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Dwarf-Dwarf Mergers and "Satellites of Satellites" in the Local Group

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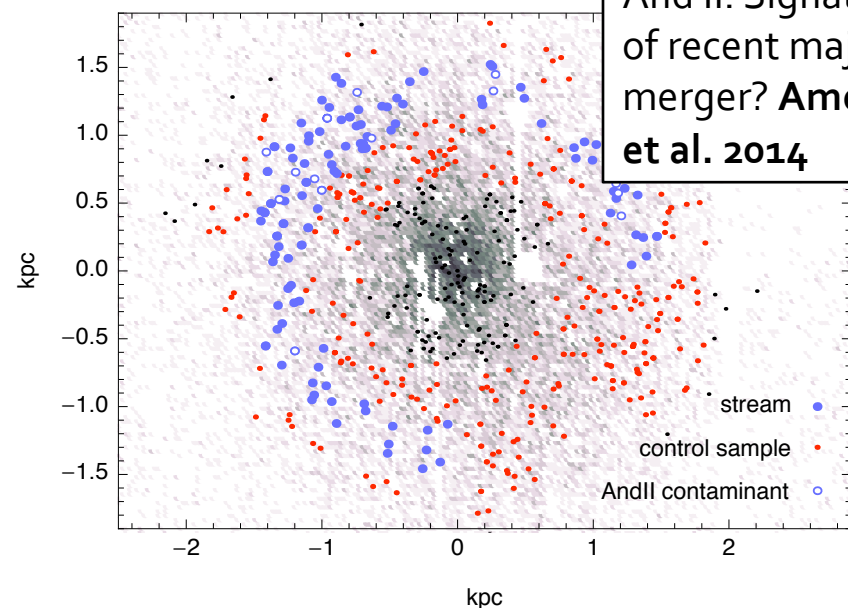
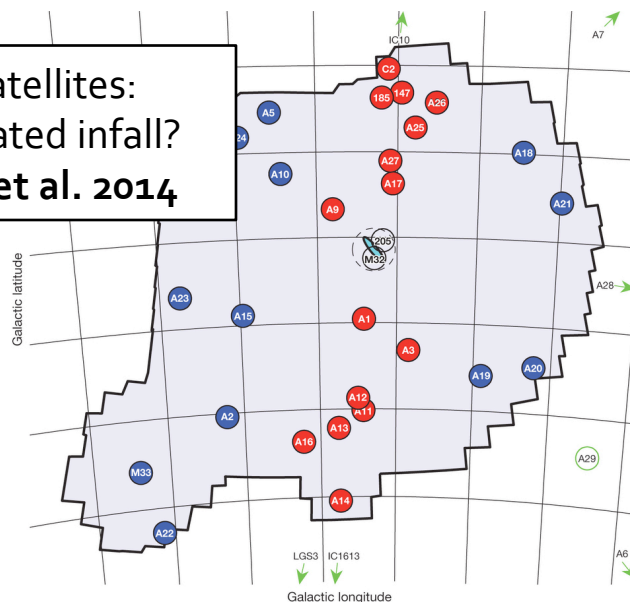
Image Credit: R. Jay Gabany

$$M_{\text{star}} < 10^9 M_{\text{sun}}$$

Importance of Dwarf-Dwarf Interaction

- ❑ Are interactions between dwarfs important? We normally worry about proximity to massive host, but what about other dwarfs?
- ❑ **Mergers:** Generally ignored for Milky Way satellites. Models for chemical evolution, SFH, etc. usually assume dwarfs are isolated.
- ❑ **Group Infall:** Subhalo accretion not random, correlated infall. Disk(s) of satellites? (not going there...). Group pre-processing?

M31 satellites:
correlated infall?
Ibata et al. 2014

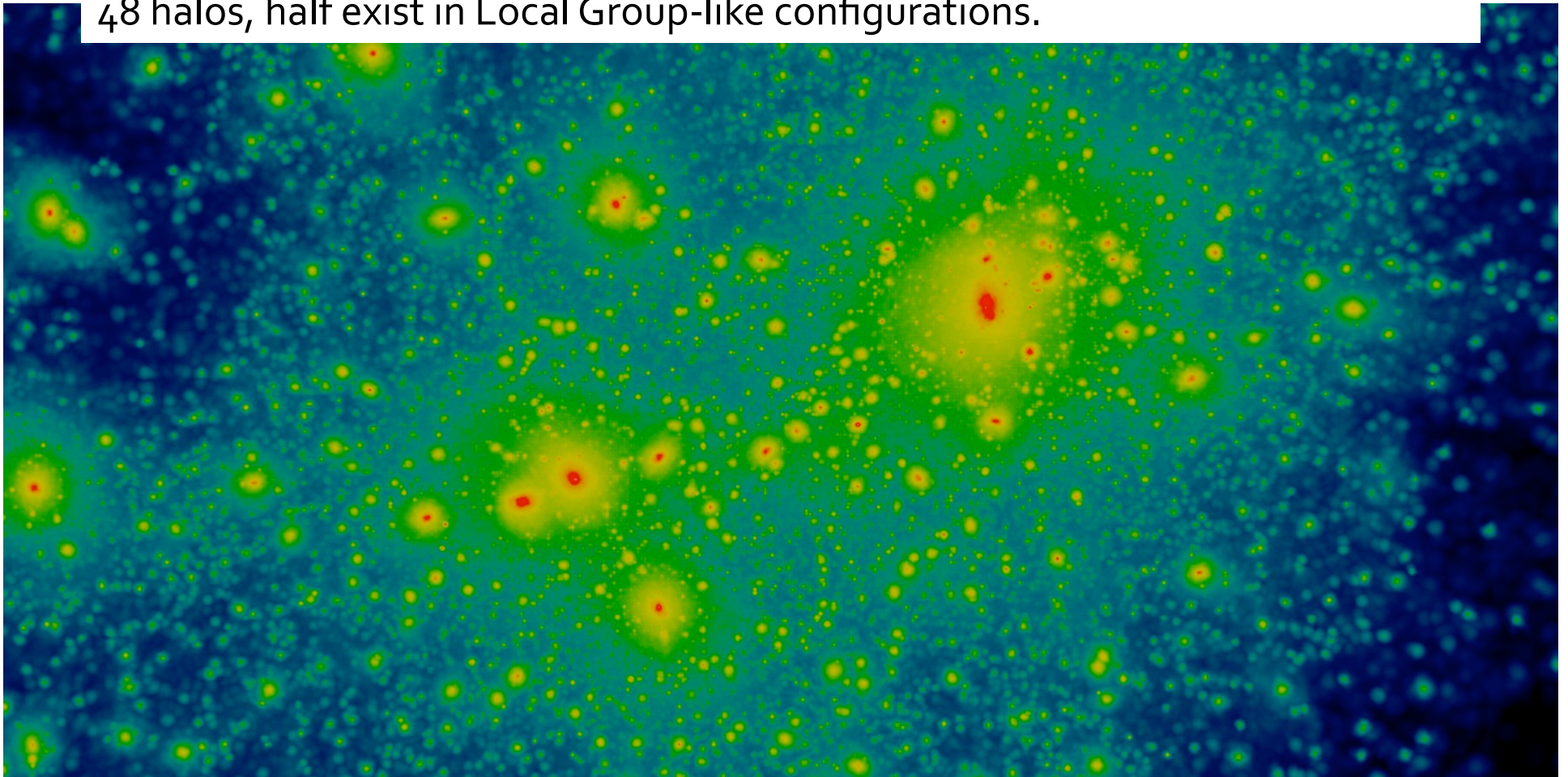


And II: Signature
of recent major
merger? Amorisco
et al. 2014

ELVIS: Exploring the Local Volume In Simulations

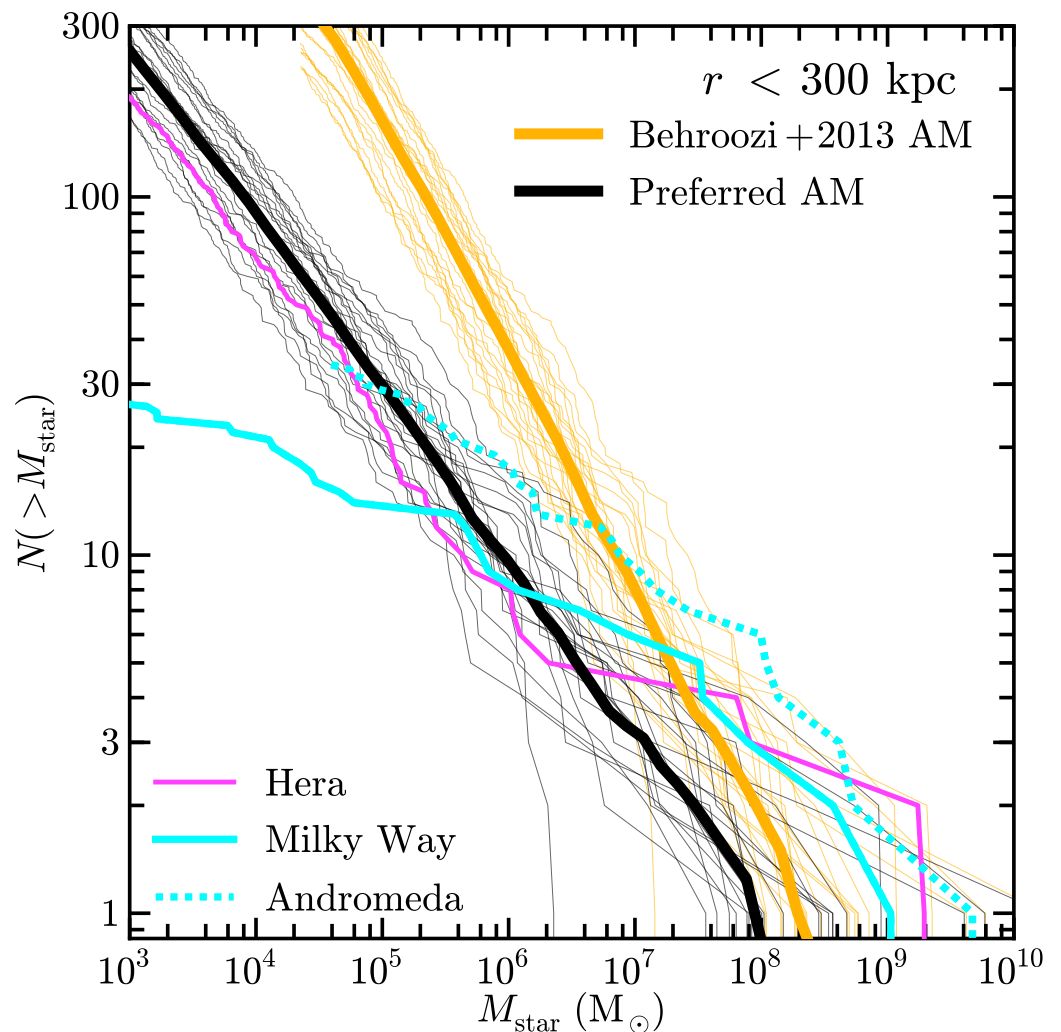
High-resolution ($m_p \sim 2 \times 10^5 M_{\text{sun}}$, $\epsilon=140$ pc), **dark matter only cosmological zoom-in simulations.**

48 halos, half exist in Local Group-like configurations.



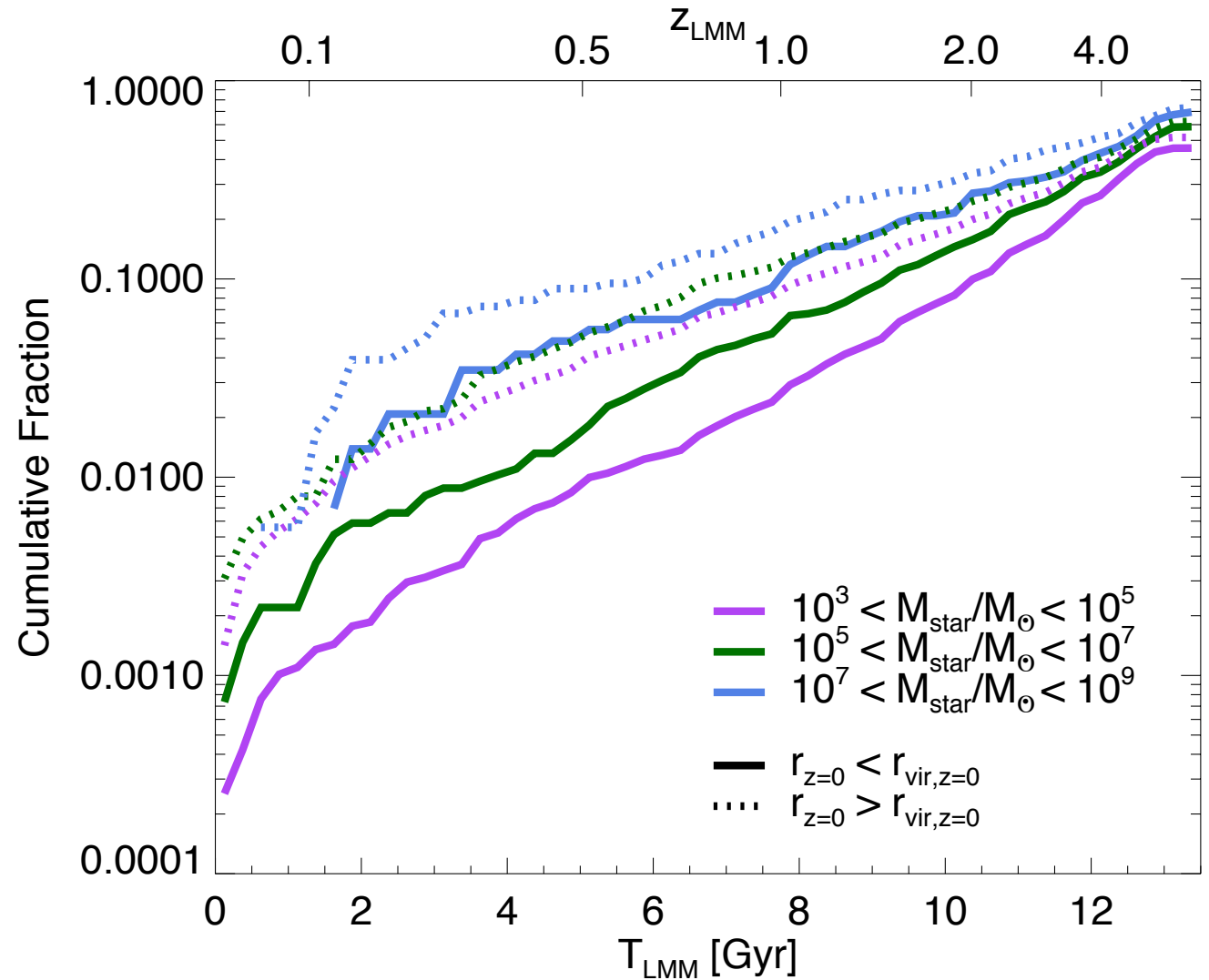
Definitions

- ❑ Subhalo tracking: ROCKSTAR halo finder, CONSISTENT-TREES algorithm (Behroozi et al. 2013a,b)
- ❑ $M_{\text{star}}-M_{\text{peak}}$ relation from Garrison-Kimmel et al. ($M_{\text{star}} \sim M_{\text{peak}}^{1.92}$)
- ❑ **Major Merger:** Peak-mass ratio > 0.3 , stellar mass ratio > 0.1
- ❑ **Caveats:** $M_{\text{star}}-M_{\text{peak}}$ highly uncertain at low masses, likely with significant scatter. No baryons – affect on subhalo orbits etc. Dark dwarfs?

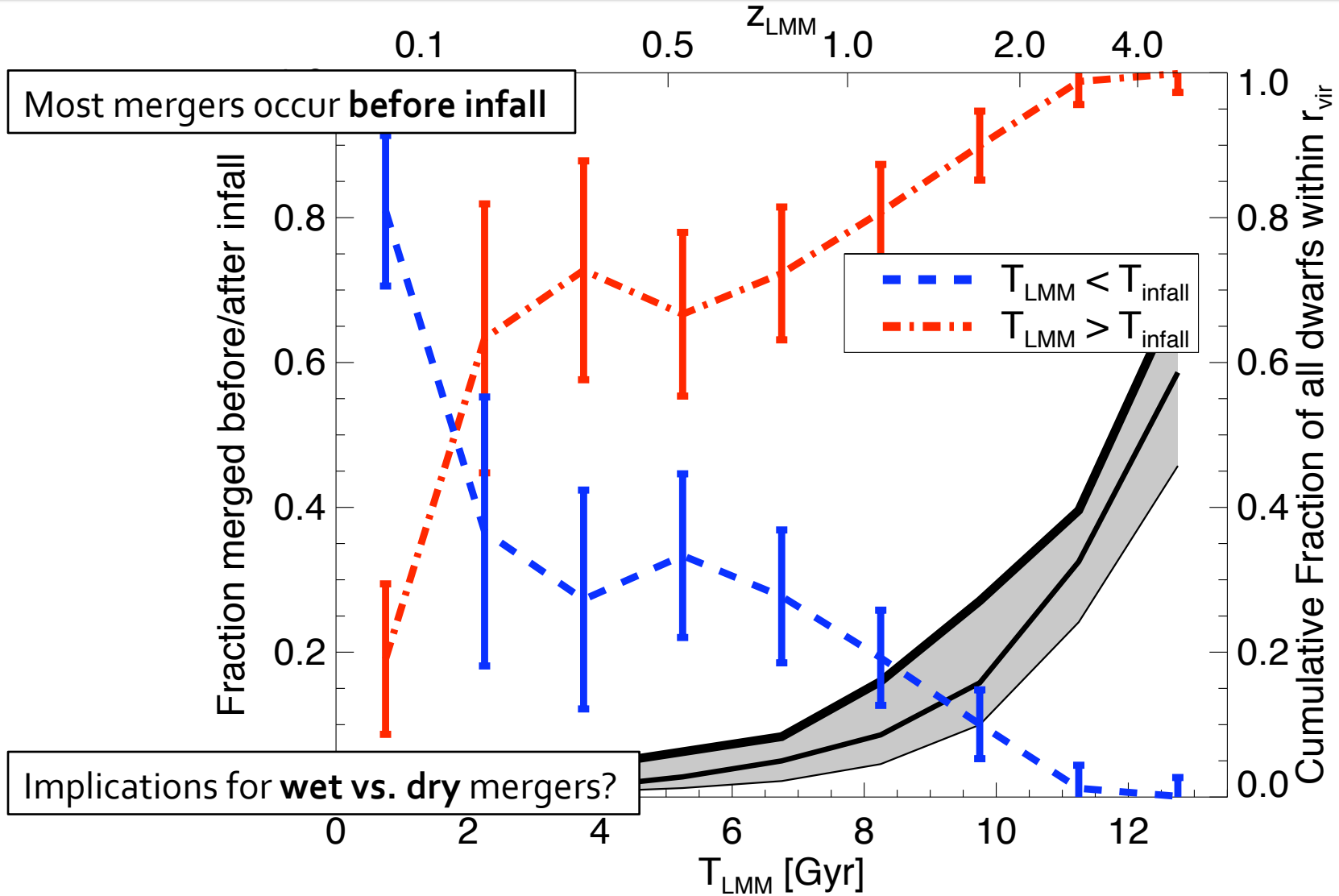


How Common are Dwarf-Dwarf Mergers?

- Mergers more common at higher redshift.
- Mergers more common for **more massive dwarfs**.
- Mergers more common for **non-satellites** ($r > r_{\text{vir}}$).
- Approx. **10%** of Fornax-mass dwarfs have experienced a major merger since $z=1$.



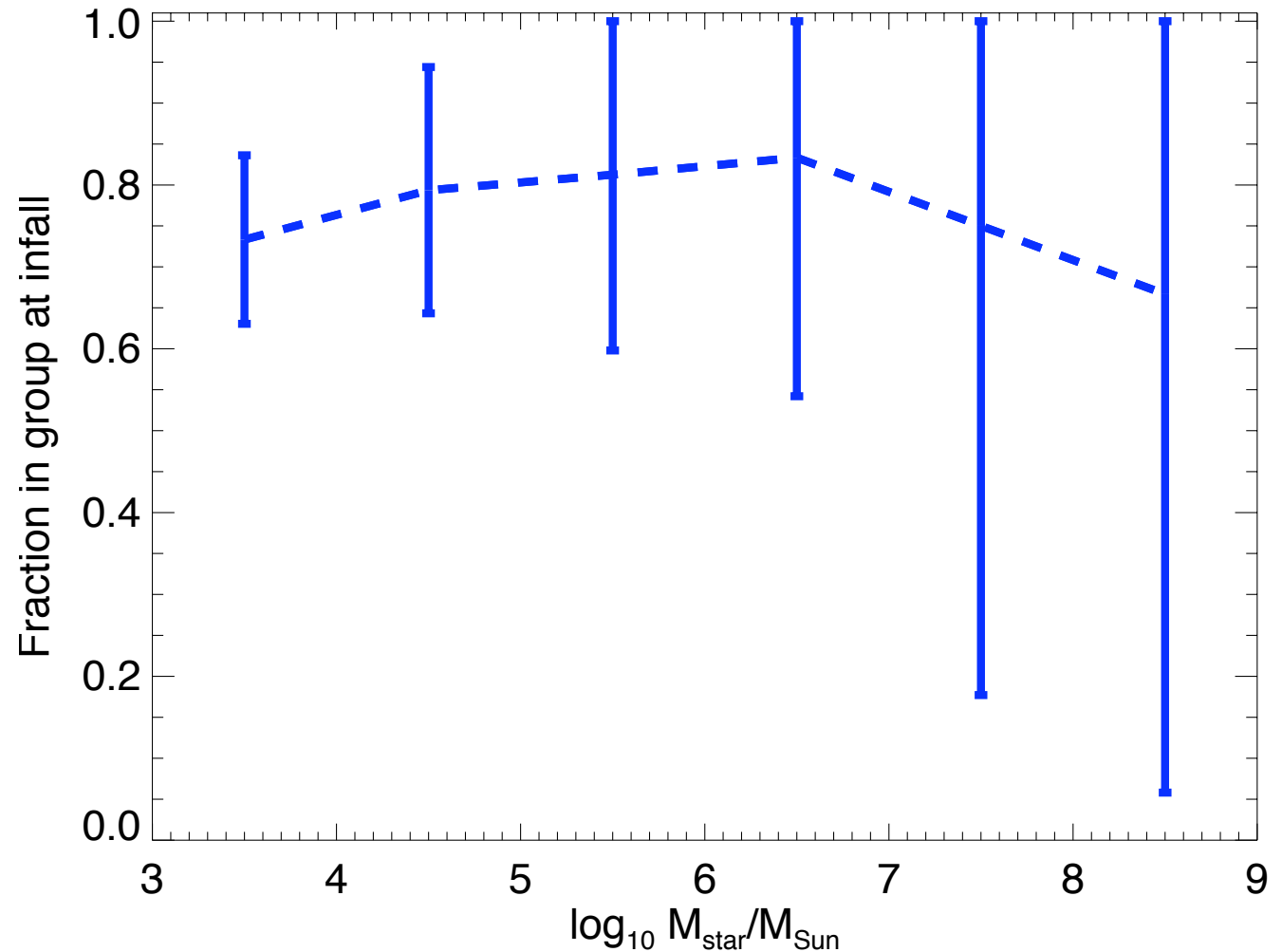
Before/After Virial Infall onto Host



Relation to Group Infall

☐ Mergers after infall less common, but do occur.

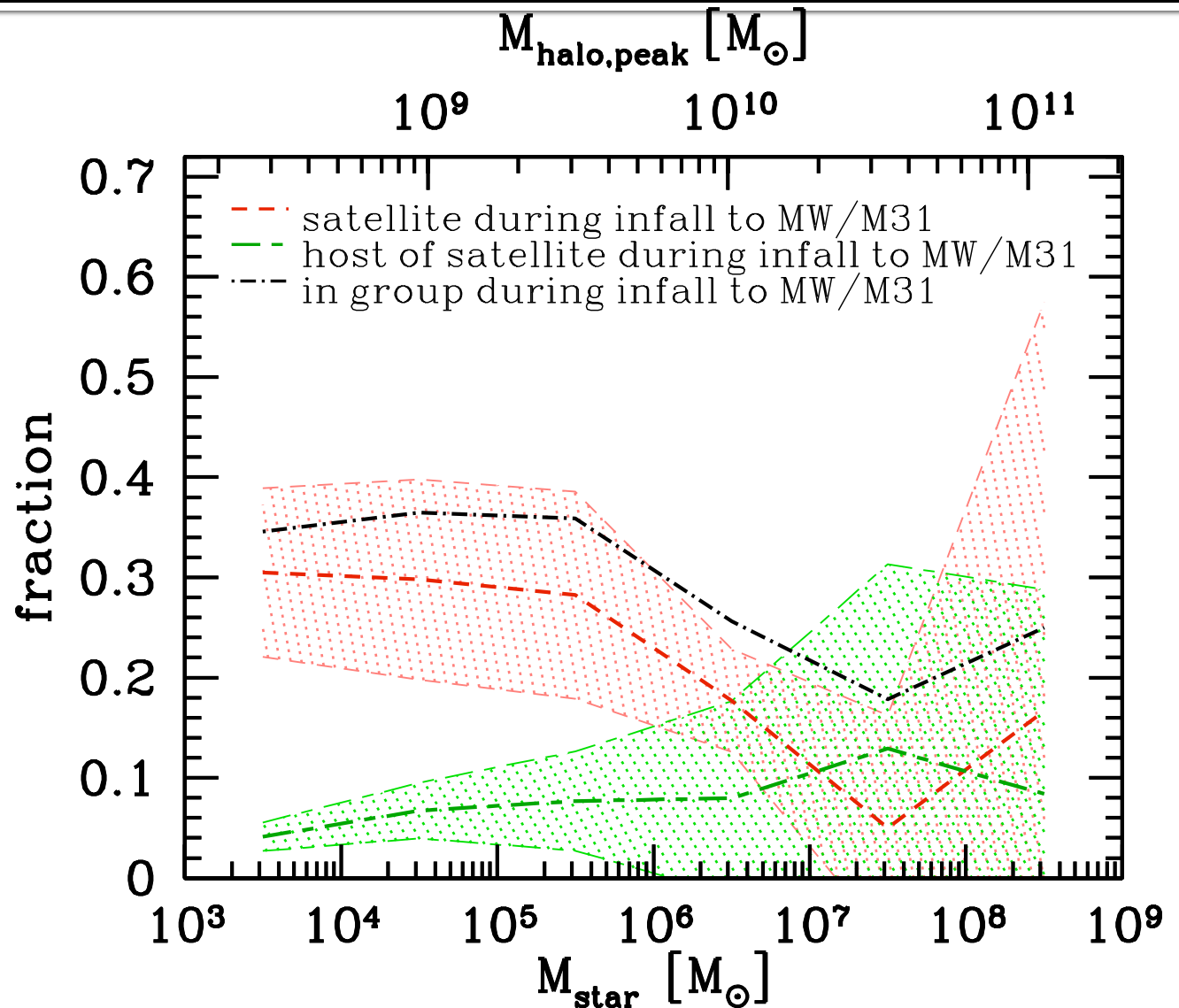
☐ High fraction (~70%) related to **group infall**, independent of mass.



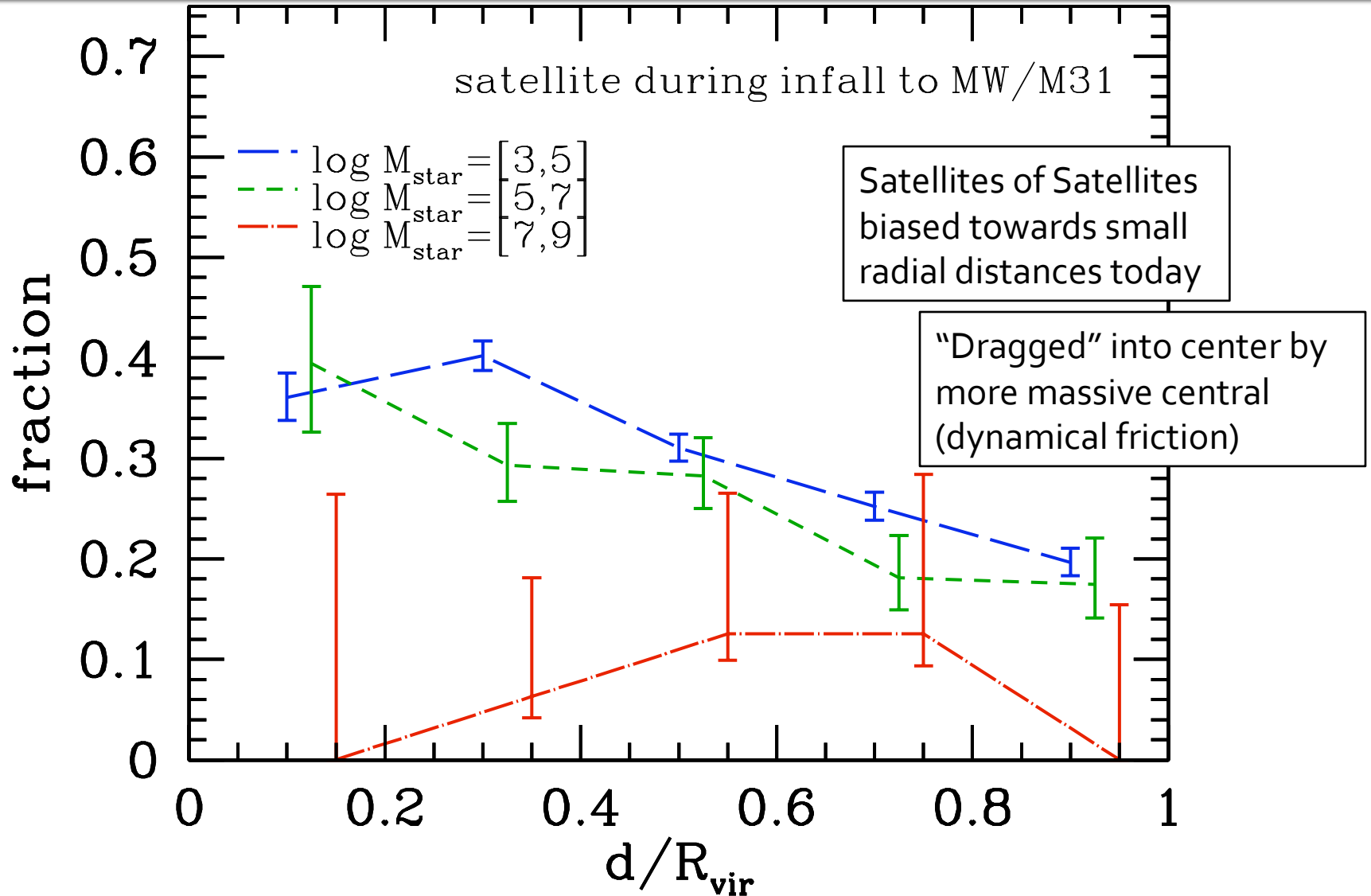
Groups of Dwarfs at Infall

□ Fraction of “satellites of satellites” at infall increases at lower dwarf masses.

□ Approx. 30 % of UF dwarfs came into Milky Way halo as part of a group.



Radial Bias: Implications for UFs?

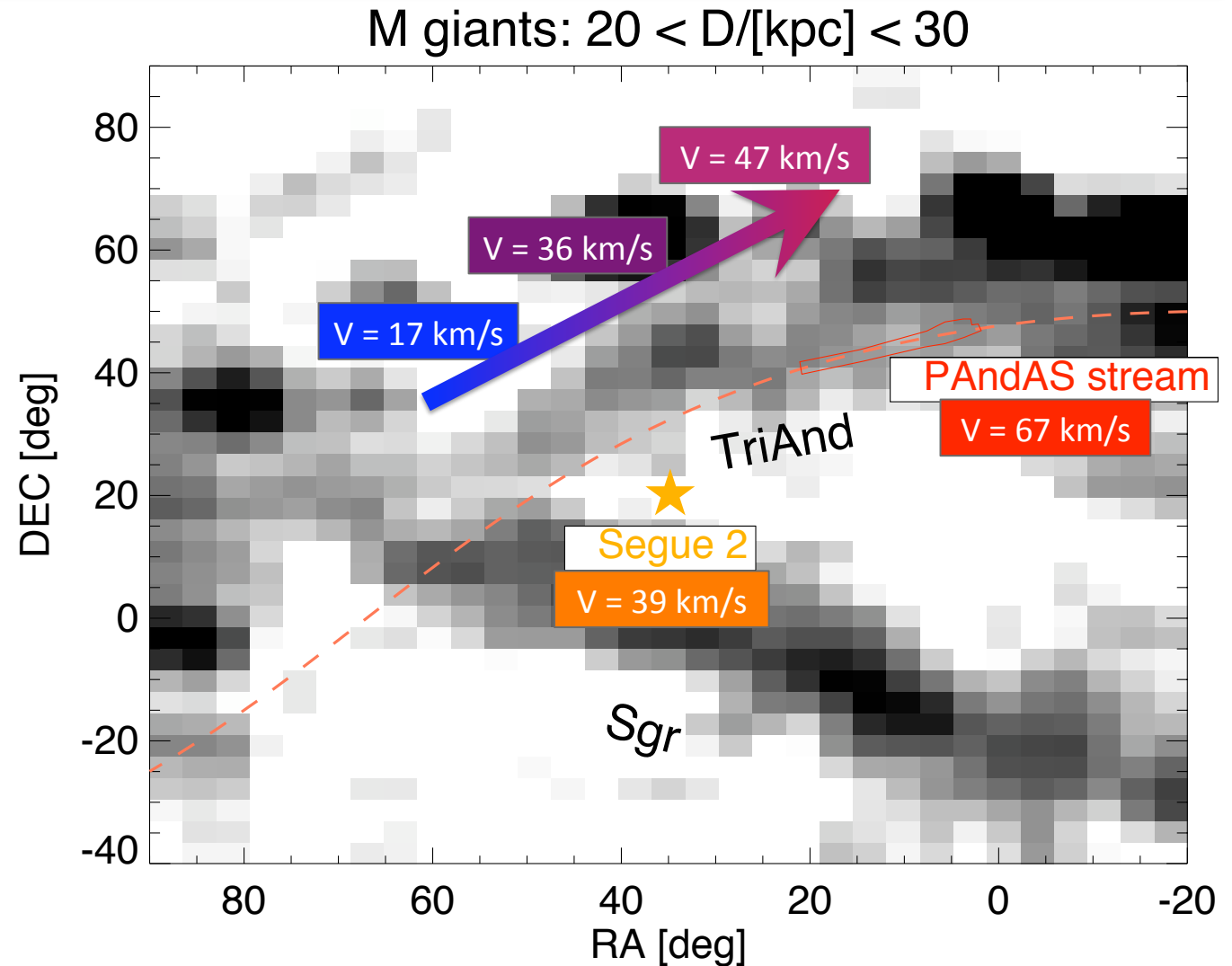


TriAnd and its Siblings

☐ TriAnd overdensity in Milky Way Halo.

☐ Position on the sky, LOS velocity, distance coincident with **Segue 2 satellite** and **PAndAS stream**.

☐ Fossil record of **group infall** onto the MW halo?



Summary

- ❑ Dwarf-Dwarf mergers **not negligible**, but not super-common.
(More common in the field).
 - ❑ Mergers inside r_{vir} rare, if it does happen likely due to **group-infall**.
 - ❑ Mergers before infall – **wet mergers** may be more important than dry mergers?
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- ❑ Significant fraction (30%) of UF dwarfs may have fallen into Milky Way as **“satellites of satellites”**
 - ❑ Tidal features in UFs? Metallicity spread? Bias towards inner halo?
Group pre-processing may be important.
 - ❑ **Evidence for satellites of satellites in the MW**: best place to look is close to massive dwarfs (either destroyed or intact), as these likely dragged in smaller mass dwarfs.