Cocoons around Tidal Streams

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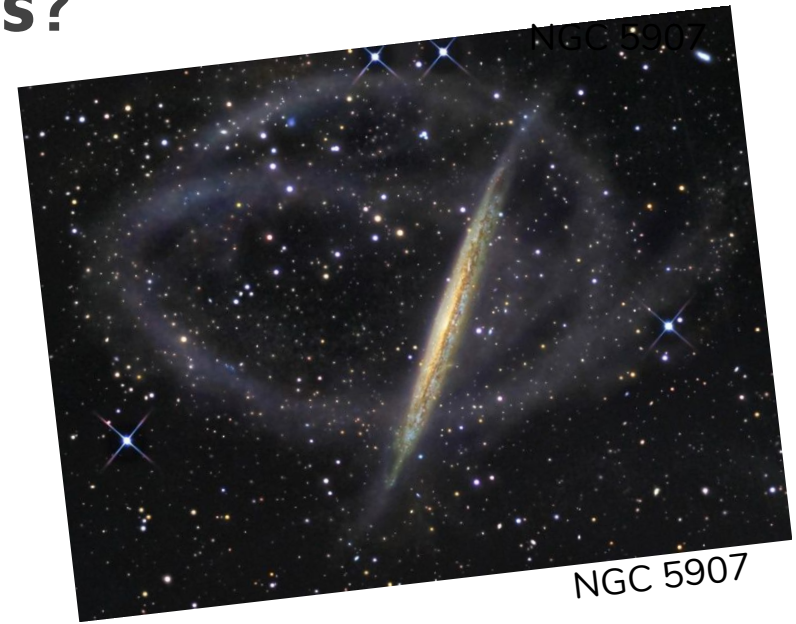
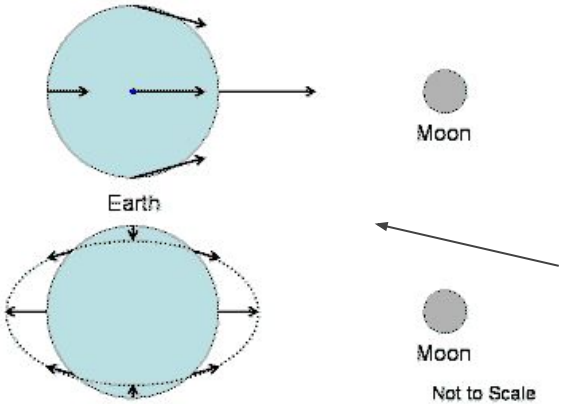
What are Tidal Streams?

- **Tidal streams**: long and thin overdensities of stars & debris (dust + gas + dark matter?) in galactic halo
- ***How do they form?*** tidal disruption of satellites (globular cluster or dwarf galaxy)
  - GC streams: narrow and thin, dynamically cold
  - dG streams: wider and more extended in size, dynamically hot



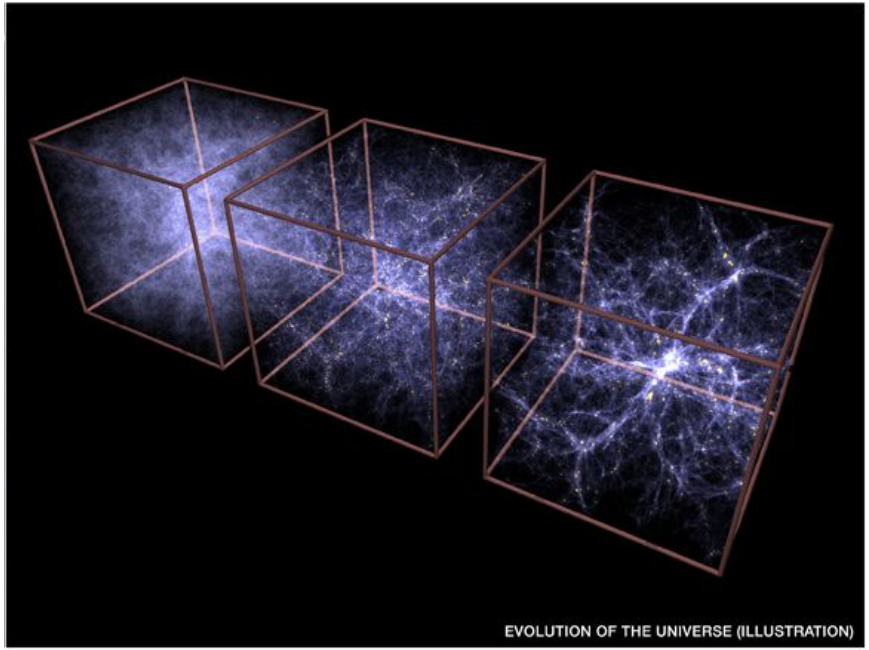
NGC 5907



Tidal force: differential force due to gradient in gravitational pull on extended body

→ responsible for tides on Earth

Why are they important?



- Constrain models of galaxy formation & evolution
  - ΛCDM (Lambda Cold Dark Matter) model: clustering + merging of dark matter

- Probe dark matter main halo as well as the sub-halo structures within it
  - **Why tidal streams are so effective:** (1) probe outer regions of DM halo & (2) are dynamically cold → easier to detect interactions w/ DM subhaloes

Existence of a “Cocoon”?

BUTTERFLY IN A COCOON,
UNDERSTANDING THE ORIGIN AND MORPHOLOGY OF GLOBULAR CLUSTER STREAMS:
THE CASE OF GD-1

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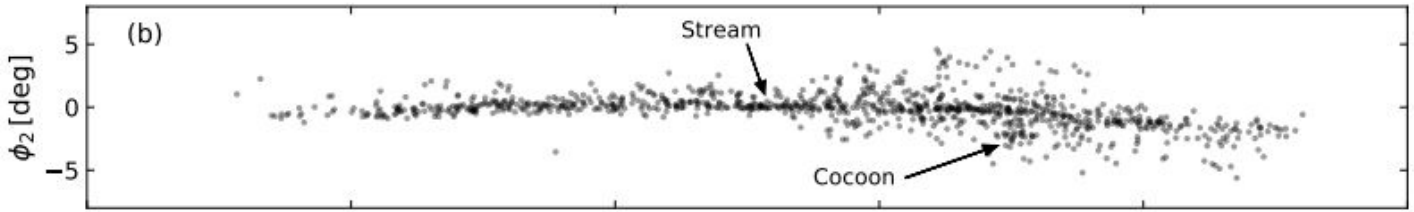
ABSTRACT

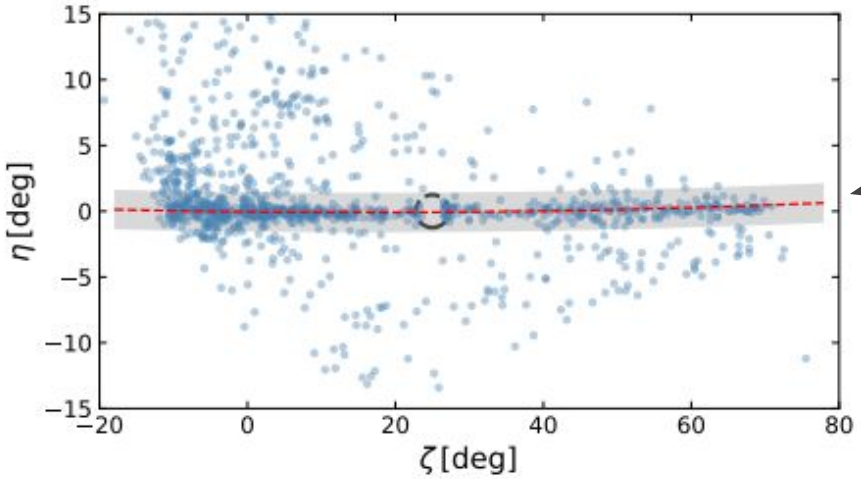
Tidally disrupted globular cluster streams are usually observed, and therefore perceived, as narrow, linear and one-dimensional structures in the 6D phase-space. Here we show that the GD-1 stellar stream (≈ 30 pc wide), which is the tidal debris of a disrupted globular cluster, possesses a secondary diffuse and extended stellar component (≈ 100 pc wide) around it, detected at $> 5\sigma$ confidence level. Similar morphological properties are seen in synthetic streams that are produced from star clusters that are formed within dark matter sub-halos and then accrete onto a massive host galaxy. This lends credence to the idea that the progenitor of the highly retrograde GD-1 stream was originally formed outside of the Milky Way in a now defunct dark satellite galaxy. We deem that in future studies, this newly found *cocoon* component may serve as a structural hallmark to distinguish between the in-situ and ex-situ (accreted) formed globular cluster streams.

Subject headings: Galaxy : halo - Galaxy: structure - Galaxy: formation - stars: kinematics and dynamics -globular clusters



My Research:

- Simulate tidal disruption of ex-situ formed globular clusters as they are accreted onto MW
- **Goal:** try to reproduce stellar cocoon around GD-1 type tidal stream



Simulations from paper: tidal disruption of GC showing a cocoon around tight stream (gray band)