ASTR400B

Dr Besla: gbesla@arizona.edu

Hayden Foote: haydenfoote@arizona.edu

Beginning of Semester Survey

Class GitHub Repository

https://github.com/gurtina/ASTR400B_2023

Syllabus

- Office Hours
  - Prof Besla: After Class on Tuesdays in N312
  - Hayden: Wed Afternoon 3-5 in 3rd floor library of Steward Observatory

What is a Galaxy?

- Bunch of stars! Billions – but some galaxies only have 100 stars!
- “light matter” – gas, ISM, stars --> Baryonic Matter
  - Some galaxies don’t have gas!!

- Dark matter!!
- Willman & Strader 2012: “Galaxy” Defined

A galaxy is a gravitationally bound set of stars whose properties cannot be explained by a combination of baryons (gas & stars) and Newton’s laws of gravity.

Sizes of Galaxies: 1kpc – 10s of kpc

Luminosity : 100Lsun – 10^12 Lsun

Dark Matter: 10^8 Msun – 10^13 Msun

What is a Galaxy?

What are the components of a Galaxy?

- Baryons- gas and stars, DUST! → Disk or Spheroid/Elliptical Distribution
- Centralized Supermassive Black Hole!!
- Dark Matter Halo → Sphericalish distribution of dark matter that surrounds the disk/spheroid. Extend to 10x the size of the disk itself.
- Surrounding the Disk/Spheroid:
  - Satellite Galaxies – smaller galaxies that orbit around the larger one.
  - Globular clusters, groups of stars, stellar streams === Stellar halo
  - Gaseous Halo – gas (typically “hot”) 10^6 ish K (xrays) to 10^4 K (HI)

What is the Local Group?

- Milky Way + Andromeda Galaxy + the collections of satellite galaxies that orbit them

How do galaxies evolve over time?

- In what way can a galaxy change over time?
  - **Run out of gas** – gas forms stars (can become "Quenched" – no detectable levels of star formation).
  - **Stellar mass** can grow
  - Colors of galaxies can change (blue → red)
    - Ages of the stellar populations
  - COLLIDE!! -- Merging Galaxies → **Structure changes** (disk → elliptical?)

    →Speed up the process of gas turning into stars

    → Black holes **GROW** – grow by eating more gas ! Black holes can merge!!

What is a Galaxy Merger?

- Galaxy Pairs vs Colliding Systems
- A system is defined to be merged once their nuclei have coalesced.
  - So there is only one central luminosity peak.

Why do Galaxies Merge?

- Dynamical Friction !!
  - Gravitational wake that forms behind a galaxy that is moving through the dark matter distribution of another galaxy
  - The wake pulls back on the galaxy – causing it to decelerate.
  - The wake acts as friction

What does “Cosmology” mean in astronomy?

- Cosmology is the developing theory of the origin, evolution, and fate of the universe.