

The shape of the Milky Way's dark matter halo

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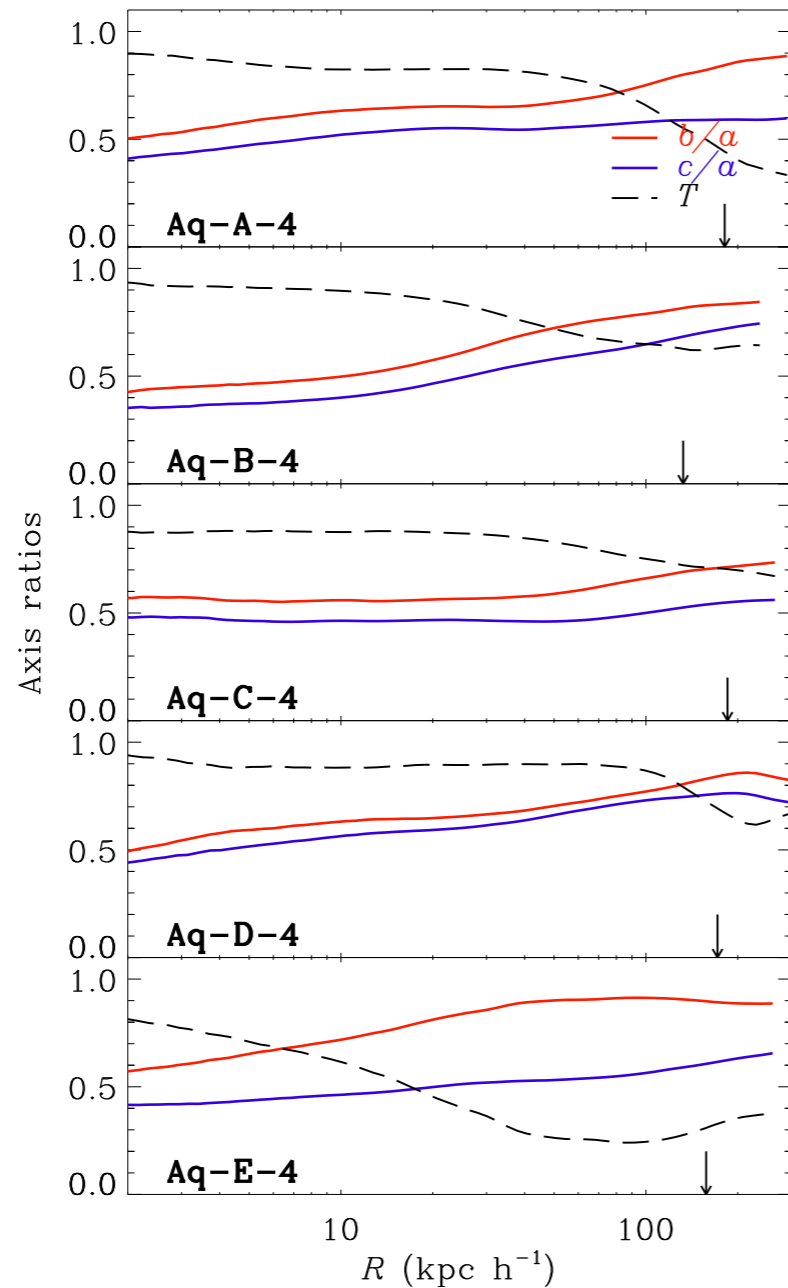
Amina Helmi



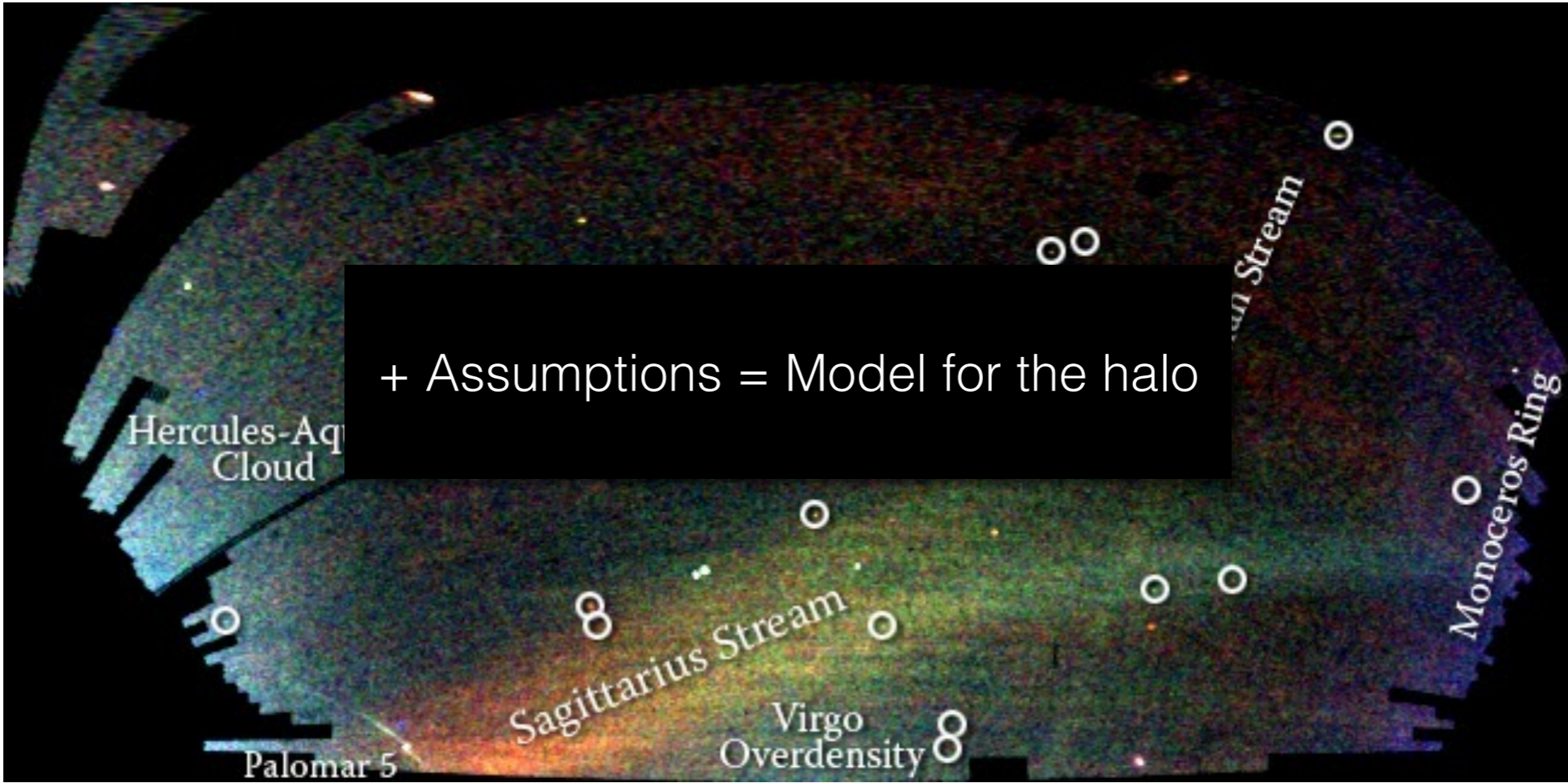
The questions

- Is the shape of the Milky Way's dark halo another 'unsolved' challenge for LCDM?

Predictions from LCDM



shapes of MW-like halos
assembled in CDM

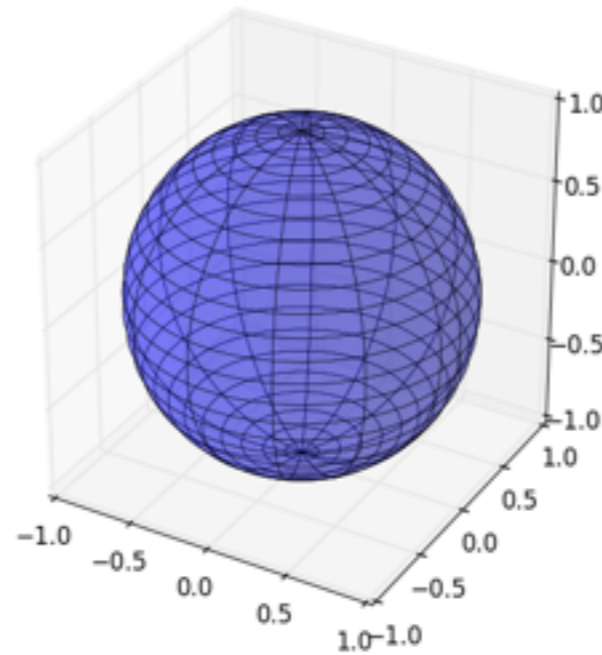


About the assumptions

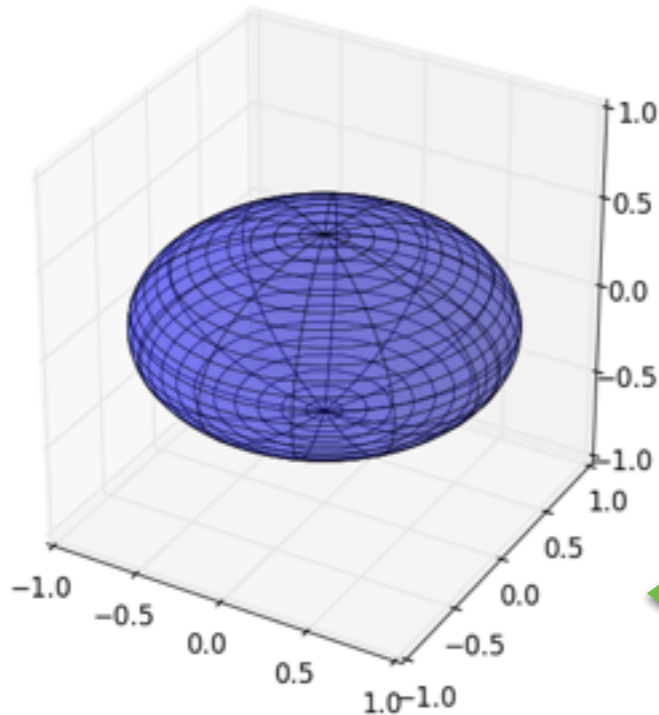
- The stream closely traces the orbit of the progenitor
(although see Eyre & Binney 2011, Gibbons et 2014, Price-Whelan & Johnston 2013, (...))
- The geometry of the underlying MW potential is static: dark halo, disk & bulge (Belokurov?)
- The stream is only affected by the potential of the MW

A simple model

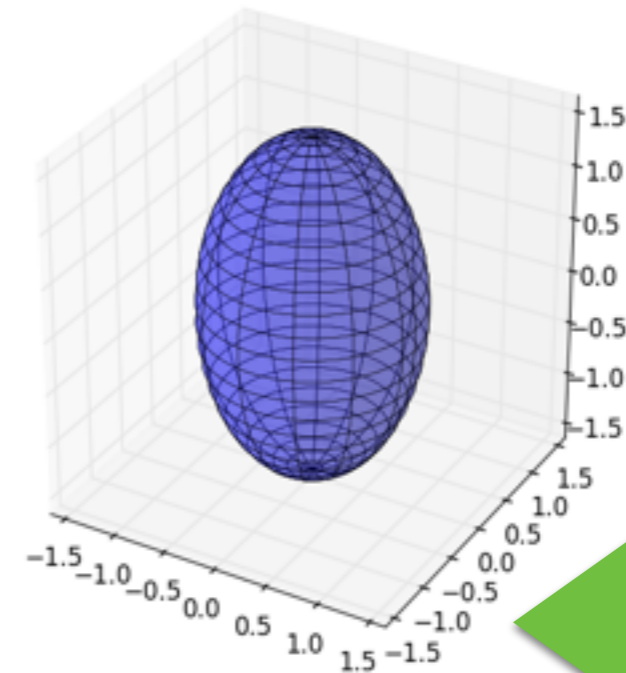
$$\Phi_{\text{halo}} = \Phi_{\text{halo}}(x^2 + y^2 + z^2/q^2)$$



$q=1$, spherical

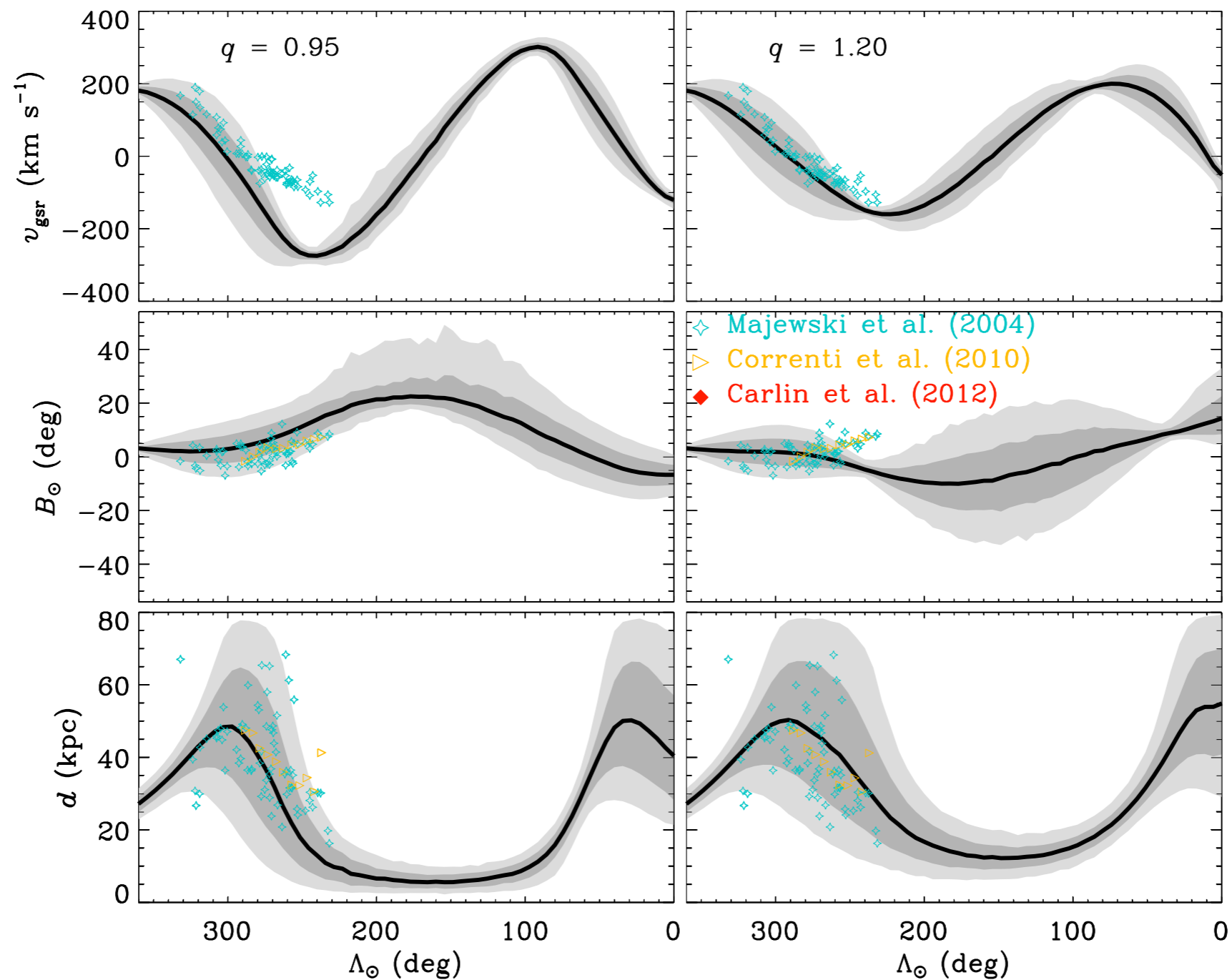


$q < 1$, oblate



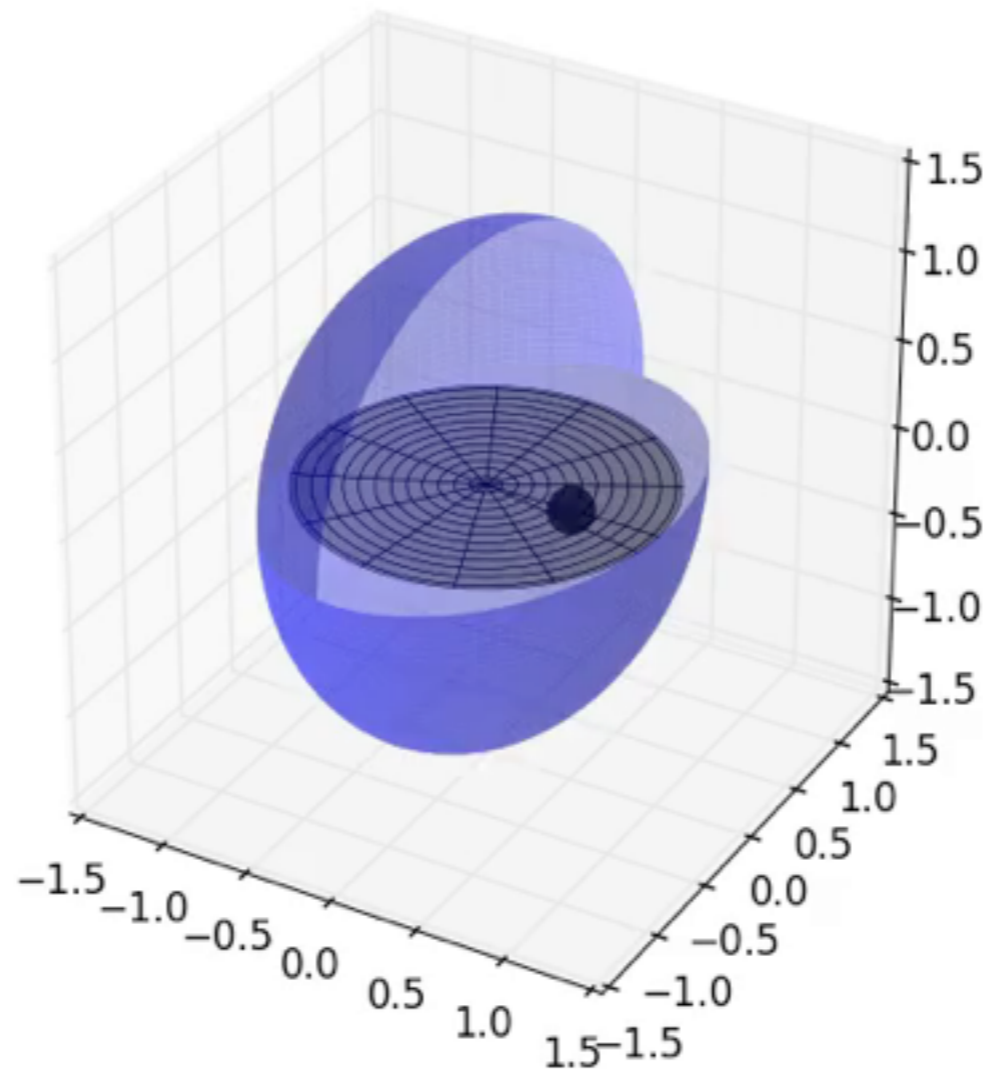
$q > 1$, prolate

Oblate or Prolate?



The solution ...

- Not prolate, not oblate ... just triaxial (Lava & Majeski 2010)



Some issues

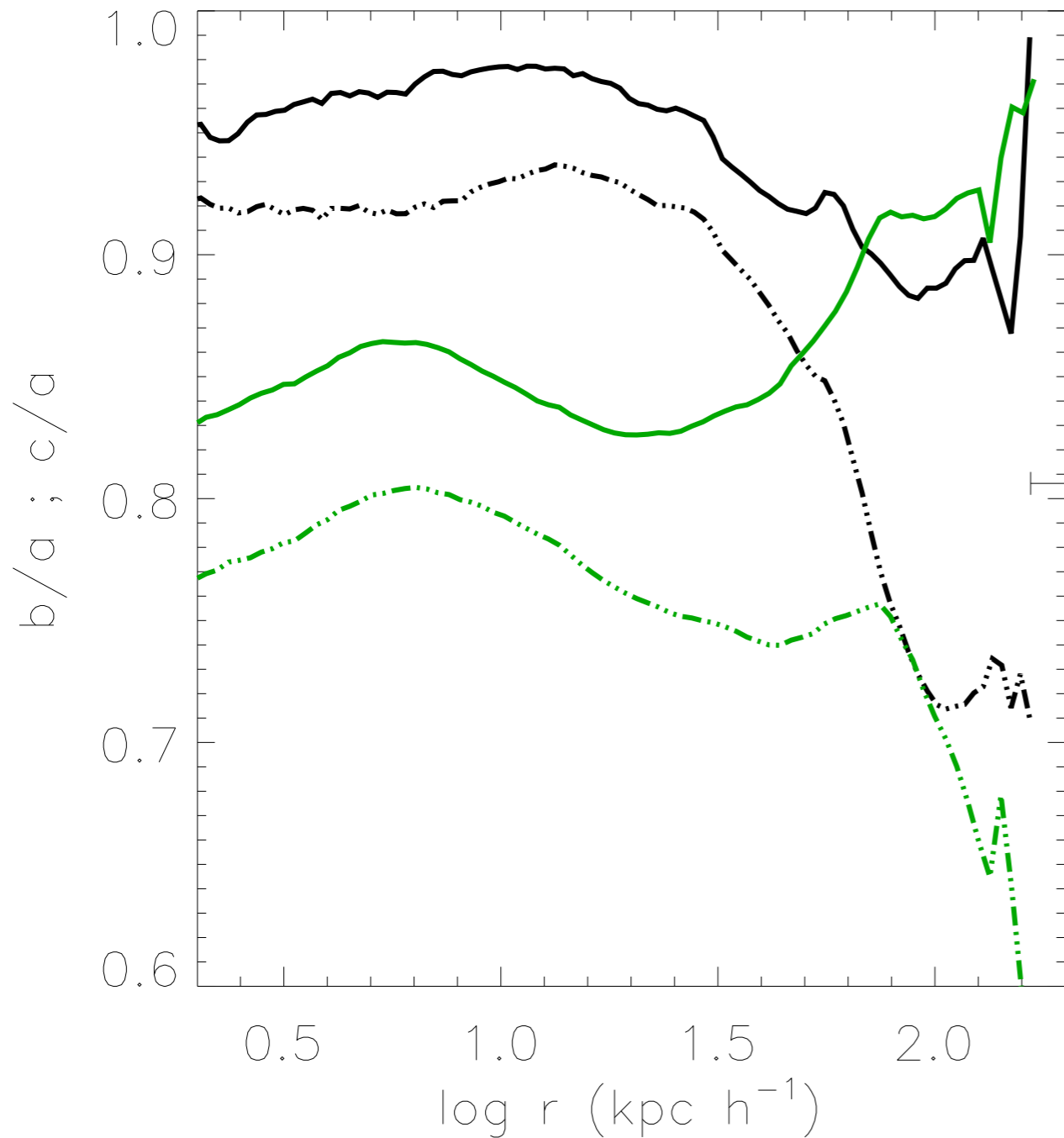
- Difficult to introduce a stable disk in this potential
(Debatista et al. 2013)
- Does not take into account the effects of introducing a baryonic disk (Bryan 2013, ...)
- At odds with results from N -Body experiments of MW-type galaxies (Hayashi et al. 2007)

The list of issues

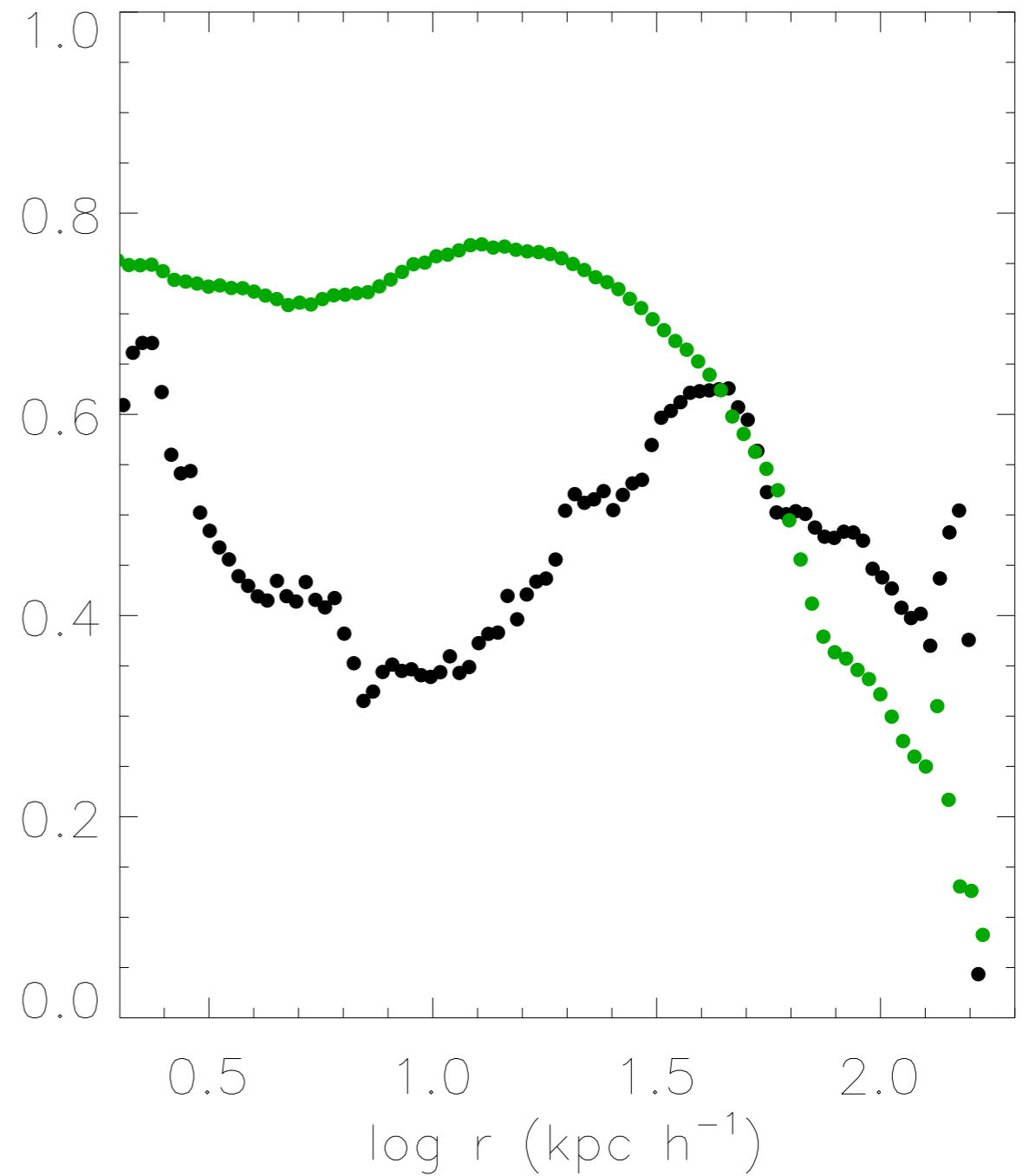
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The effect of the disk

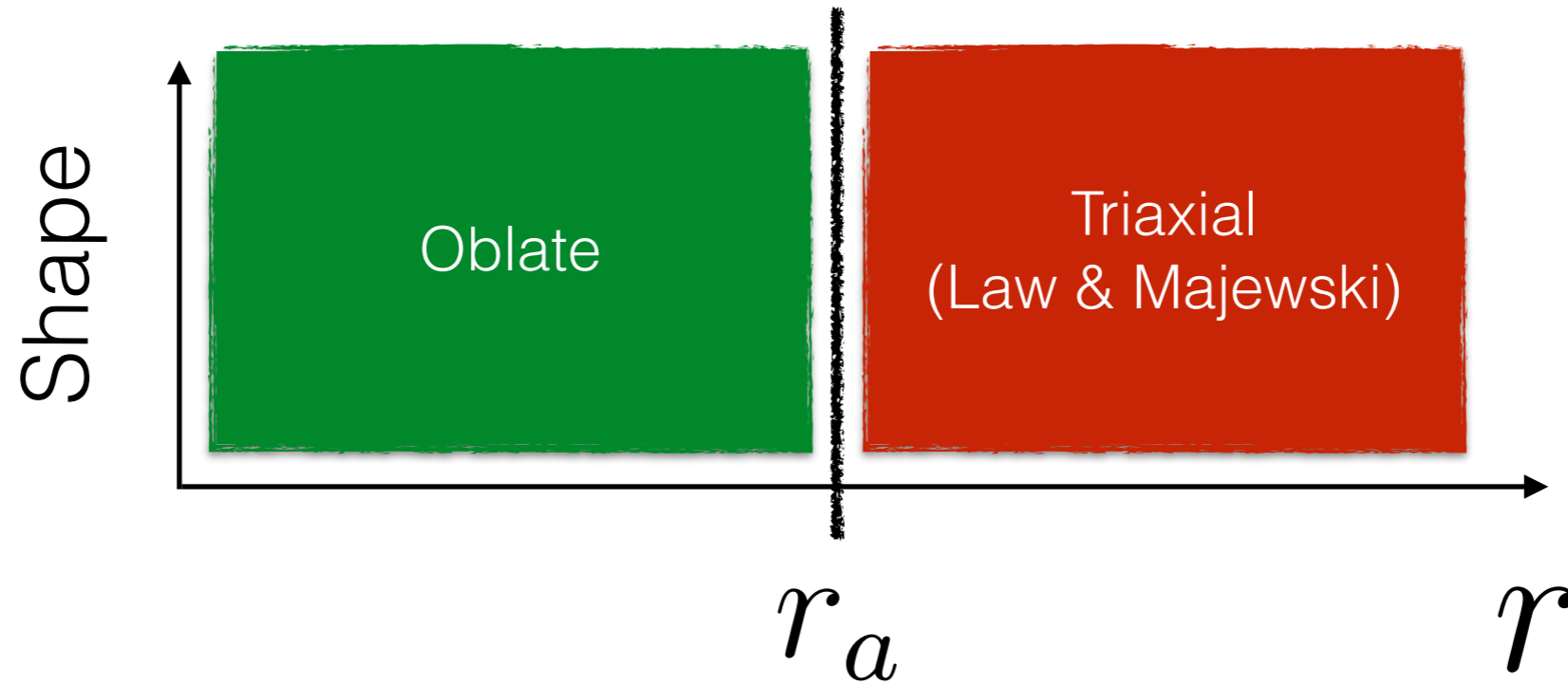
Aq-A-5



Aq-A-5




The effect of the disk



THE FOLLOWING **SLIDES** HAVE NOT BEEN PRODUCED USING ANY SORT OF
MCMC METHOD
BY THE AUTHORS

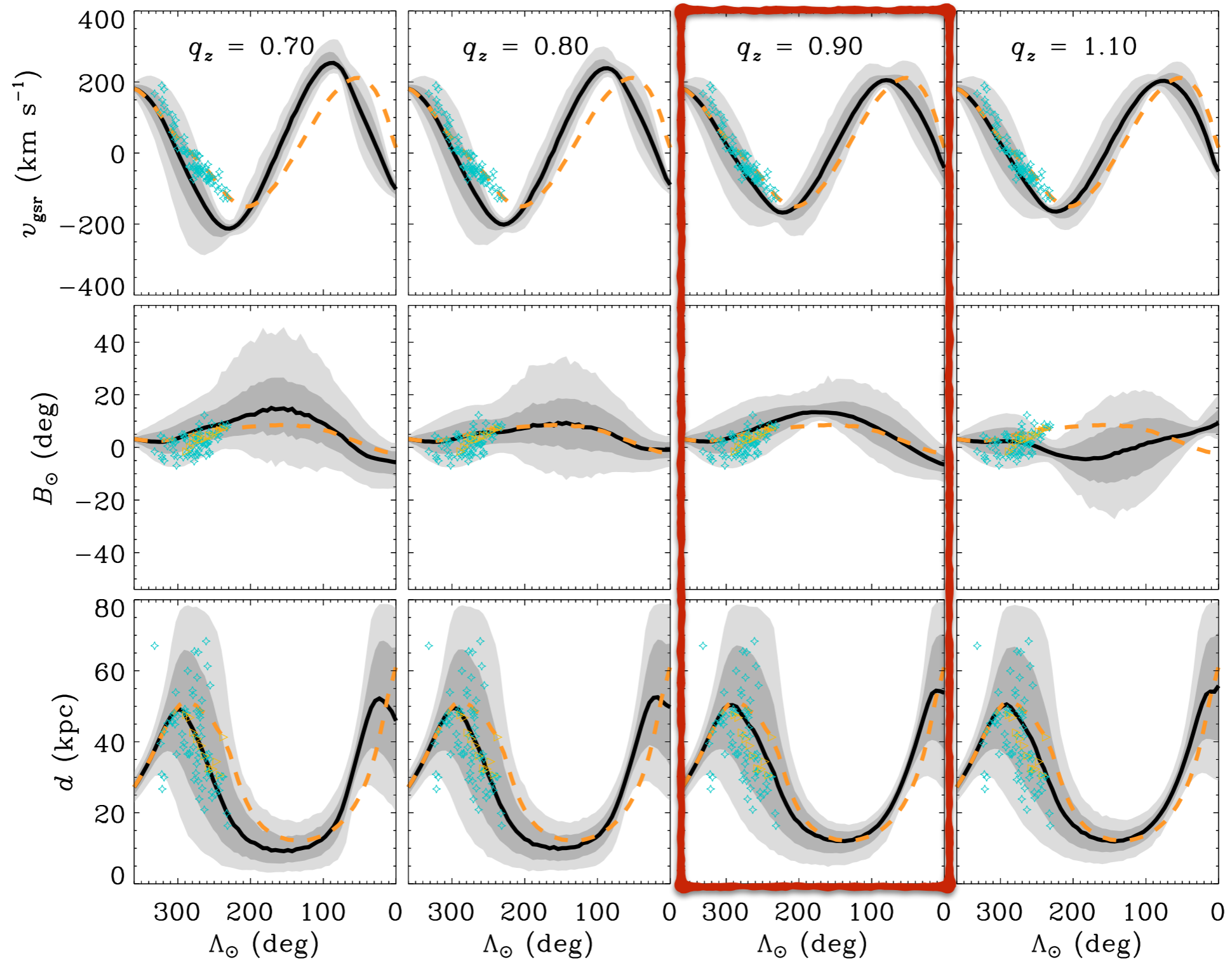
THE PRESENTATION ADVERTISED HAS BEEN RATED

PG-13	MCMC ENTHUSIASTS STRONGLY CAUTIONED 
SOME MATERIAL MAYBE INAPPROPRIATE FOR MCMC EXPERTS	
WATCH OUT FOR THE LMC	

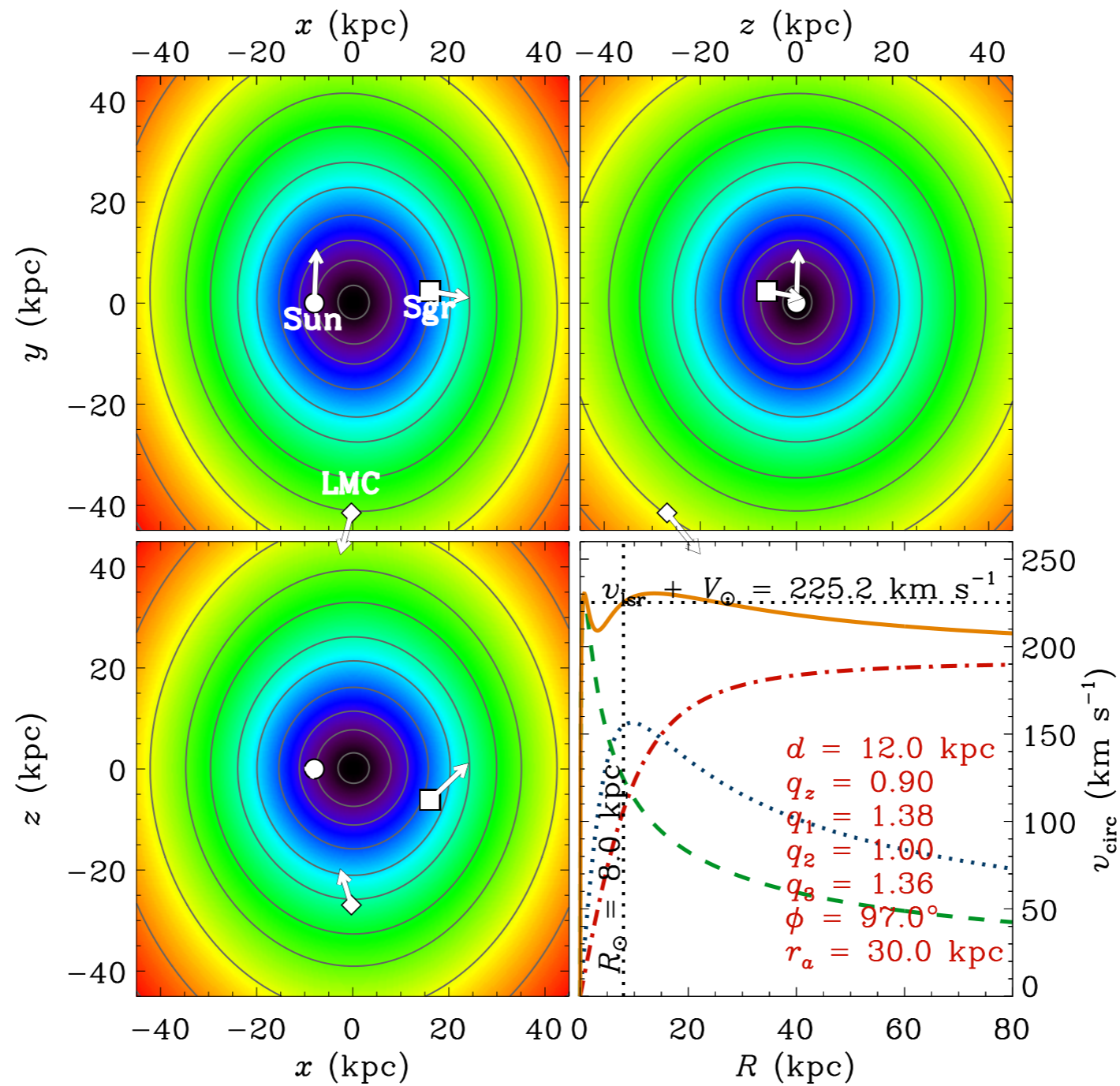
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How oblate?

Leading Arm



Our model so far ...



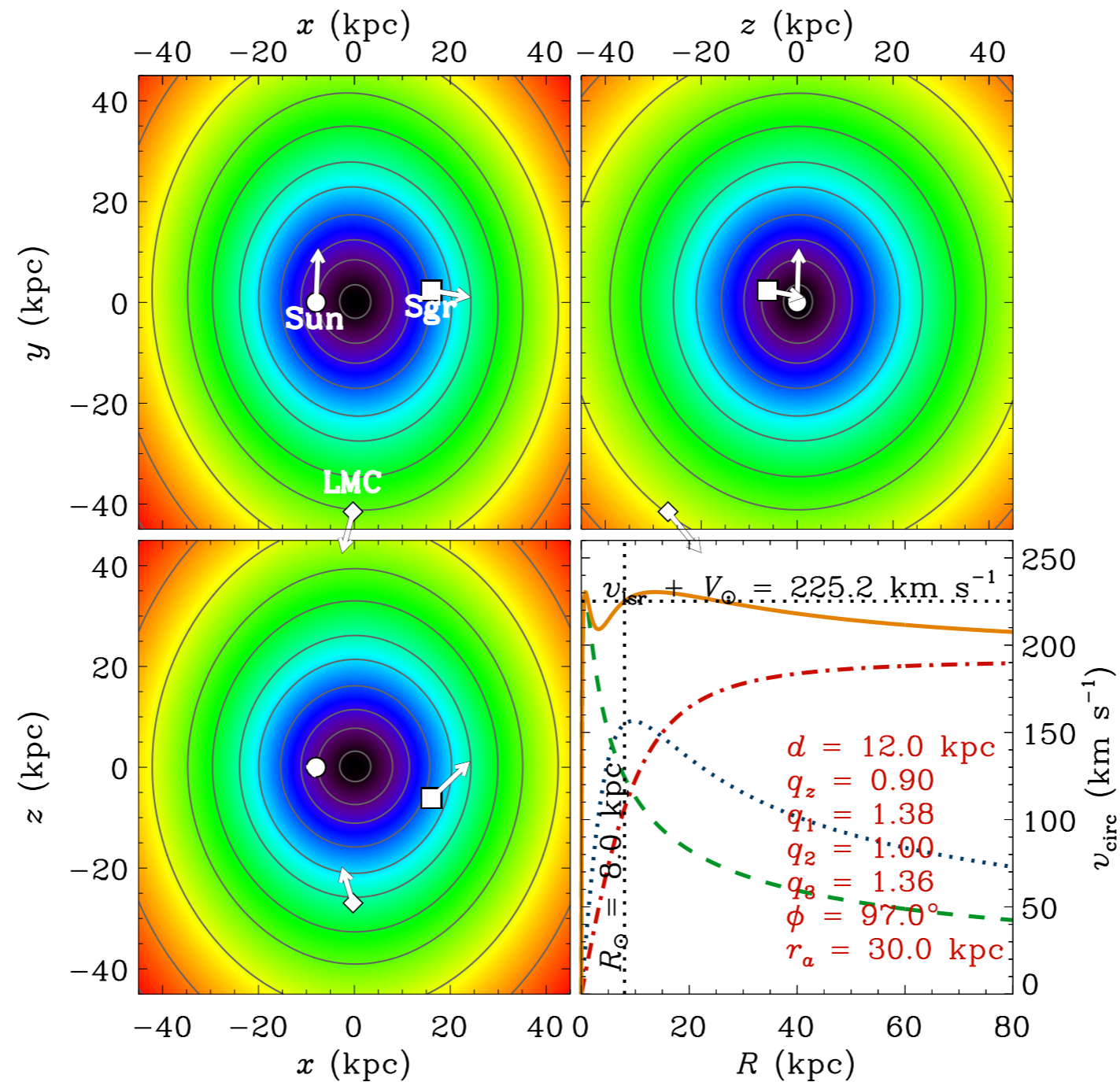
Our model so far ...

- Oblate ($q_z = 0.9$) in the center and triaxial (As in Law & Majewski) in the outskirts
- The transition occurs at ~ 10 kpc
- Beware the LMC!

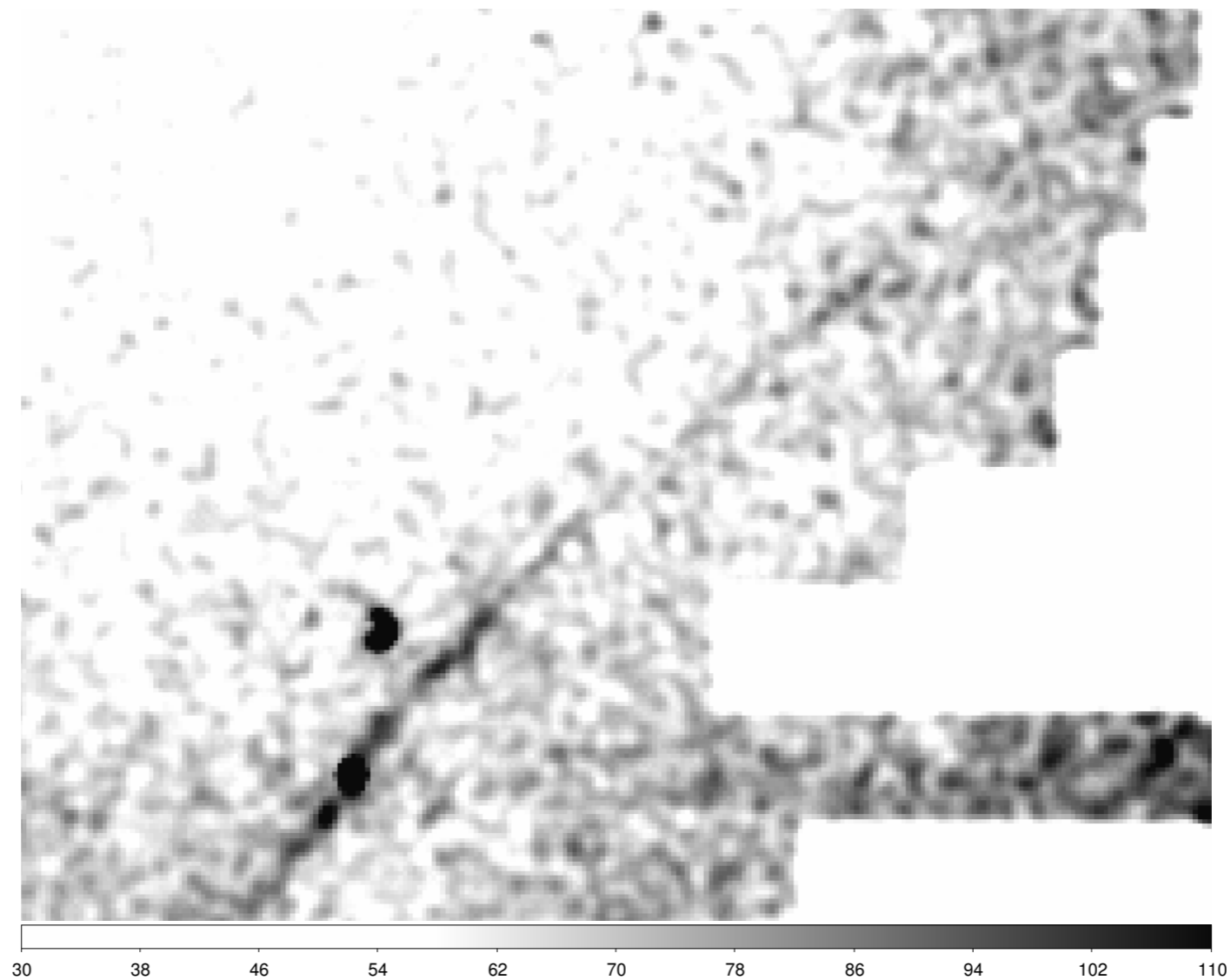
The list of issues

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(Debattista et al. 2013)
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What is the LMC doing there?

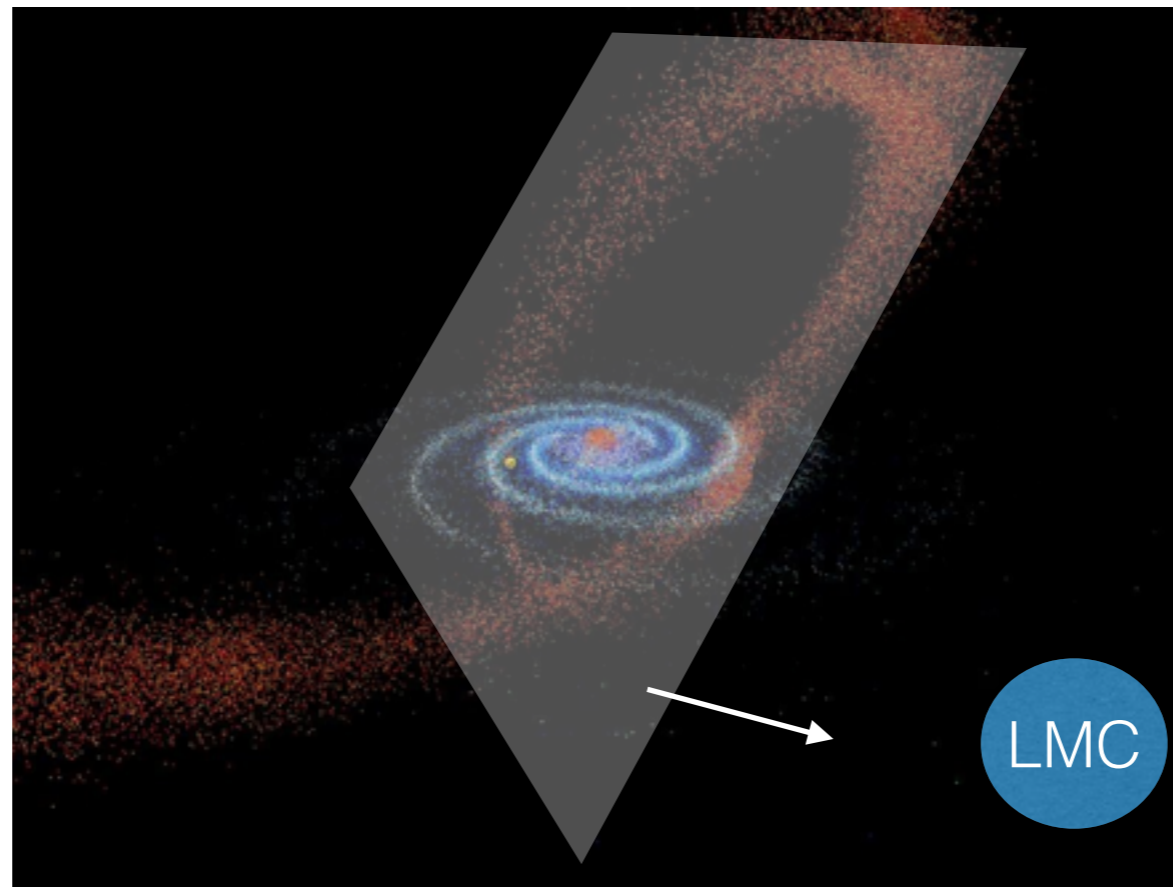


Streams/Subhalos interactions?



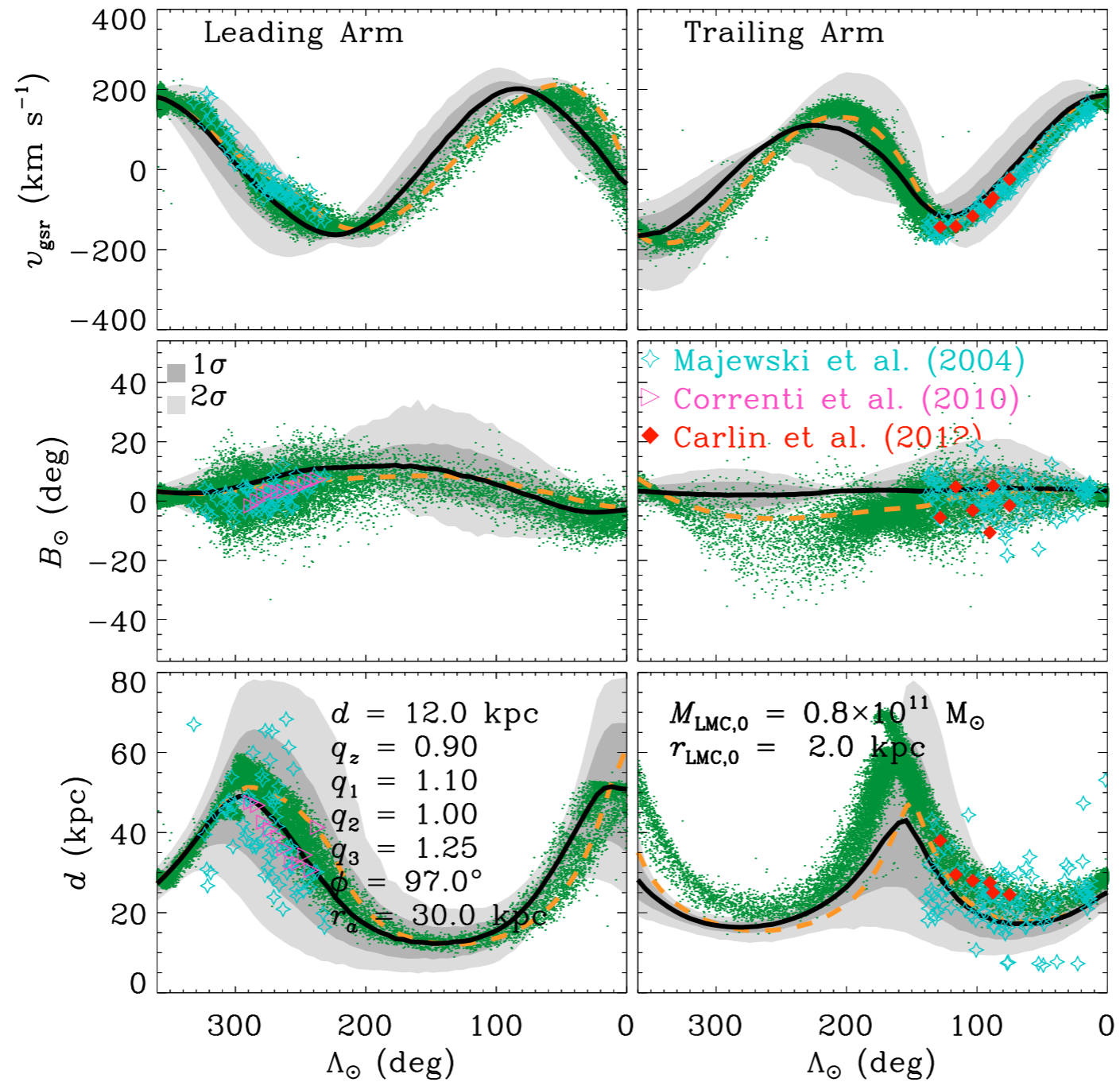
Carlberg et al. 2012, 2013, ...

The tilt of the orbital plane

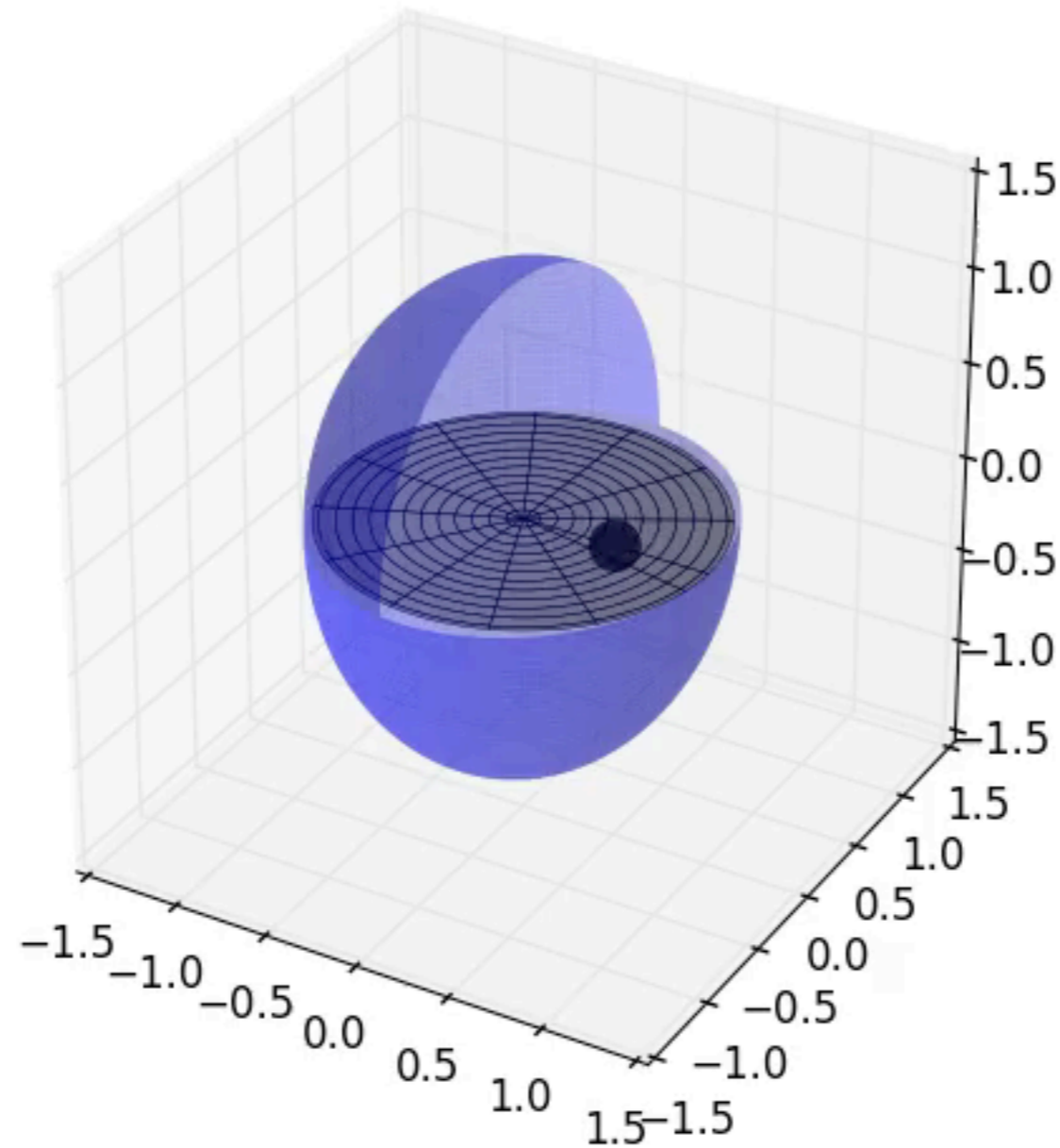


The dynamical effect of the LMC is as important as the Law & Majewski's triaxial halo

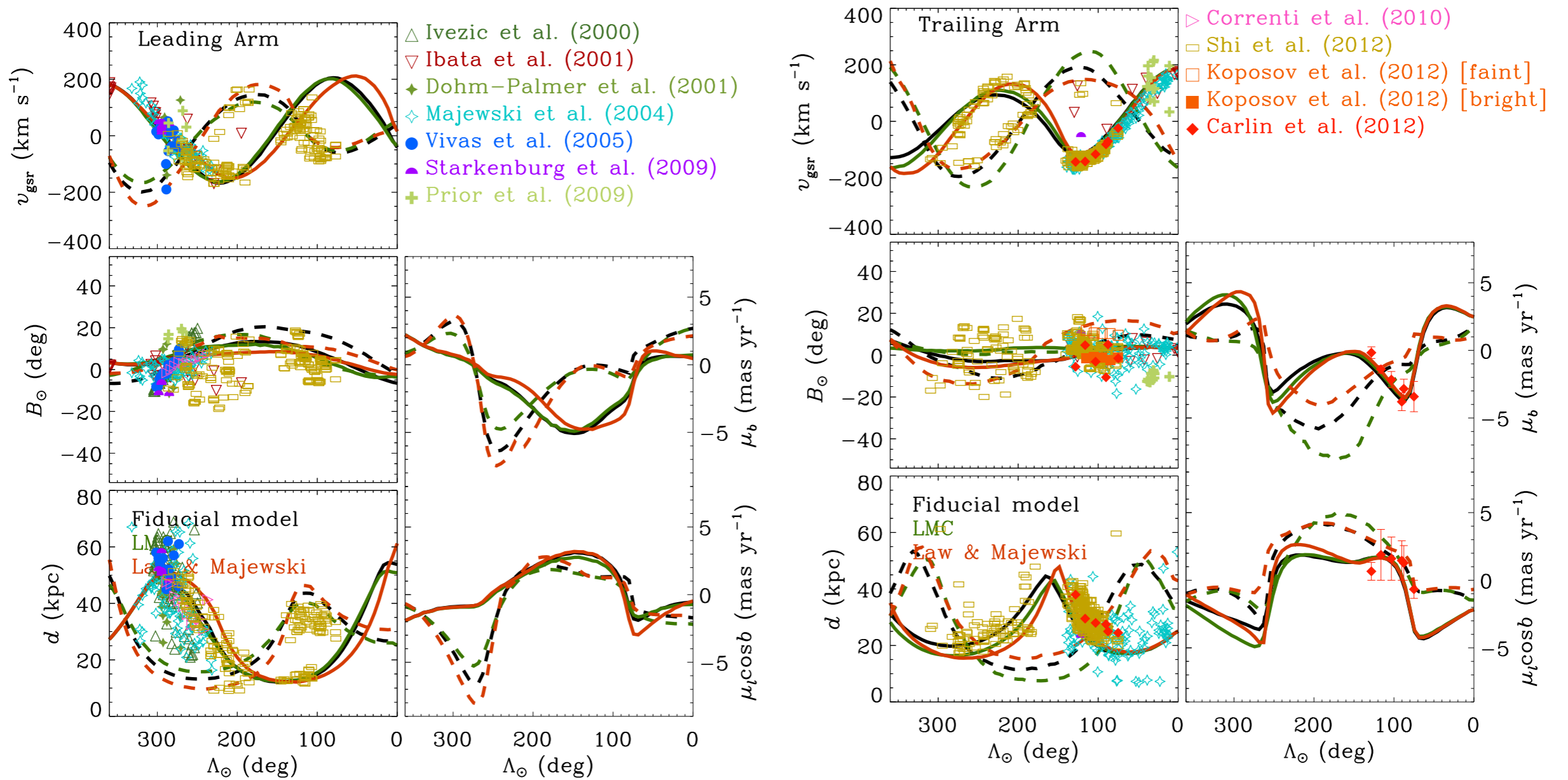
The model so far ...



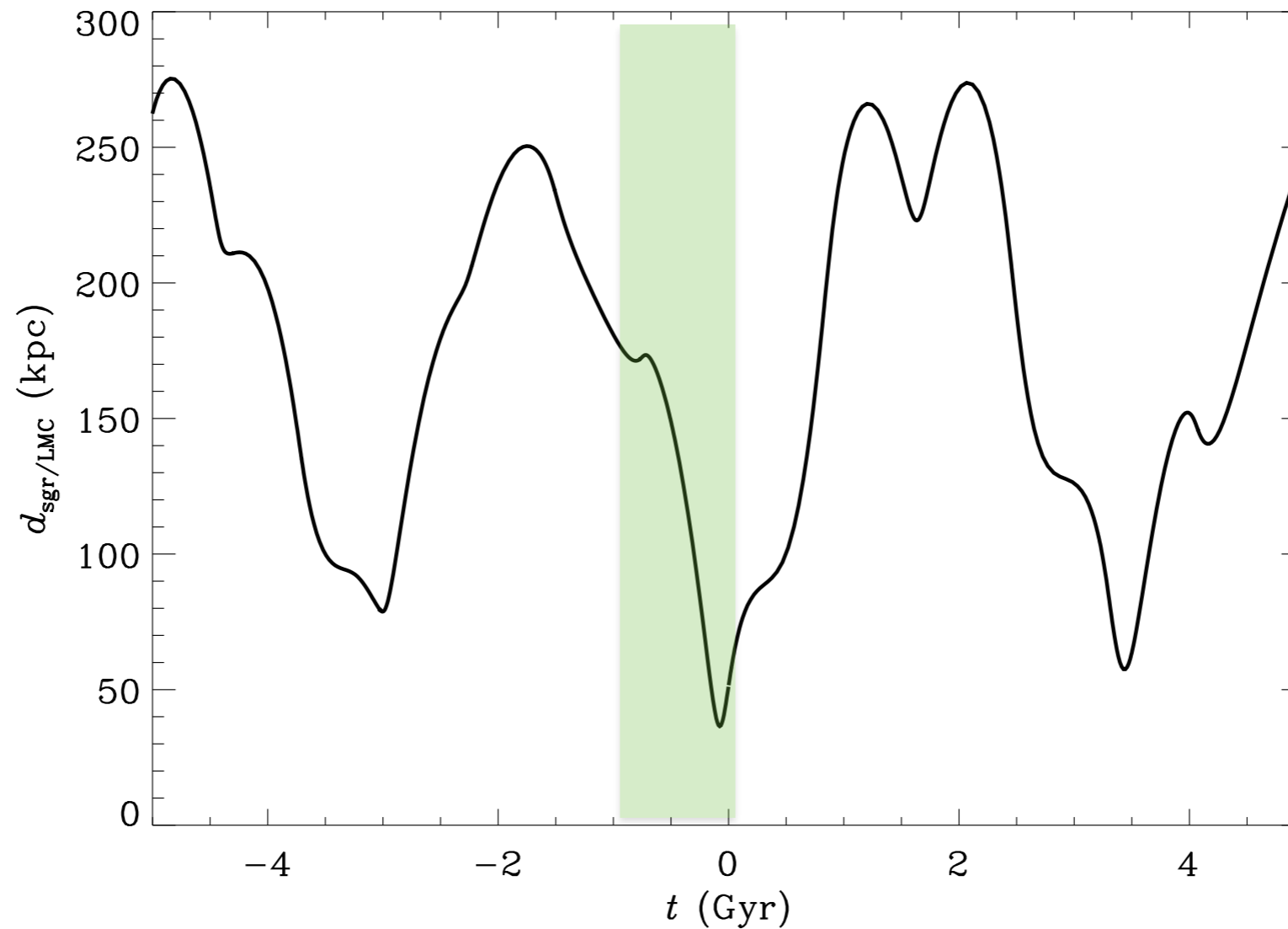
The model so far ...



Comparing the models



What can we say about the LMC



Probably not much!

TODO LIST

- Formal search of the parameter space
- Introduce the orbit - arms difference
- There's still a misalignment between the minor axis of the inner -oblate- and the outer -triaxial- region of the potential

Conclusions

- SGR suggests an oblate halo in the inner, disk-dominated region of the potential, with a transition to a triaxial halo towards the outskirts at around 10 kpc.
- Our oblate halo is consistent with simulations of galaxy formation
- Our triaxial halo is consistent with simulation of MW-type dark halos
- ***DO NOT*** ignore the presence of satellite galaxies in your dynamical models of the MW