

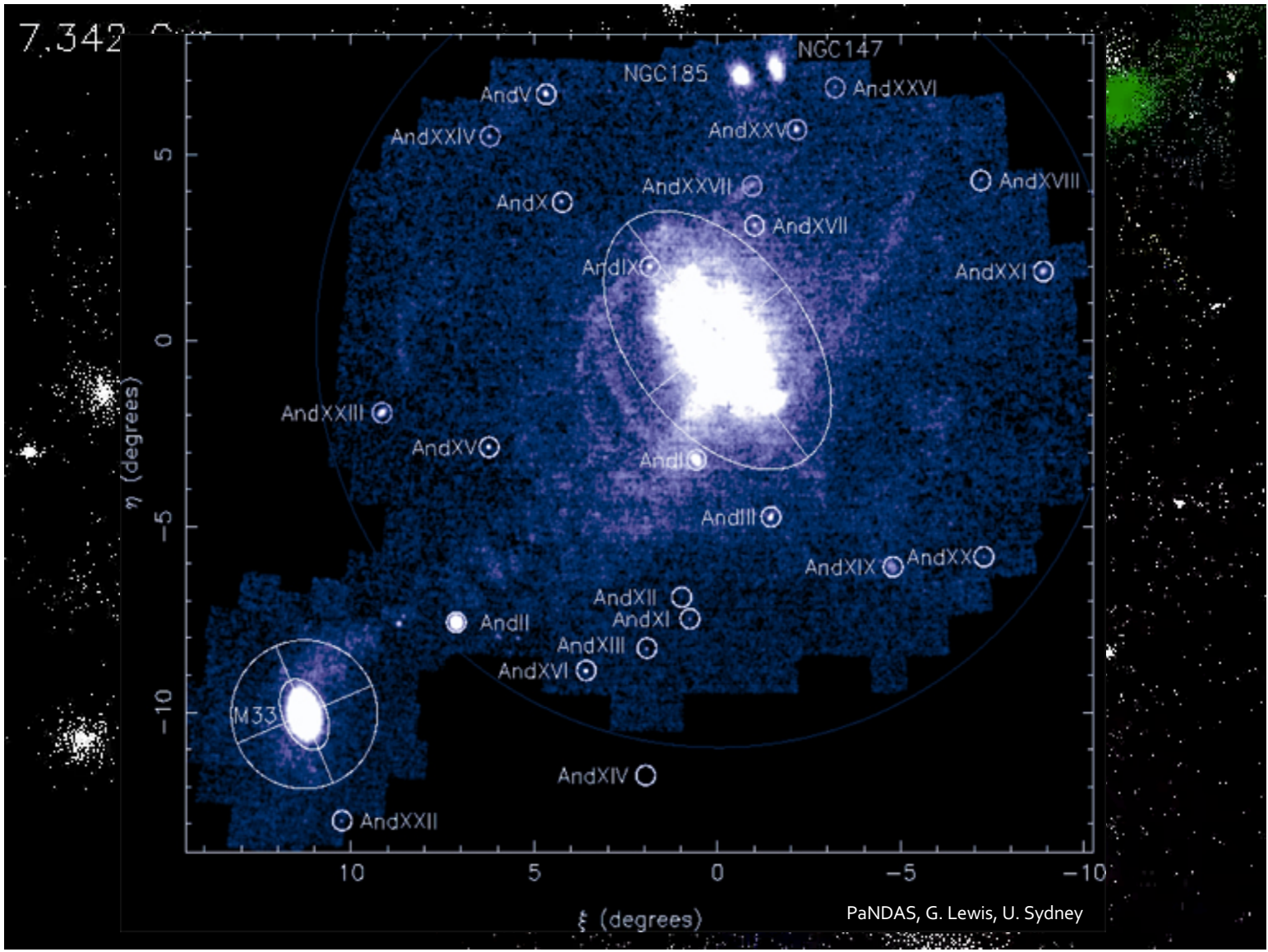


Stellar Halos in Illustris + the Milky Way and the Gaia Sausage

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*Science in our own Backyard with WFIRST
Caltech, Pasadena, CA*

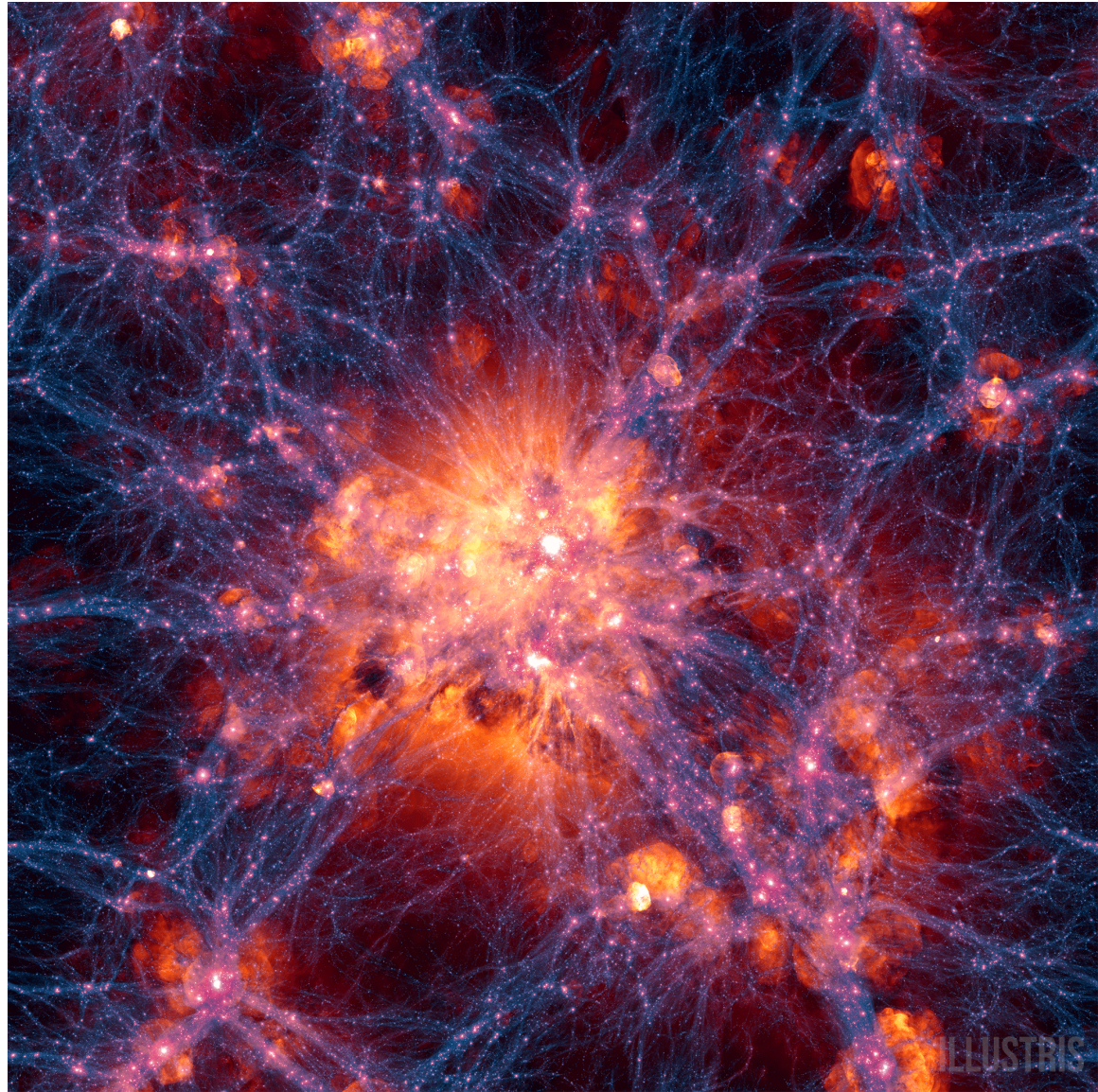
Credit: V. Belokurov (Cambridge, UK and CCA, New York, US) based on the image by ESO/Juan Carlos Muñoz



Credit: A.Helmi, 2011

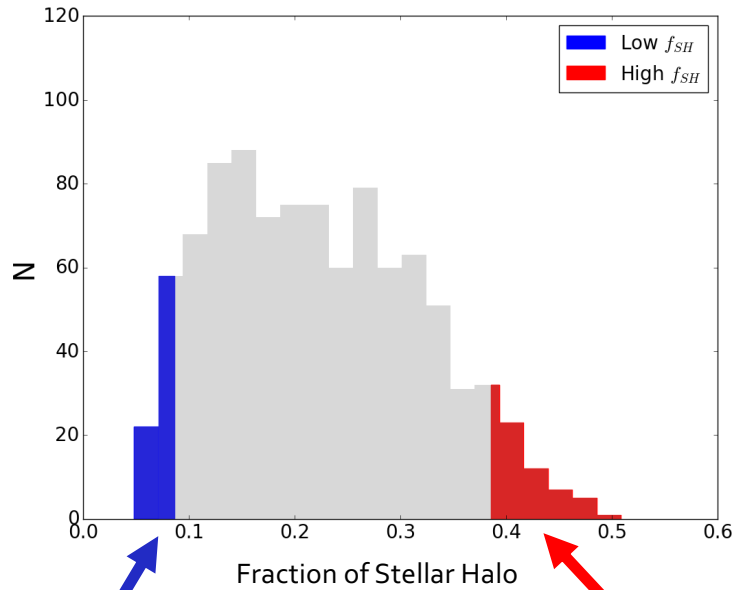
Illustris -1

- Cosmological hydrodynamical simulation
- Box size: $(106.5 \text{ Mpc})^3$
- $M_{\text{baryon}} = 1.3 \times 10^6 M_{\text{sun}}$
- $M_{\text{DM}} = 6.3 \times 10^6 M_{\text{sun}}$

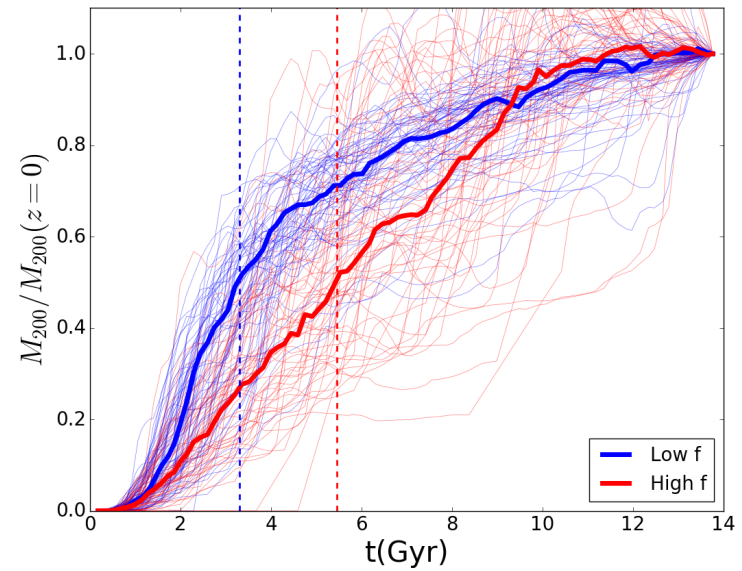


What Causes Diversity in Stellar Halos?

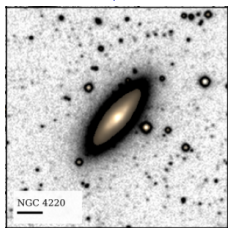
Milky Way-like Sample
(n=967)



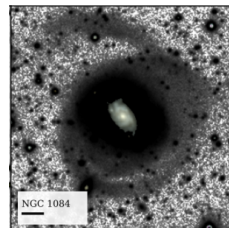
Merger Histories



Galaxies with little stellar halo form earlier than galaxies with a lot of stellar halo

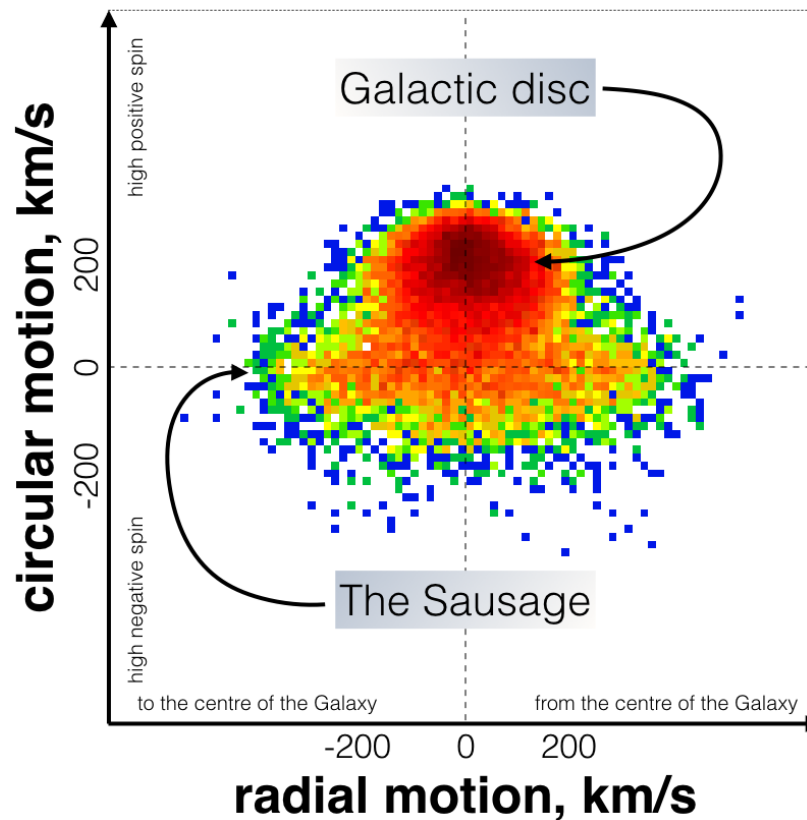


Diversity in Dragonfly



The Milky Way and the Gaia Sausage

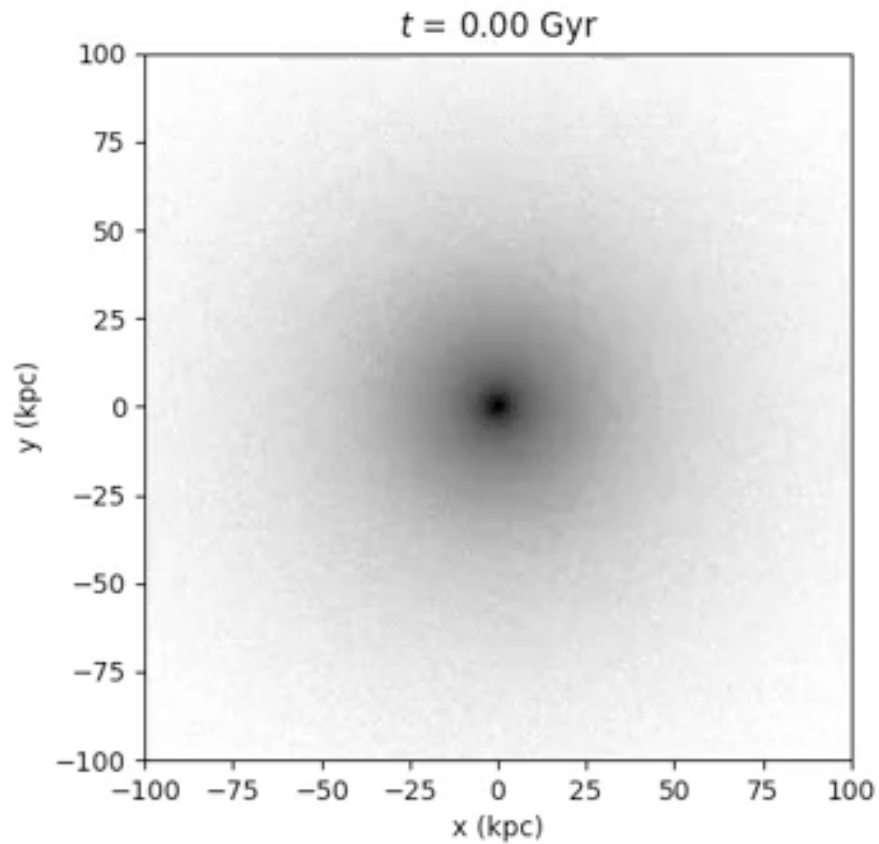
Motions of 7,000,000 Gaia stars



Gaia DR2 has provided 6D data (3D positions and velocities) for stars within 10kpc of our sun.

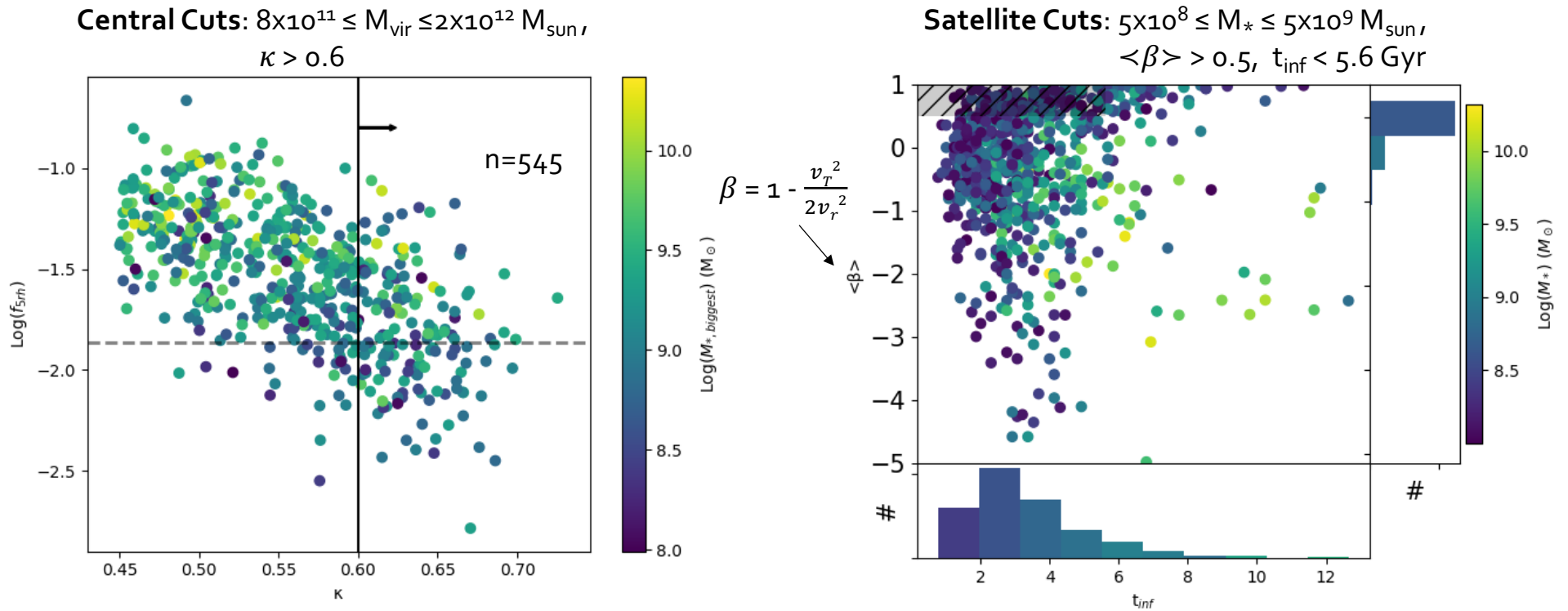
Extreme range of radial motion

The Milky Way and the Gaia Sausage



Credit: D. Erkal (Surrey UK)

A Sample of Gaia Sausage Analogs in Illustris

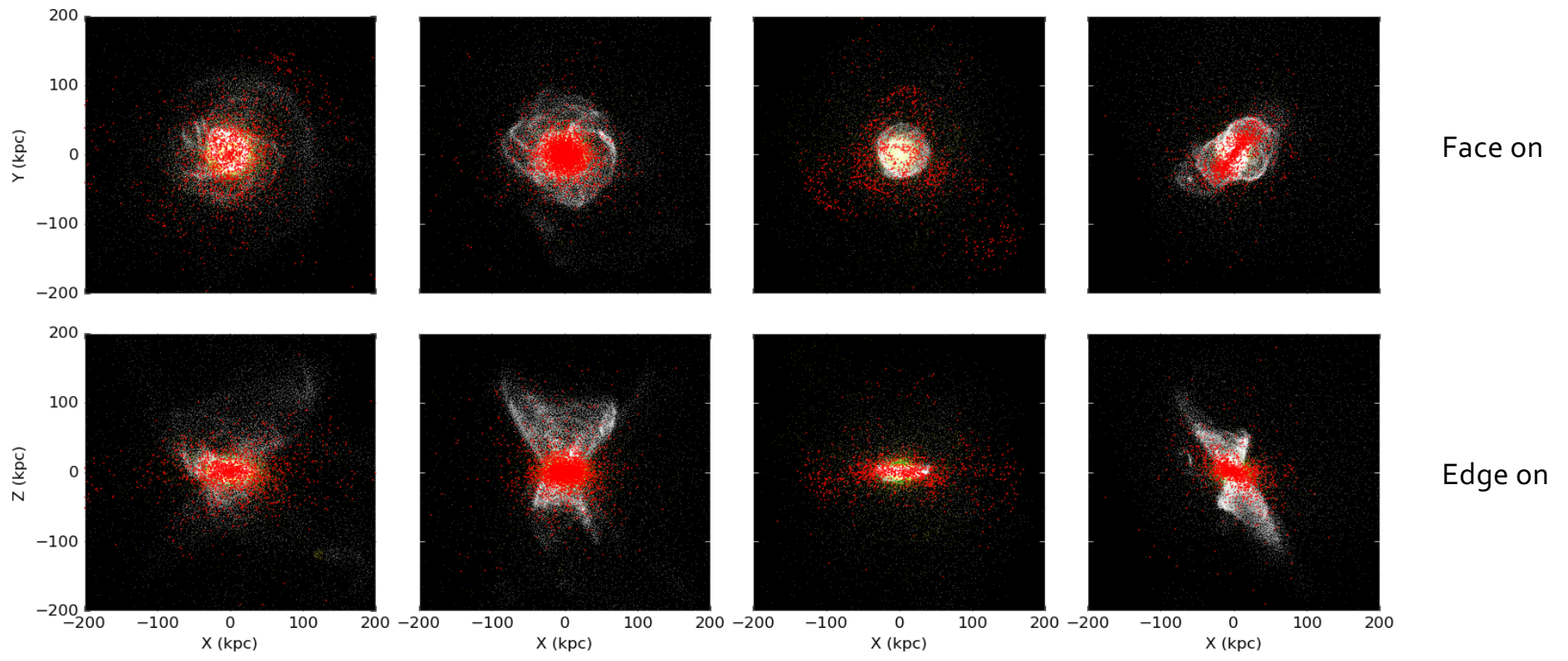


With these cuts, **every** central experiences a merger with satellite $M_* \geq 10^8 M_{\text{sun}}$

n=37

Elias et al. 2019, *In Prep*

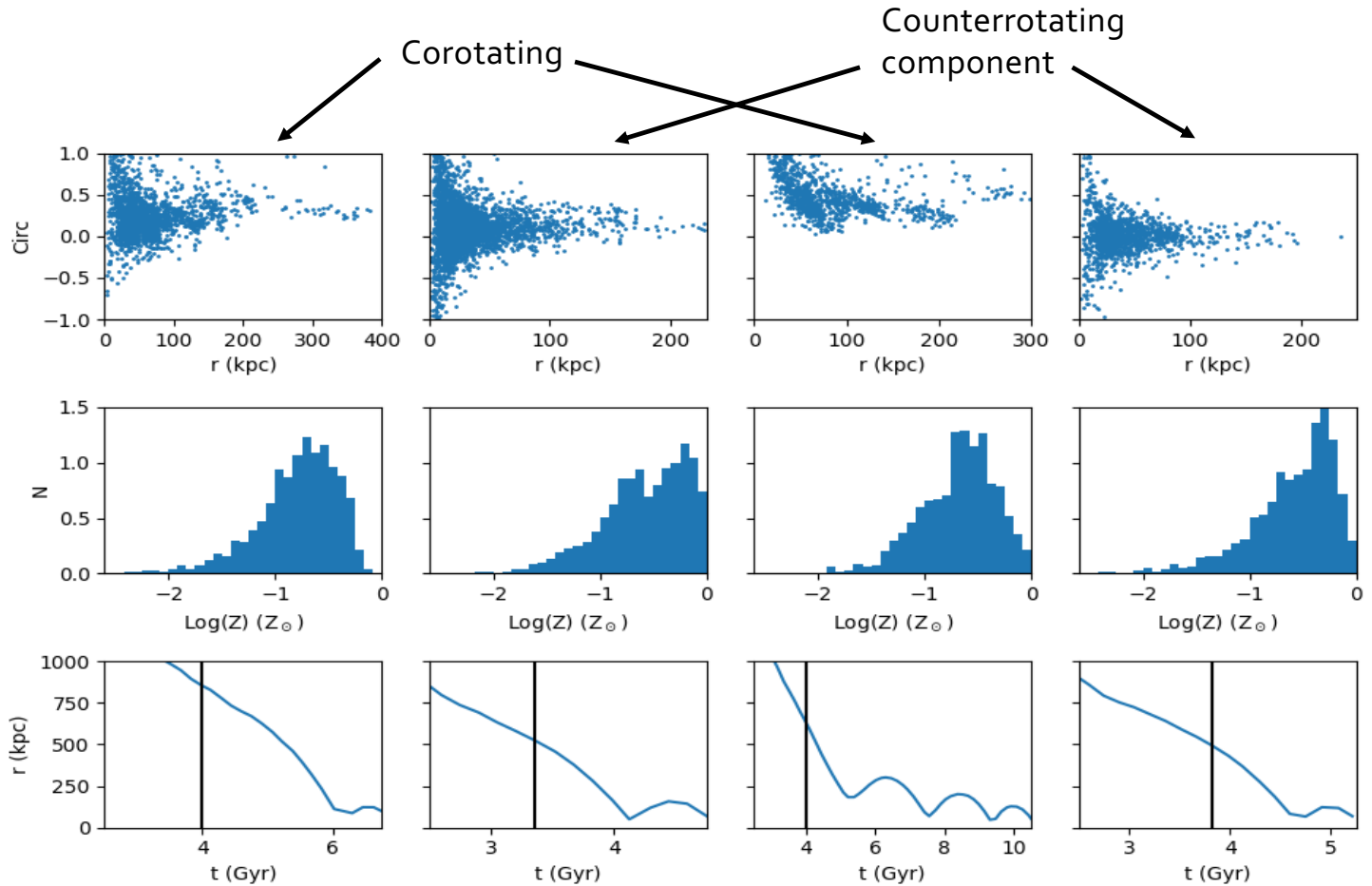
Four Diverse Gaia Sausage Analogs



Diversity in Gaia Sausage Debris

Elias et al. 2019, *In Prep*

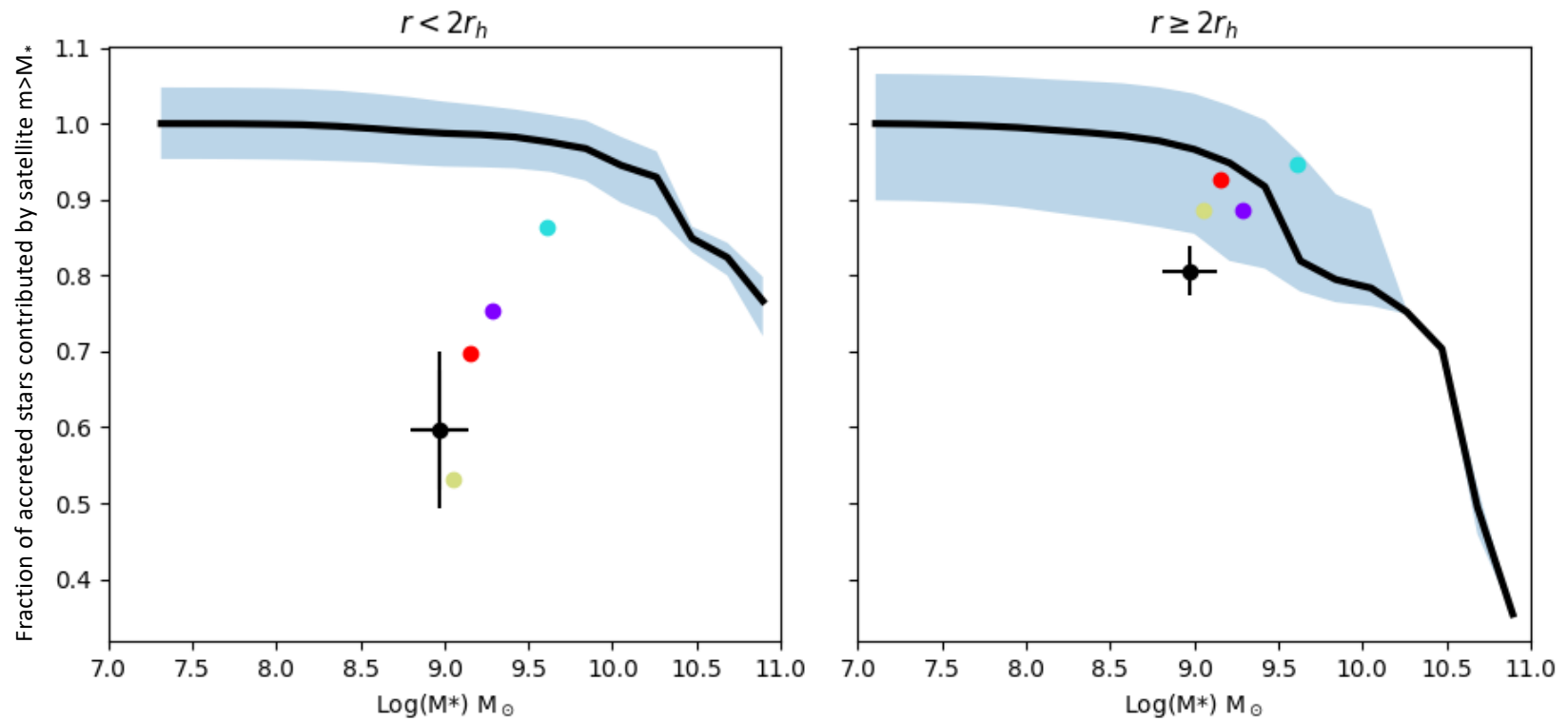
$$\text{circ} = \frac{j_z}{v_{\text{circ}} * r}$$



Broad range in metallicity

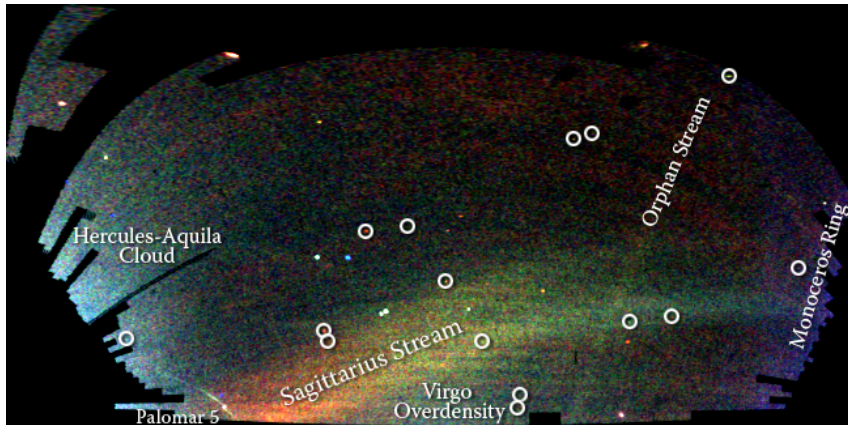
Diverse orbits of satellites

Majority of Stellar Debris Deposited in Outer Stellar Halo

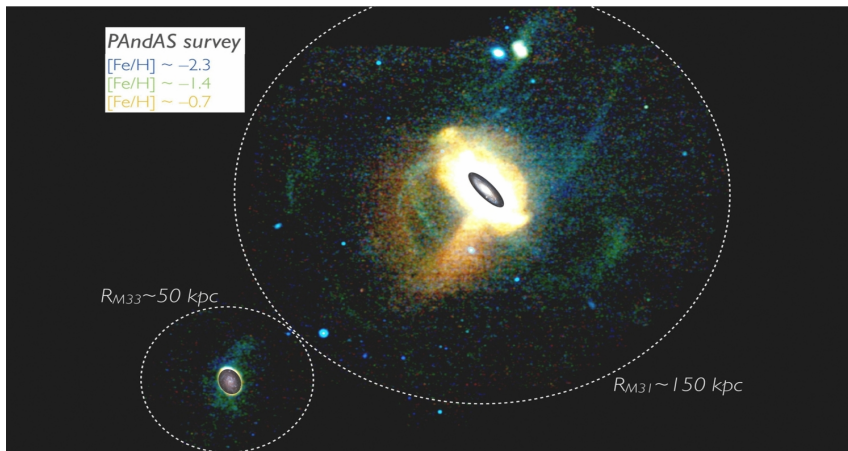


Stellar Halos and WFIRST

MW



M31



Credit: NASA / Goddard Space Flight Center WFIRST Project – Mark Melton, NASA/GSFC

X ~100!!

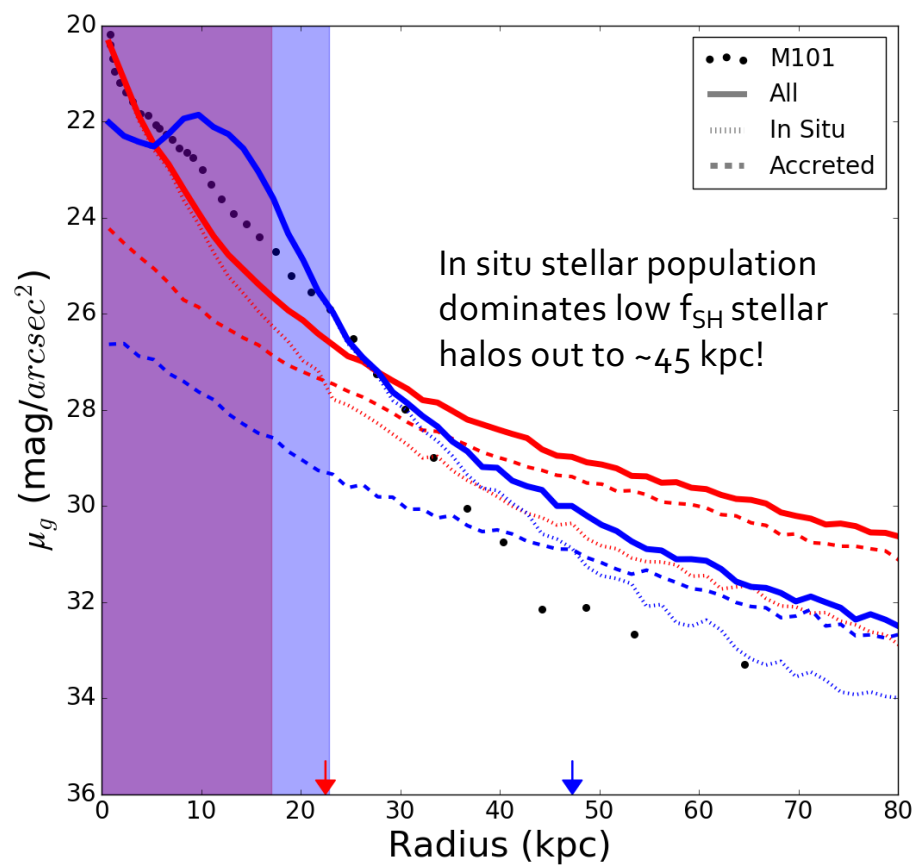
WFIRST will be able to **resolve hundreds of stellar halos** and capture their faint outskirts, probing the amount of diversity in stellar halos with a statistically large sample for the first time

Future work with TNG 50 could resolve discrepancies in surface brightnesses

Summary

- Large amount of **diversity** in stellar halos.
- Stellar halos surrounding **galaxies like our Milky Way are built early** by a few massive mergers.
- Gaia Sausage analogs in Illustris have **diverse range of metallicities, orbits, and circularities.**
- The debris from the Gaia Sausage may **extend far** into the outskirts of the halo and dominate the stellar halo in that region.
- WFIRST can aid the comparison to diversity in simulations by imaging **hundreds of stellar halos to deeper** surface brightness levels

Surface Brightness Profile



Metallicity Profile

