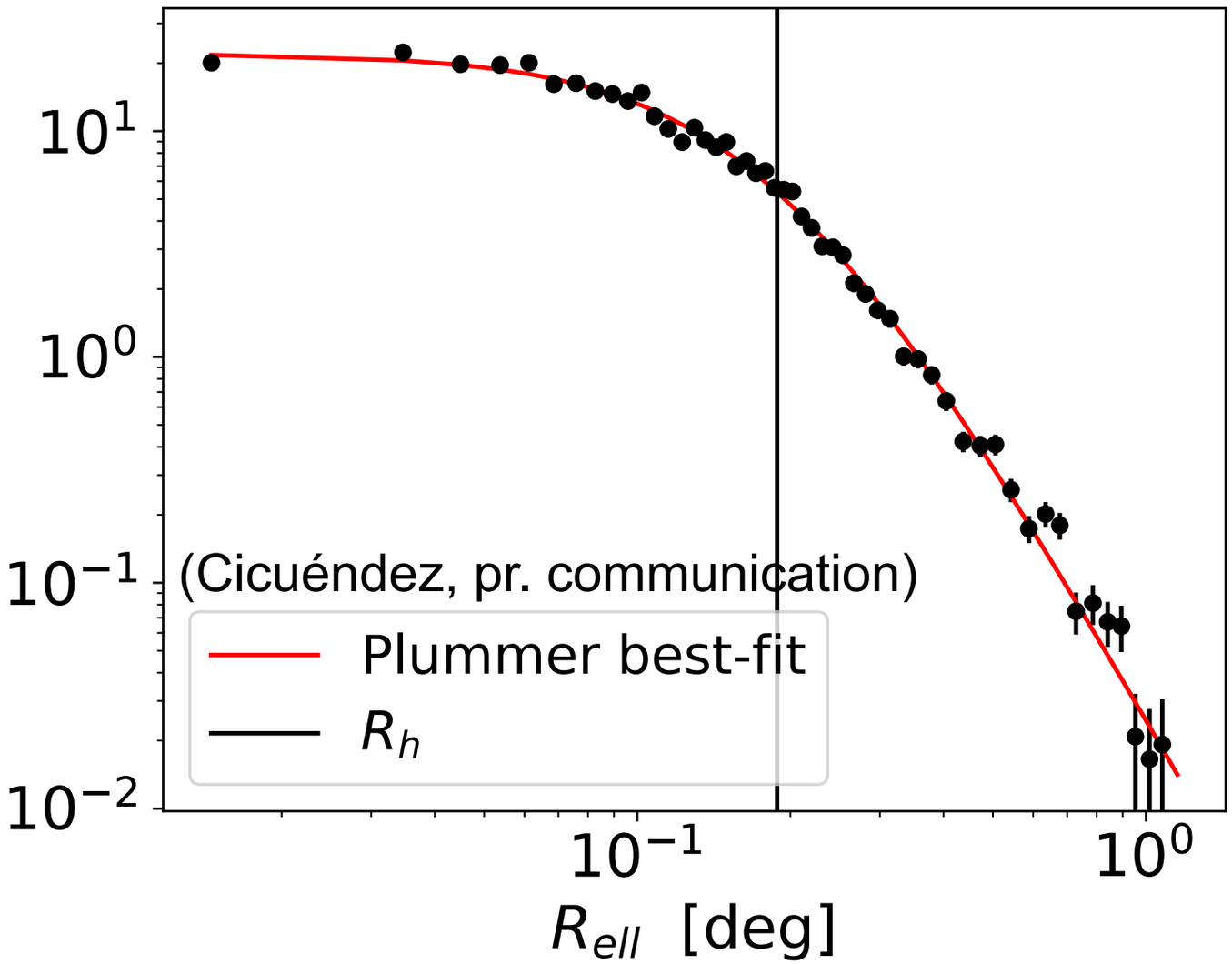
Sculptor Data



Light profile:

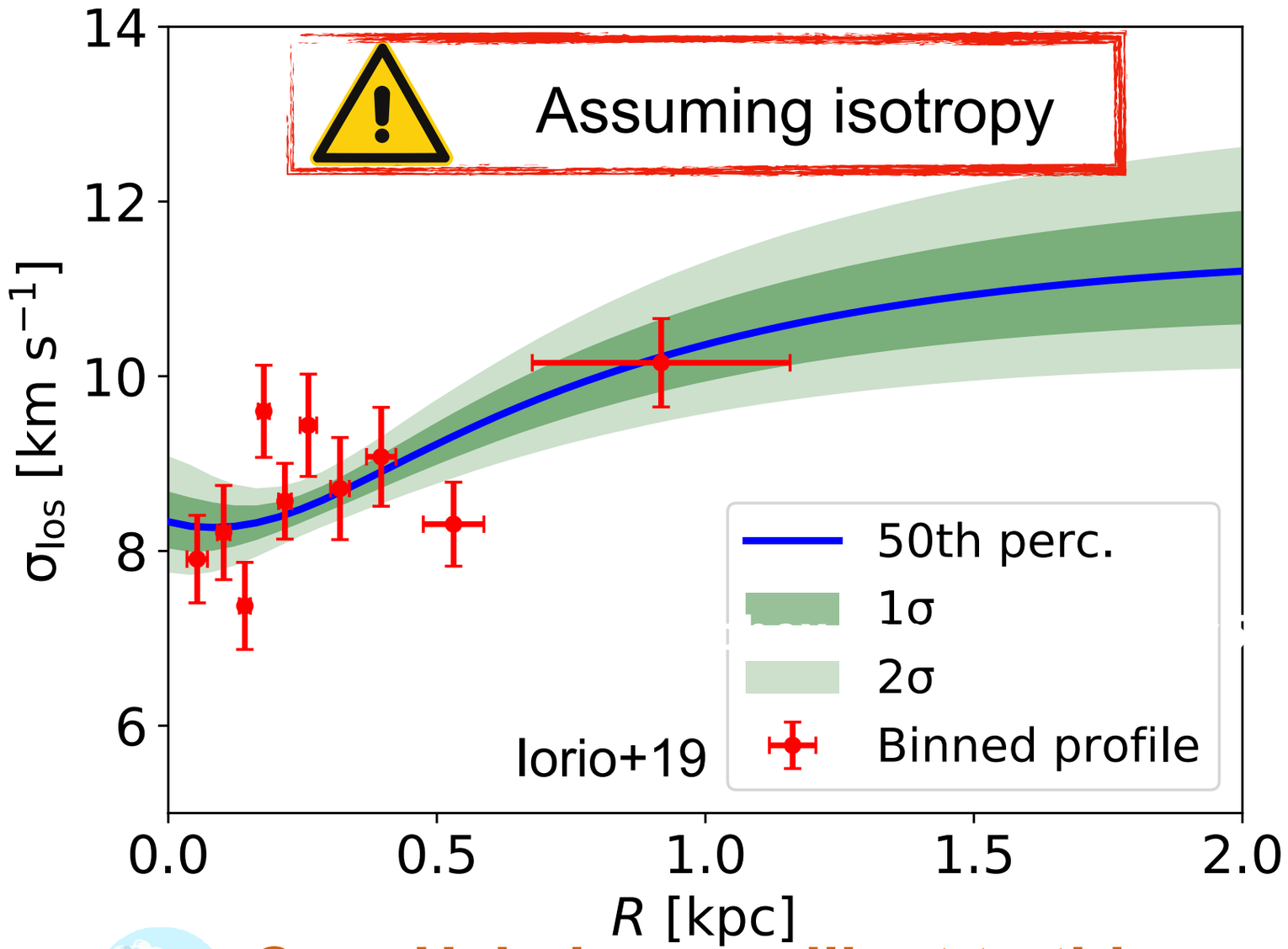
Plummer profile:

$b_* = 11.15'$ (0.28 kpc) $\quad q \simeq 0.77$

(see Cicuéndez+18)

$M_* / L_* = 2$ (Mateo98)

Sculptor Data



Light profile:

Plummer profile:

$b_* = 11.15'\ (0.28\ \mathrm{kpc}) \quad q \simeq 0.8$

(see Cicuéndez+18)

$M_* / L_* = 2$ (Mateo98)

DM profile:

Fit to kinematic datasample:

1543 stars*

Walker+09 Battaglia&Starkenburg12:

NFW-core profile

c200-Mvir relation

(Diemer&Joyce19)

$r_c \approx 0.14\ \mathrm{kpc}$

$M_{200} \approx 2.5 \times 10^9\ \mathrm{M}_\odot$

Core Halo less resilient to tides

(Penarrubia+08,10; Frings+17, **Errani poster**)

See Pascale's talk (next one)

(Walker&Penarrubia+11)
(Lazar+19, Bullock's talk)
(Strigari+18)
(Read's talk)

*https://www.dropbox.com/s/2otqdwvy5i8l9nq/online_material.zip

N-body simulation

Tree-code: **FVFPS** (Londrillo+03,Nipoti+03)

⚠ No Gas, isotropy, spherical

$$N_{star} = 5 \times 10^4 \qquad N_{DM} = 4 \times 10^6 \qquad t_{sim} \approx 6 - 7 \text{ Gyr}$$

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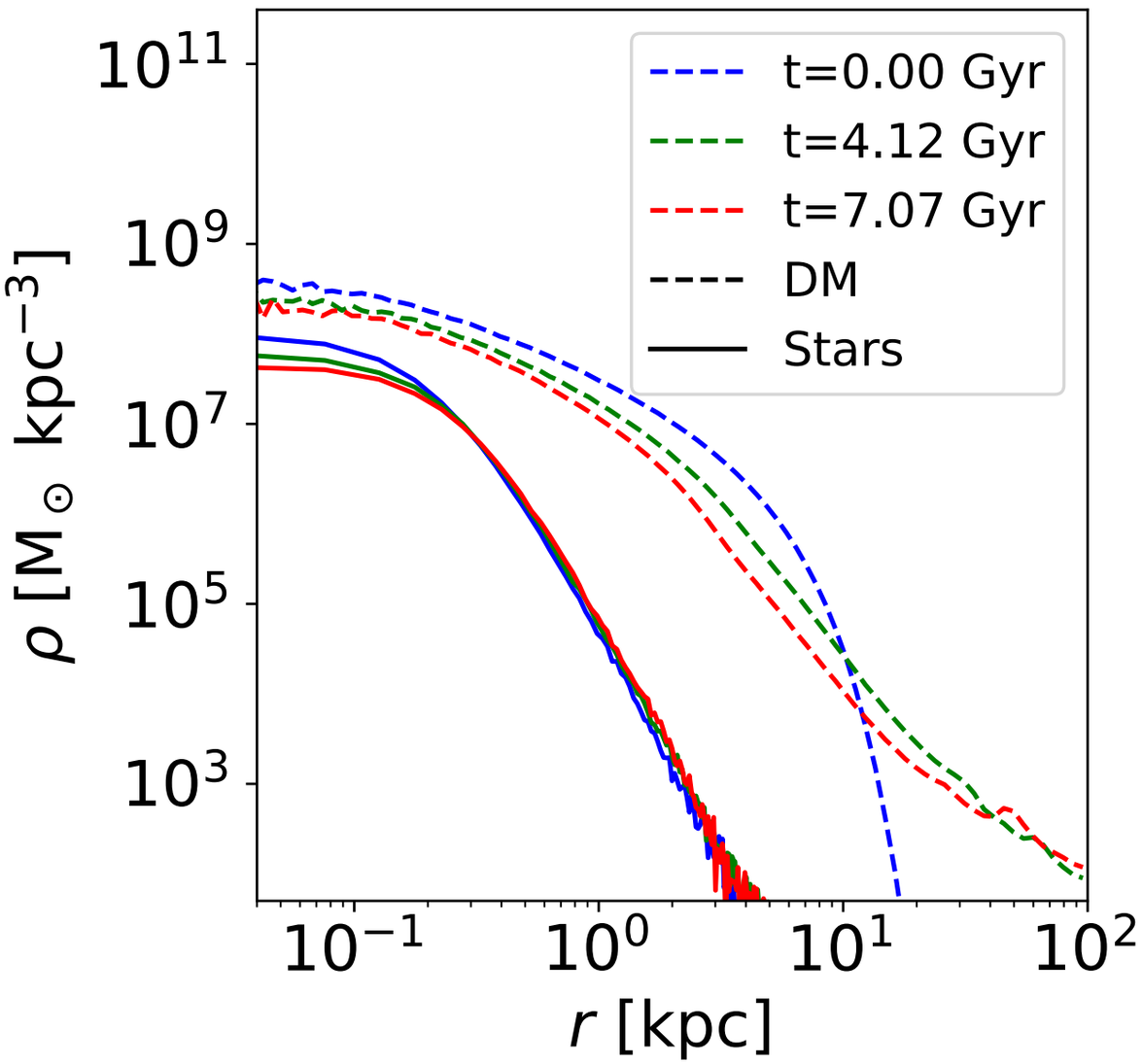
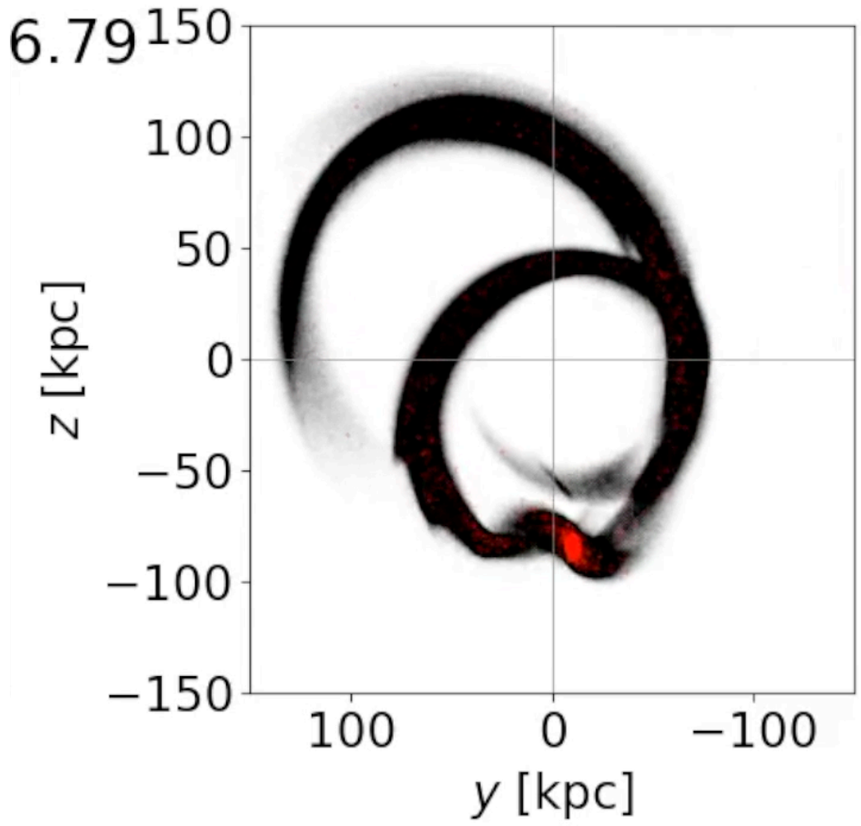
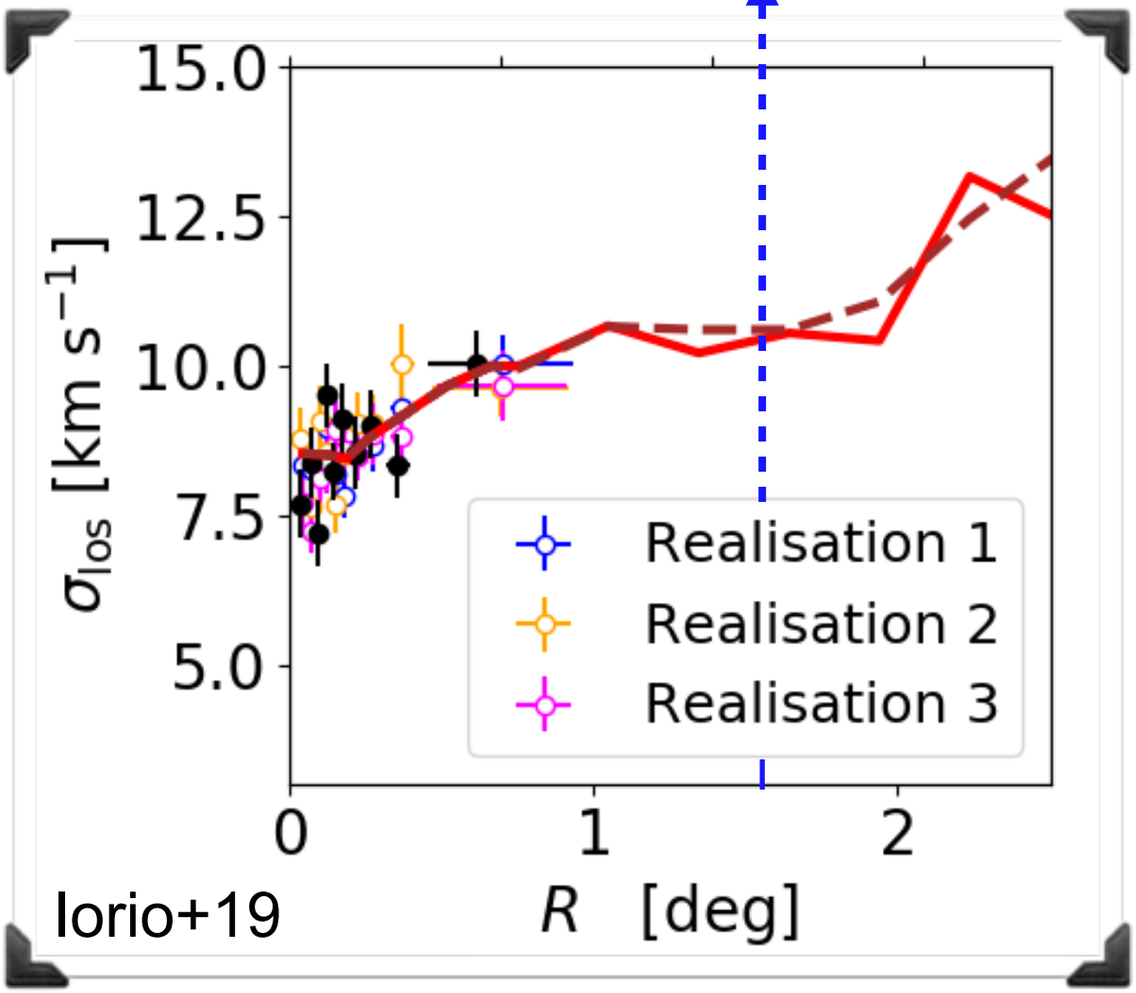


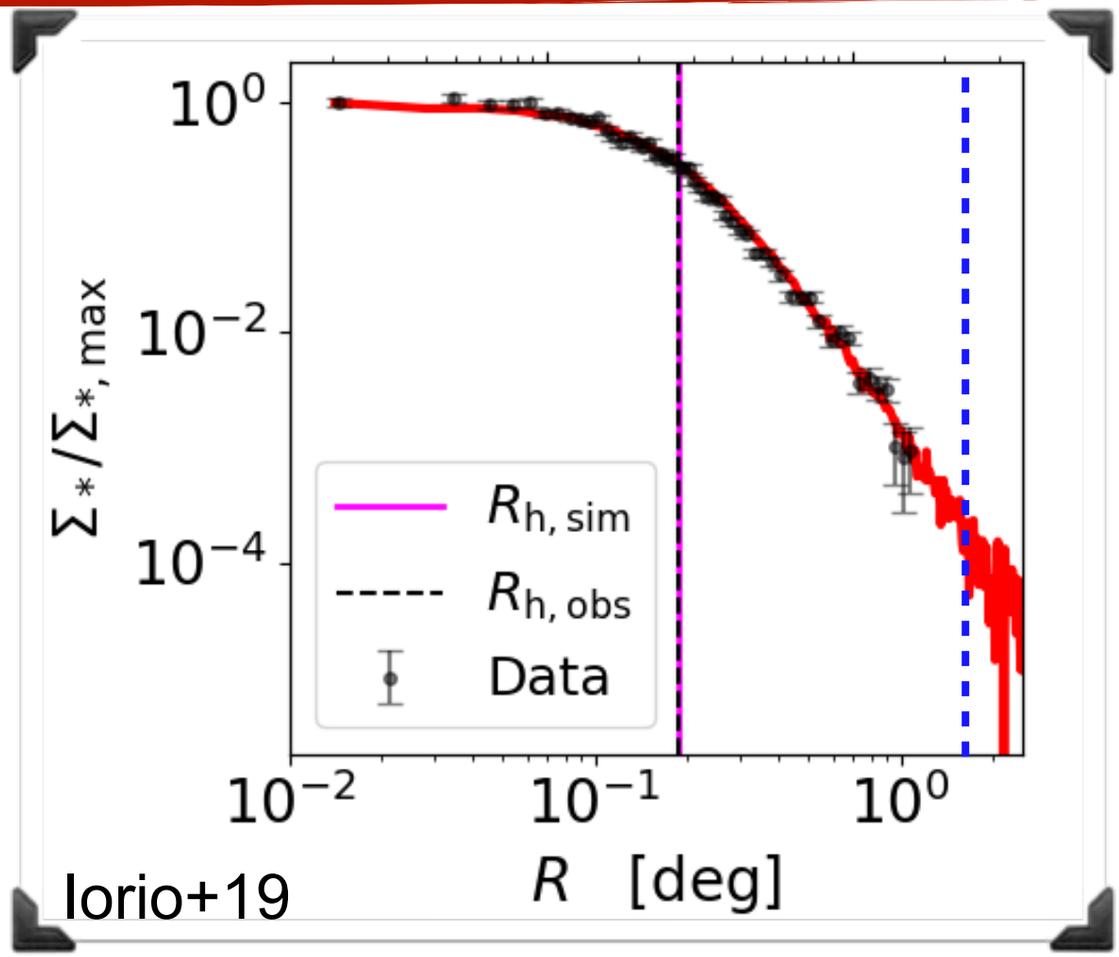


$$\frac{M_{DM}(t=0)}{M_{DM}(t_{sim})} \approx 2 - 4$$

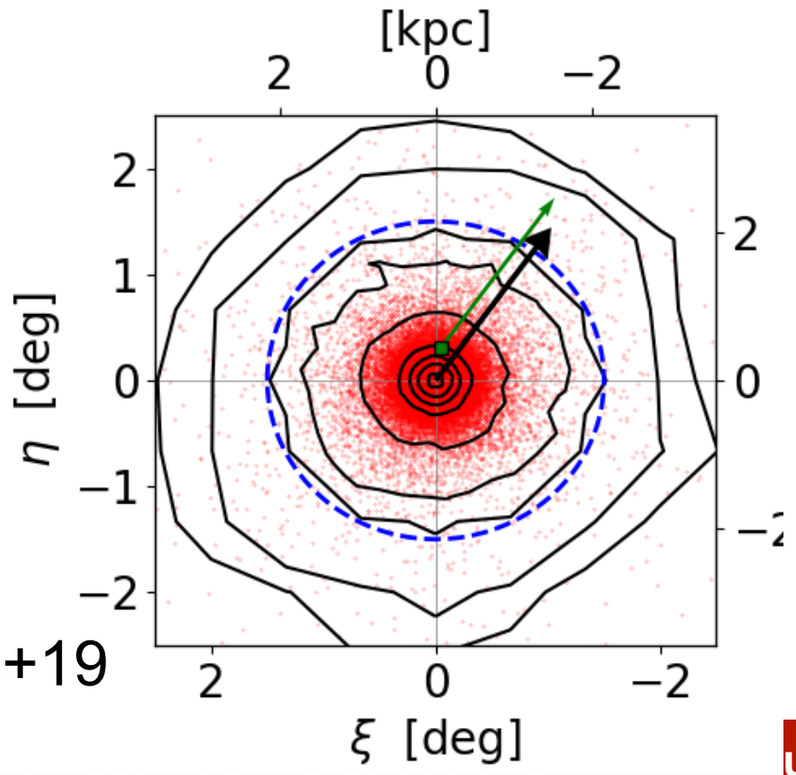
N-body Results

kinematic datasample limit R~1.5 deg





Simulation (Observed) ● Data



Very Good match to Sculptor observables

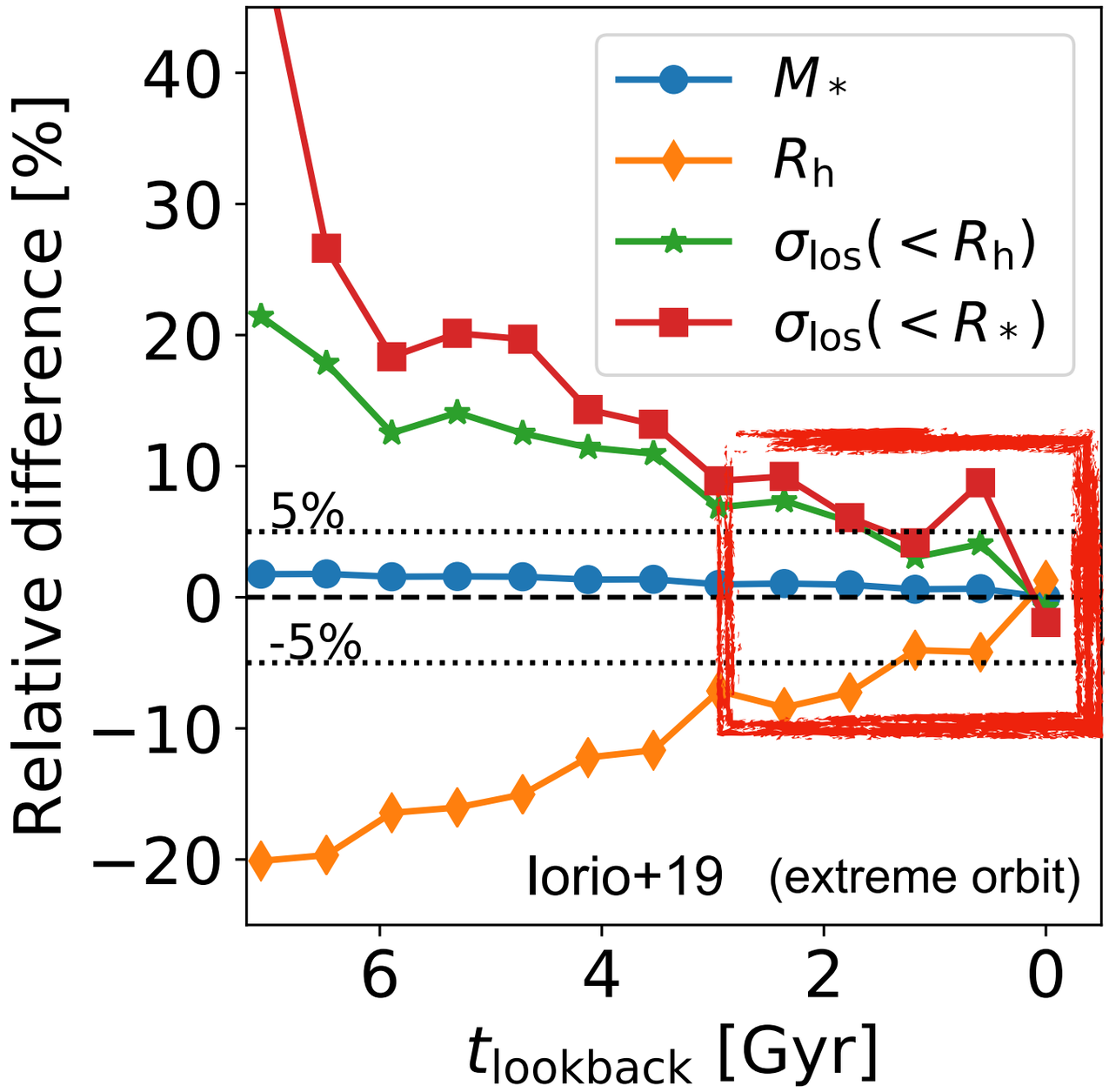
$$M / L(< R_{\rm h}) \approx 6 \qquad M / L(< 1.5^{\circ}) \approx 60$$

(end of iterative method)

No evidence of direct tidal effects

N-body Results

Can we assume Sculptor in equilibrium?

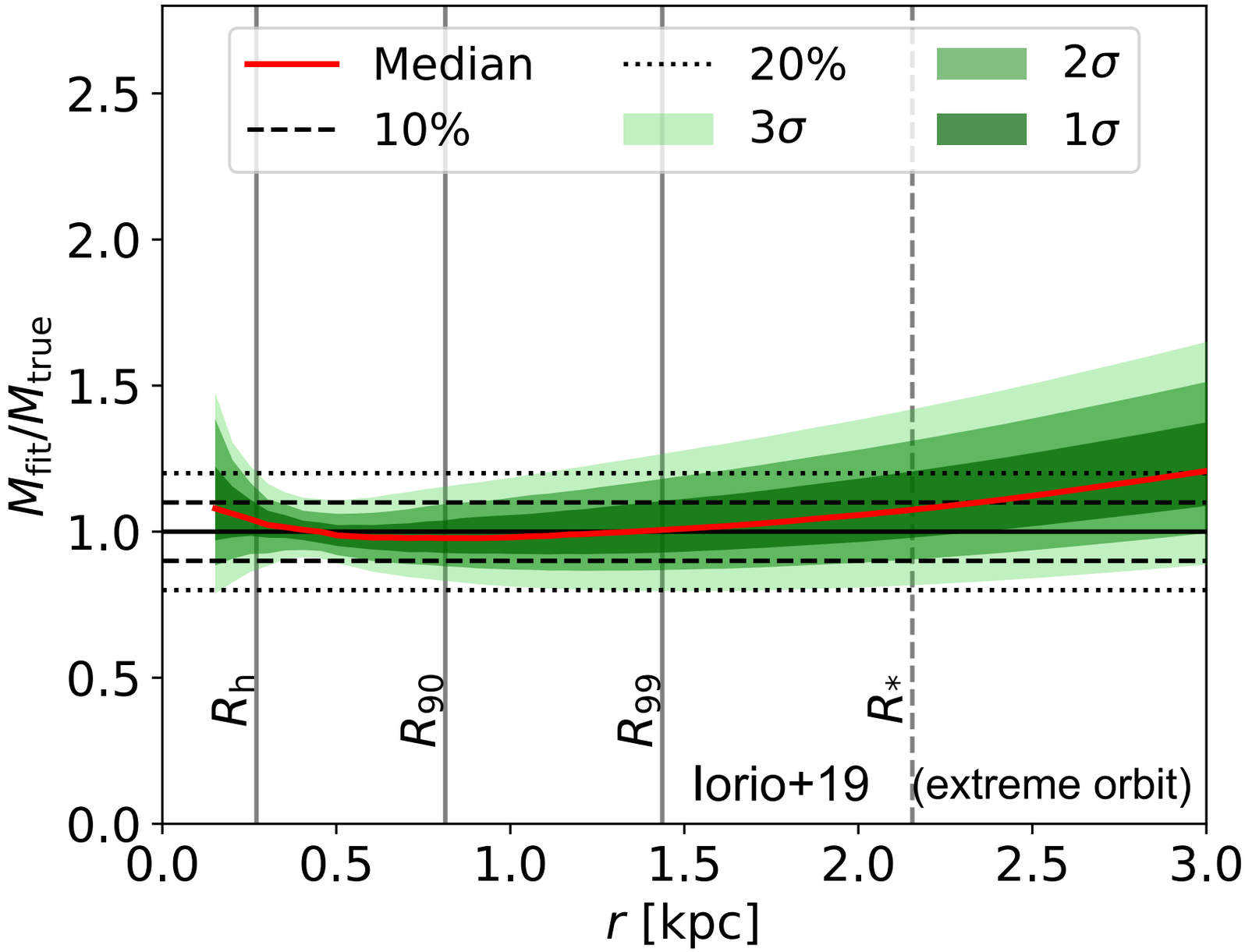


$R_* \approx 2$ kpc

~ Equilibrium
In the last 3 Gyr

N-body Results

Can we assume Sculptor in equilibrium?



$M_{\rm fit}$

dynamical fit to random samples extracted from *N*-body **stellar particles** in the last snapshot

$M_{\rm true}$

Mass profile of the ***N*-body realisation** in the last snapshot

YES!

Take away points

No direct tidal effects on Sculptor's stars

Kinematic catalogues likely free of tidally stripped stars

Can we assume Sculptor (Fornax) in equilibrium?

(see Battaglia+15)

See next talk for a detailed mass modelling of dSphs

Ad-hoc N-body simulation important to interpret observations of MW satellites!

Sohn+07 (Leol) Ural+12 (Carina) Battaglia+15 (Fornax)

Sanders+18 (Crater II) Torrealba+18 (Vasily's Talk) (Antlia 2)