

Introduction to Galactic Astronomy

Introduction to Galactic Astronomy

Key concepts, terminology, and foundational ideas for studying our Milky Way and other galaxies.

1. What Is Galactic Astronomy?

- **Definition:** The branch of astronomy that investigates the structure, composition, dynamics, and evolution of galaxies—especially the Milky Way.
- **Scope:**
 - Stellar populations and star clusters
 - Interstellar medium (gas, dust, magnetic fields)
 - Galactic dynamics and dark matter
 - Galactic formation history and future evolution

2. The Milky Way – Our Home Galaxy

Feature	Typical Values	Importance
Type	Bar?spoked spiral (SBc)	Sets the reference for other galaxies
Diameter	~100,000?ly (30?kpc)	Determines overall mass and gravitational potential
Mass	~1–1.5? $\times 10^{12}$?M? (including dark matter)	Controls orbital motions of stars & satellites
Components	• Thin disk • Thick disk • Bulge/Bar • Stellar halo • Dark matter halo	Each component has distinct kinematics & chemistry
Star Formation Rate	~1–2?M??yr? ¹	Indicates ongoing growth of the stellar disk

3. Basic Galactic Structure

1. Central Bulge / Bar

- Dense, spheroidal region; contains older, metal?rich stars.

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- The bar (~3 kpc) drives gas inflow toward the center, fueling star formation and the central supermassive black hole.

2. Thin Disk

- Height ~300 pc, radius ~15 kpc.
- Hosts most of the Galaxy's gas, young massive stars, and open clusters.
- Exhibits differential rotation (~220 km/s¹ at the Sun's radius).

3. Thick Disk

- Height ~1 kpc, older, more metal-poor stars.
- Thought to be formed by early mergers or heating of the thin disk.

4. Stellar Halo

- Spherical, low-density component extending >50 kpc.
- Dominated by old, metal-poor stars and globular clusters; retains signatures of past accretion events.

5. Dark Matter Halo

- Extends to several hundred kiloparsecs.
- Provides the majority of the Galaxy's mass; inferred from rotation curves and satellite dynamics.

4. Galactic Coordinates

System	Axes	Typical Use
Equatorial	Right Ascension (α), Declination (δ)	Telescope pointing, sky surveys
Galactic	Longitude (l), Latitude (b)	Mapping Milky Way structures; $b=0^\circ$ points to the Galactic Center
Cartesian (Galactocentric)	X (toward $b=0^\circ$), Y ($l=90^\circ$), Z (toward Galactic north)	Modeling orbits and dynamics

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5. Stellar Populations

Population	Age	Metallicity (Fe/H)	Typical Location
Population I	<10 Gyr	Near solar or higher	Thin disk, spiral arms
Population II	>10 Gyr	Low (−1 to −2)	Thick disk, halo, globular clusters

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