Rotating planar anisotropies in SDSS satellites

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SATELLITES

SNAPES on a PLANE
planar satellite anisotropies

... around the MW?

... around Cen A?

Pawłowski+12

Tully+15
planar satellite anisotropies

... around M31?

Ibata+13

Ibata+14
planar satellite anisotropies

... in SDSS?

cumulative co-rotating #
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cumulative counter-rotating #
planar satellite anisotropies

what might cause planar alignment/co-rotation?

... preferential destruction of off-plane satellites?

... filamentary infall imprinted on satellite orbits?

why care about planar alignment/co-rotation?

... challenge to $\Lambda$CDM?

... inform models of environmental evolution?
the experiment

examine pairs of satellites in SDSS for statistical signatures of planar co-rotation
select isolated, M31-like hosts with at least two bright satellites

hosts: $-23 < M_r < -20$, no brighter objects within 500 kpc and 1000 km/s

sats: $M_{r,\text{host}} + 1 < M_r < -16$, bound

final sample contains 426 hosts, 965 satellites
Figure 2: Anti-correlated satellites in the SDSS. 

(a) The number of satellite pairs that have correlated and anti-correlated velocities is shown as a function of the tolerance angle. There is a clear surplus of anti-correlated pairs for all angles considered.

(b) This fraction shows an overall decline with increasing tolerance angle, reaching $2.4$ at $15^\circ$, which we consider the maximum useful opening angle given the low number of satellite pairs in the SDSS.

(c) The significance (in units of standard deviation) of the excess of anti-correlated satellite pairs. The most significant peak has significance $>4$ at an opening angle of $8^\circ$. 

The data from Phillips+14 and Ibata+14.
the data

![Graph showing co-rotating fraction vs. angle (degrees)]
toy models

disc (planar) model —
the data

100% disc

co-rotating fraction

$\alpha$ (degrees)
toy models

isotropic model
toy models

isotropic model
toy models

isotropic model
the data
can we make it work?

two ways we can suppress the signal at intermediate $\alpha$:

cut out all face-on disks

restrict discs to a narrow range of $\alpha$
can we make it work?

all satellites

small $\alpha$

$|\Delta V|$ (km/s)

projected distance (kpc)

$\sim V_0$

$\sim 0.3V_0$
can we make it work?
where does that leave us?

random isotropic realization

Co-rotation fraction vs. $\alpha$ (degrees)
conclusions

planes as traced by bright satellites are not ubiquitous

-at most ~10% of hosts have such planes

M31-like planes may still be common

the hunt is still on!