

The Origin of Spin Alignment in The Local Sheet



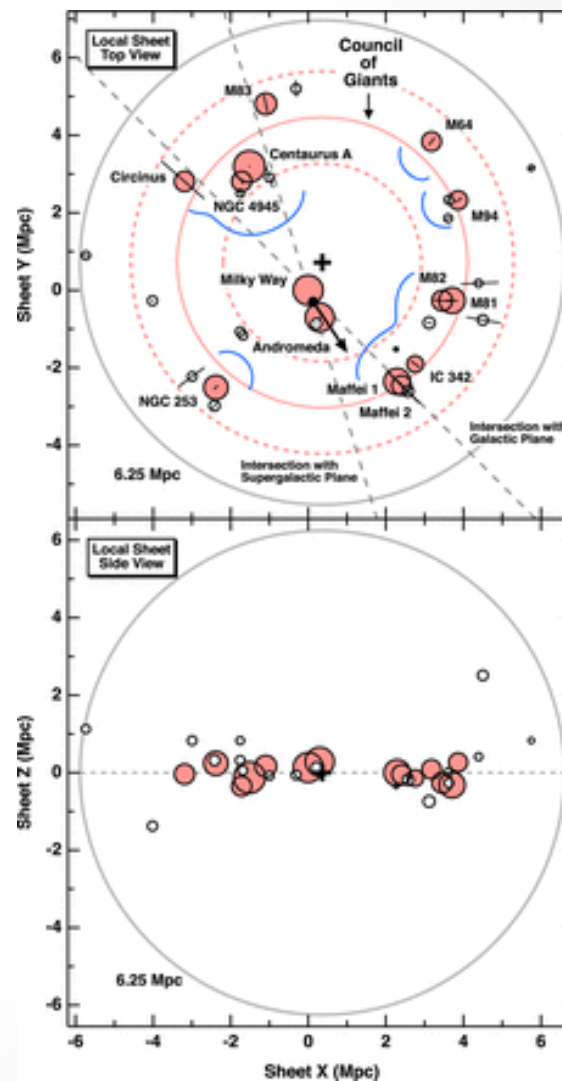
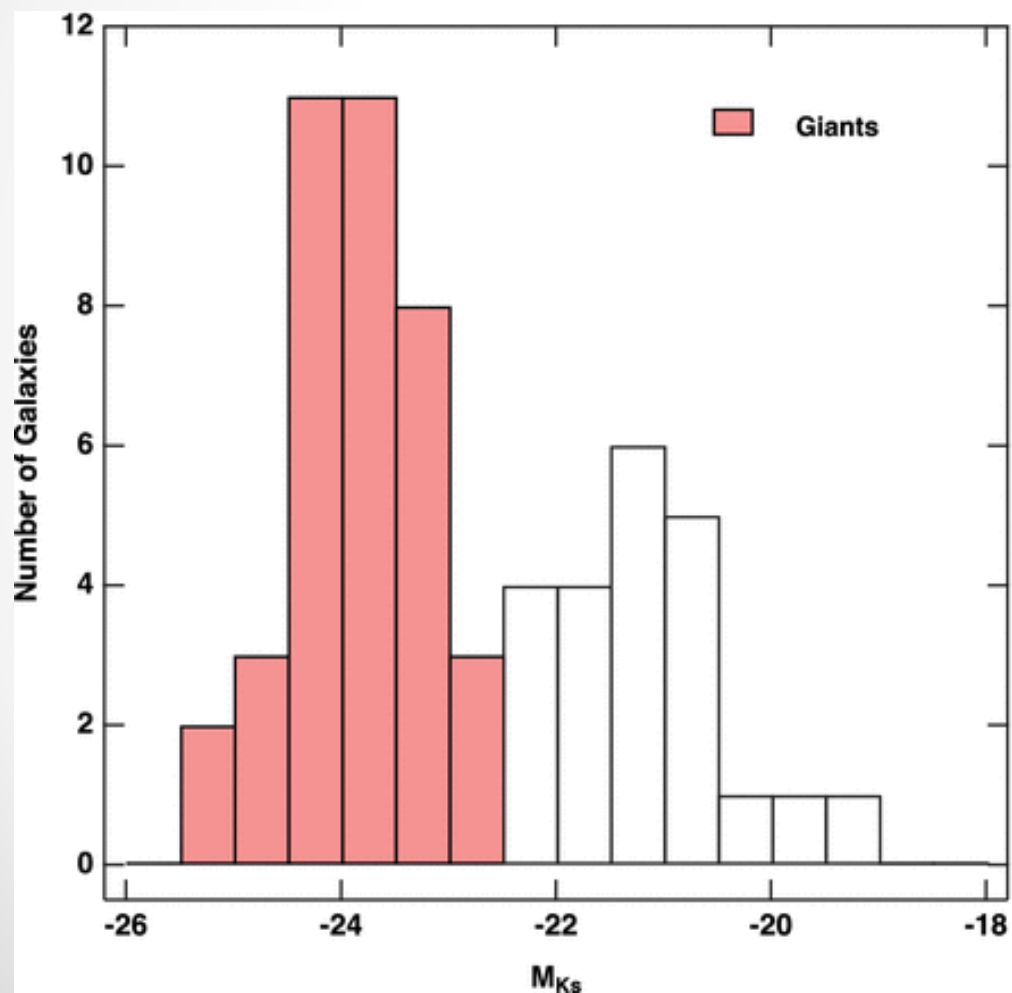
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York University, Canada

IAU308: June 24, 2014

The Local Sheet



(McCall 2014, MNRAS, 440, 405)

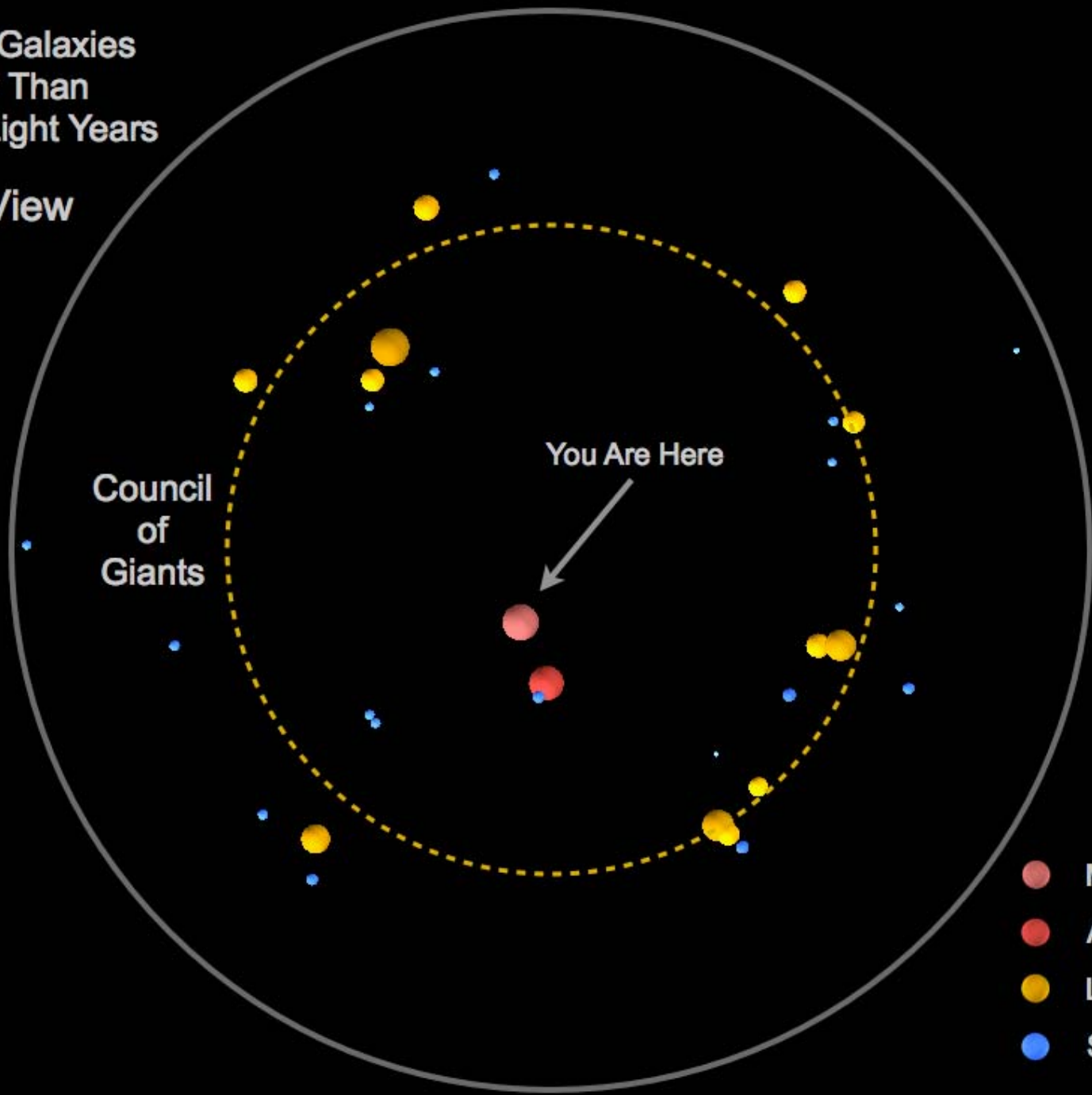
All Bright Galaxies
Nearer Than
20 Million Light Years

Top View

Council
of
Giants

You Are Here

- Milky Way
- Andromeda
- Large Galaxy
- Small Galaxy



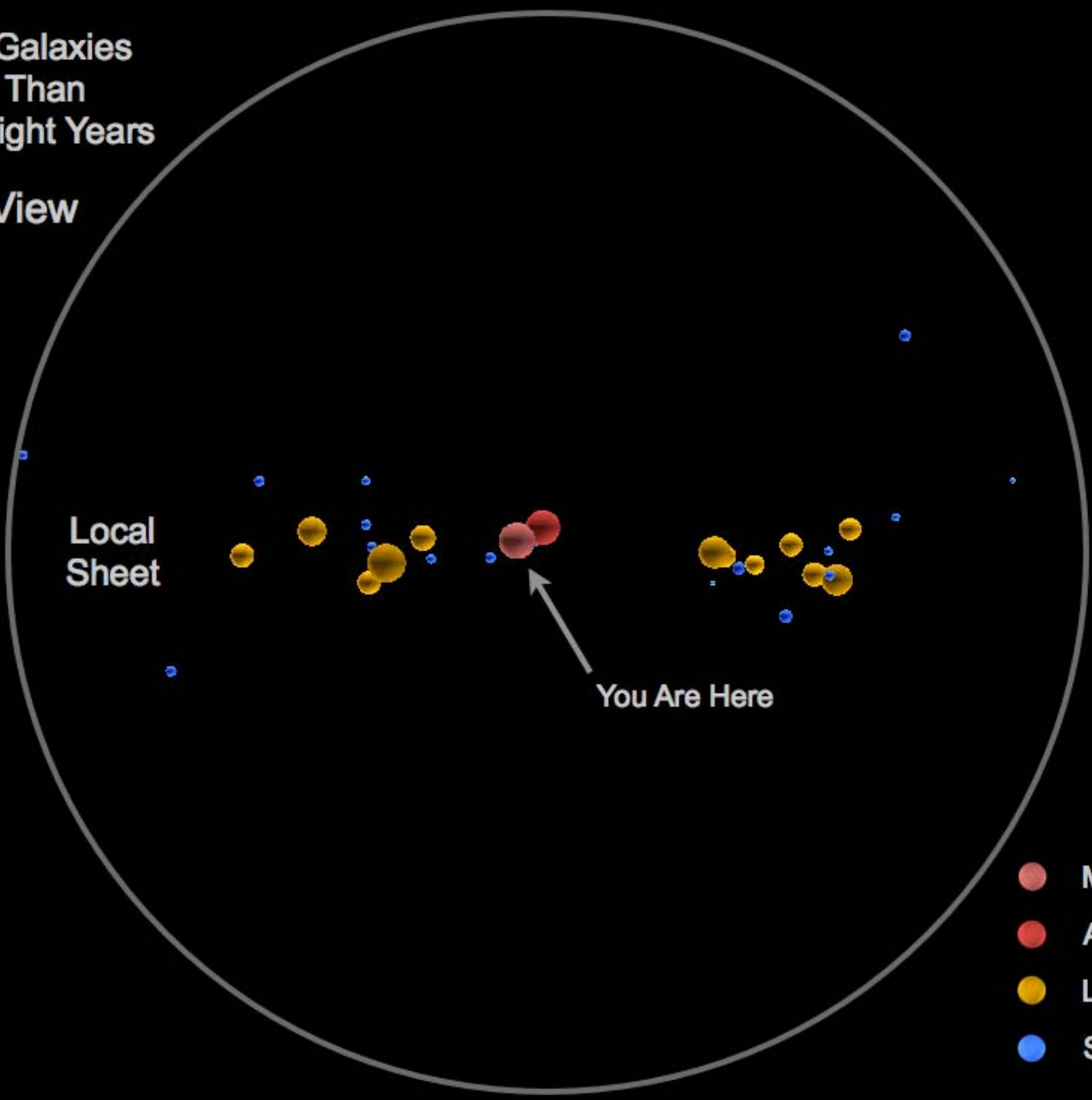
All Bright Galaxies
Nearer Than
20 Million Light Years

Side View

Local
Sheet

You Are Here

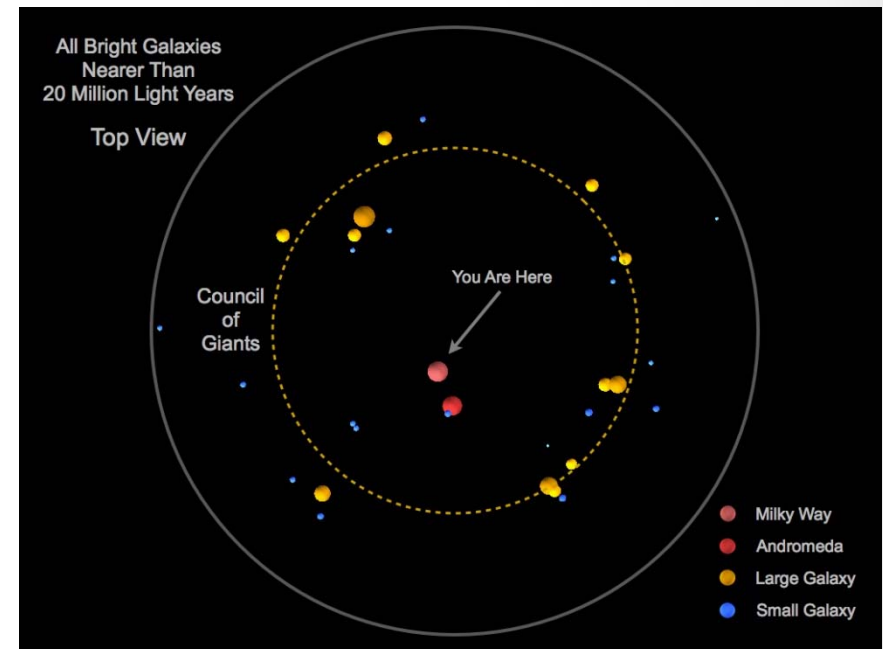
- Milky Way
- Andromeda
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The Local Sheet

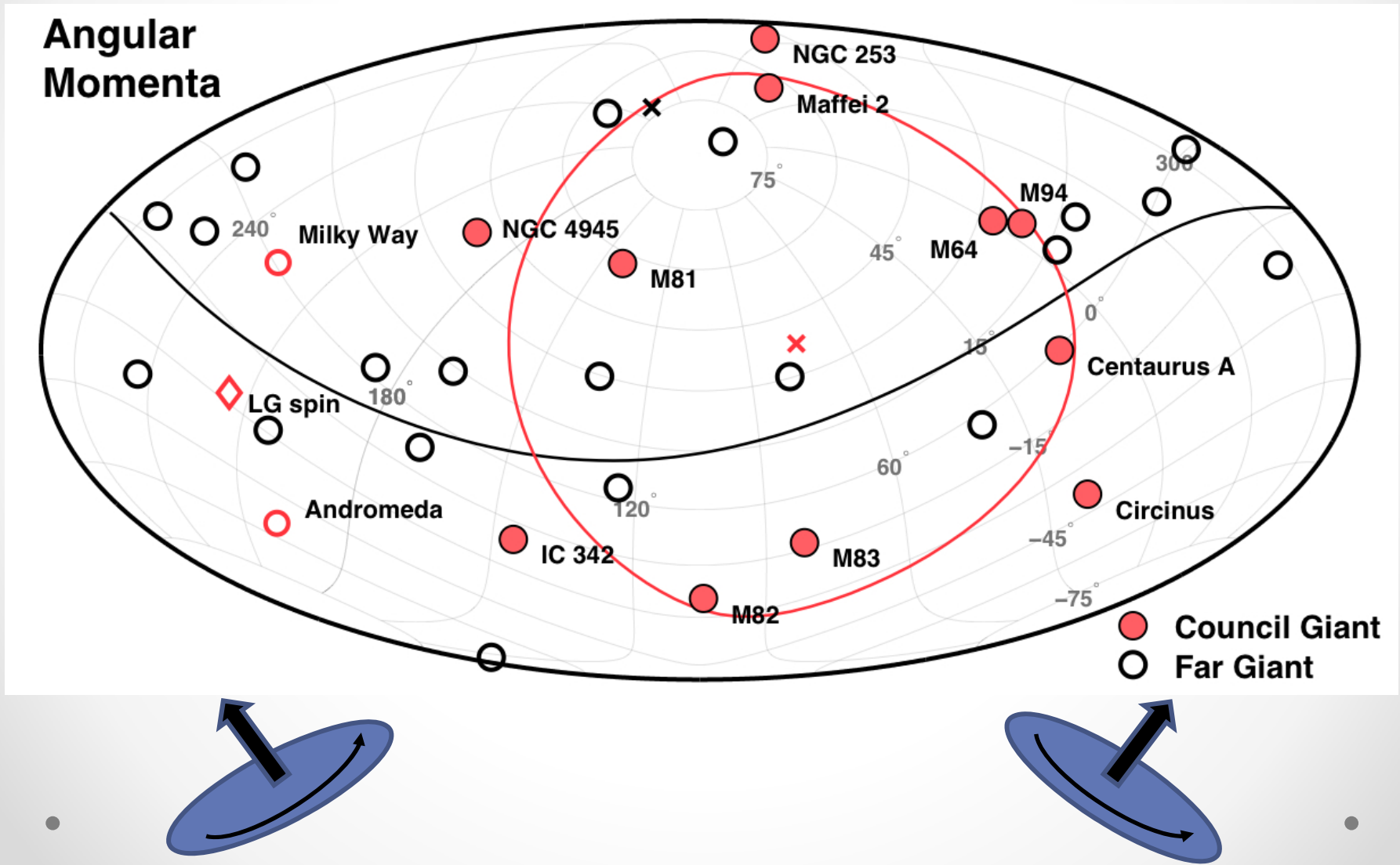
Physical Parameters

# of Giant Galaxies	= 14
# of Disk Galaxies	= 12
# of Elliptical Galaxies	= 2
Elliptical Separation	= 6.7 Mpc
Elliptical Diff. Angle	= 160 °
Council Diameter	= 7.5 Mpc
Thickness	= 0.47 Mpc



(McCall 2014, MNRAS, 440, 405)

Spin Alignment in The Local Sheet



Why are Local Sheet Galaxies Perturbed?

The Local Group?

(The Milky Way – M31 System)

Convenient Location:

1.1 Mpc from Council Centre

Asymmetrical Mass Distribution
(Tidal Torquing)

Local Group Mass Fraction:

27% of Giants



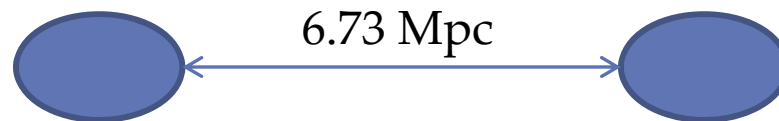
Analogues of The Local Sheet

- Key Features for Identifying Analogues in SDSS DR9
 - Elliptical Pairs
 - Prototype: Maffei 1 and Centaurus A
 - Isolated Interacting Pair of Disks Between the Ellipticals
 - Prototype: The Milky Way – M31 system (The Local Group)
 - Coplanar Arrangement of Galaxies
 - Preserving the height to extent ratio of the Local Sheet (0.03)
 - Additional sheet member population > 7 disk galaxies

180 Analogues of The Local Sheet Found!

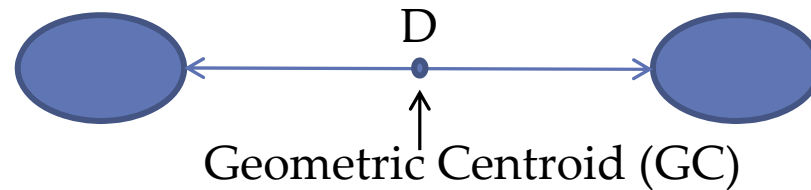
Analogues of The Local Sheet

- The Elliptical Dipole (Maffie 1 & Centuarus A)
 - Seperation Distance = 6.73 Mpc
 - Luminosity Ratio = 0.78



- Requirements for an Analogue Dipole
 1. Both members must be ellipticals
 2. No ellipticals within the volume contained by the analogue dipole
 3. Preserve the gravitational potential shape of The Dipole

Analogues of The Local Sheet



1. Morphology
2. No ellipsicals with a GC-centric distance $< D/2$
3. Gravitational potential shape preservation

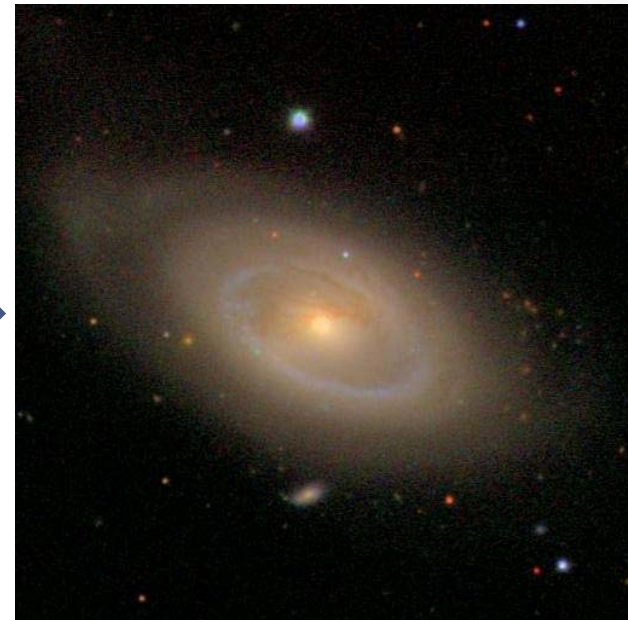
The Control Sample

Replace

Interacting Disk Pair



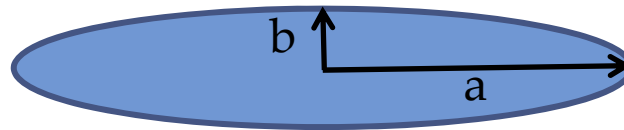
Single Disk Galaxy



(Courtesy of the SDSS Image Database)

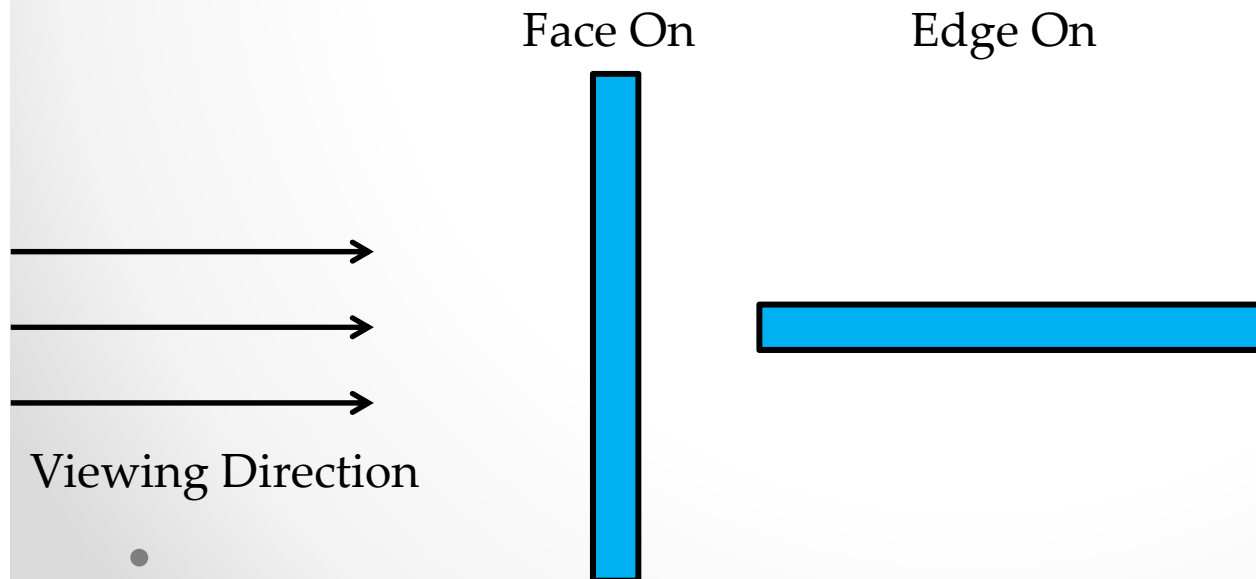
Preliminary Analysis

- Proxy of spin direction = Axis Ratio



$$\text{Axis Ratio} = (b/a)$$

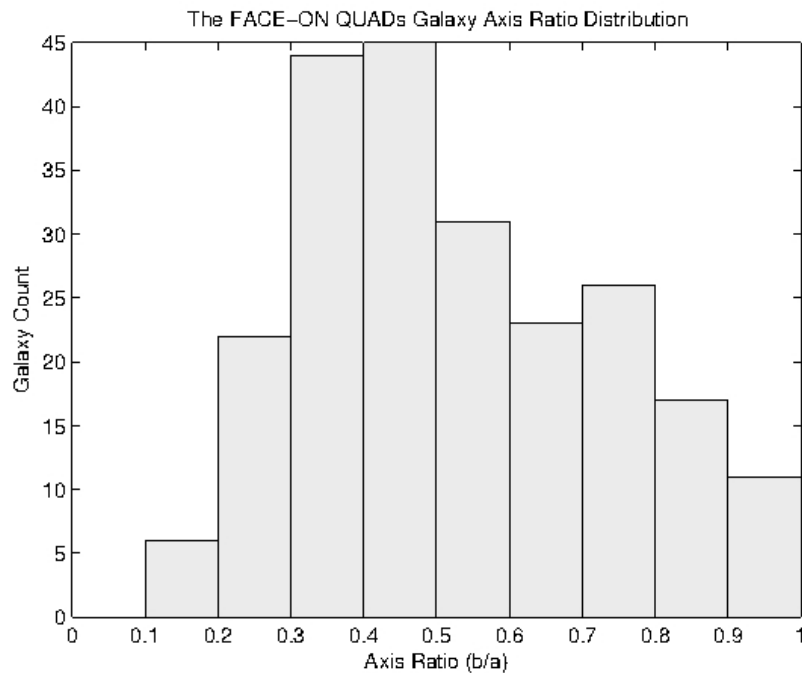
- Sheet Orientation Selection



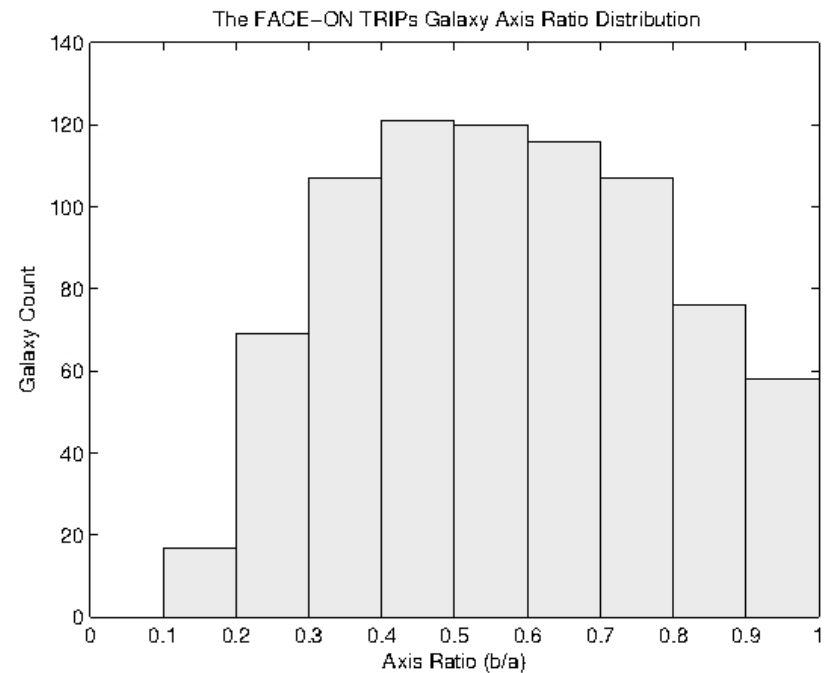
Axis Ratio Distributions: Face-On Sheets

- Face-On Definition: Sheet Tilt $< 44^\circ$ (3σ Bound)

Local Sheet Analogues



Control Sheets



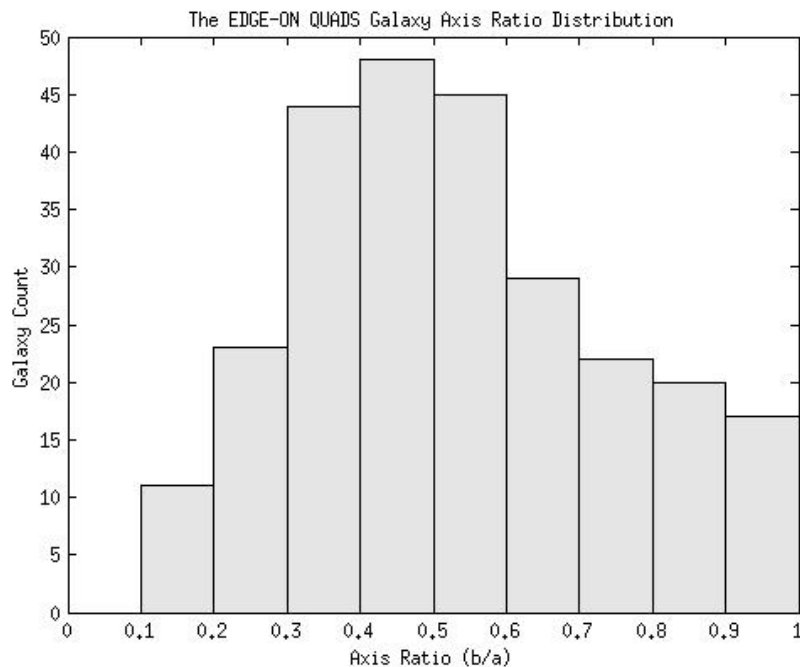
97.6% Distinct

• Interacting Pairs Make a Difference! •

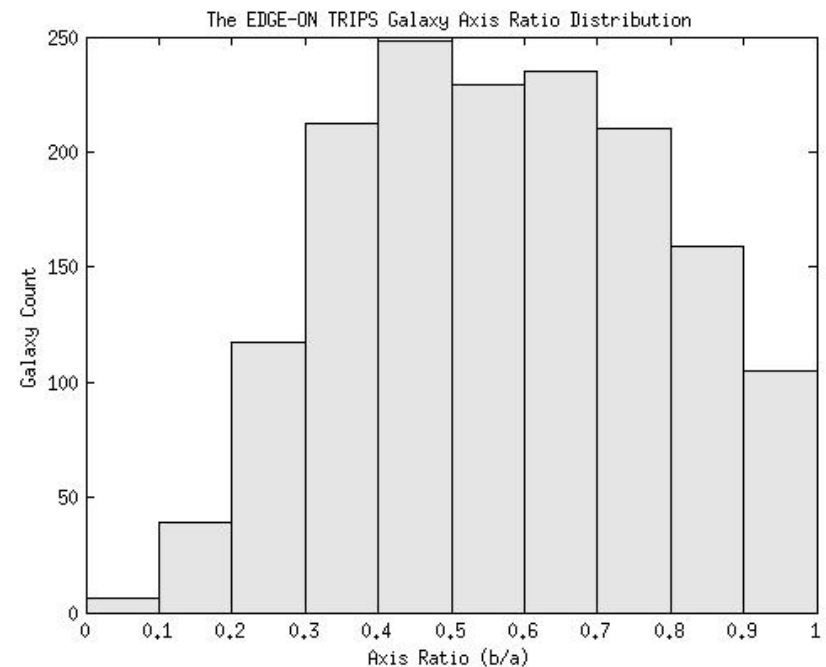
Axis Ratio Distributions: Edge-On Sheets

- Edge-On Definition: Sheet Tilt $> 72^\circ$ (3σ Bound)

Local Sheet Analogues



Control Sheets

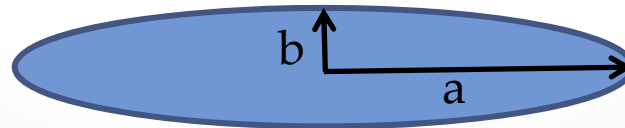
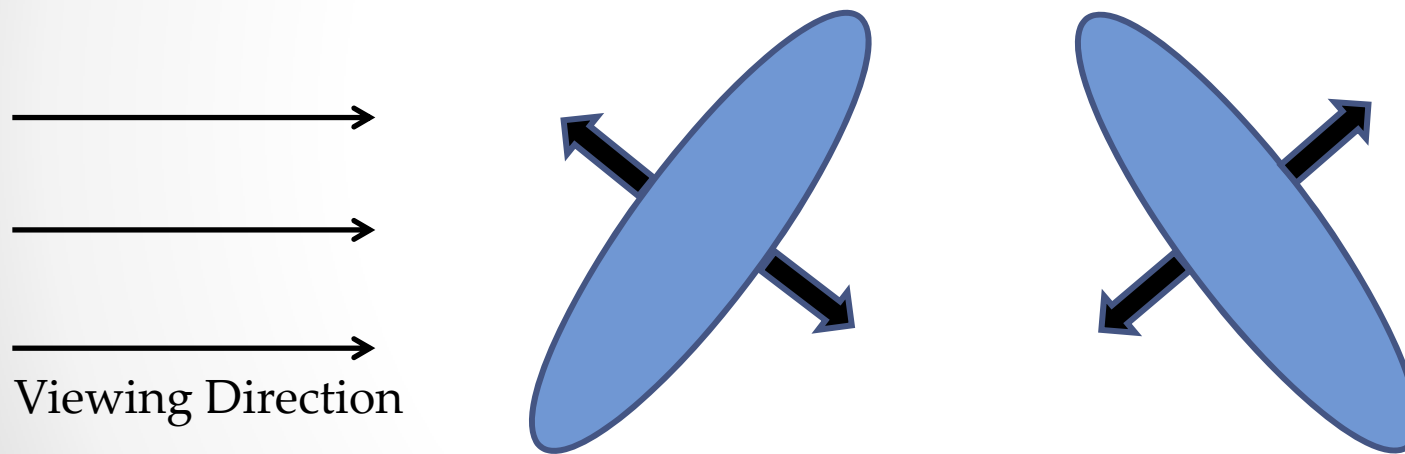


96.9% Distinct

• Interacting Pairs Make a Difference! •

3D Spin Distributions

- Projected Axis Ratios – 4-fold ambiguity



Axis Ratio = (b/a)

Future Works

- 3D Spin Vector Alignment in Analogues & Controls
 - In progress:
 - Tilt
 - Position Angle
 - Disk Rotation Direction (approaching & receding sides)
 - Spiral arm winding
- Spin Alignment in Analogues of the Local Sheet identified in Large Scale Structure Simulations
 - In Progress:
 - Identify Analogues of the Local Sheet
 - Identify Control Sheets
 - Similar Investigation of Spin Alignment



Conclusion

Interacting pairs in analogues of the Local Sheet likely perturb the spin of members!