

Galaxy



A galaxy is a large, massive system consisting of stars, an interstellar medium of gas and dust, stellar remnants, and dark matter, all bound together by gravity.

- There are probably **about 2 trillion galaxies** in the observable Universe!
- Tens of thousands of galaxies have now been catalogued, but **only a few given a well-established name** (example: Andromeda Galaxy, Magellanic Clouds, etc.)
- Sizes of galaxies range from **dwarfs** with as few as ten million stars to **giants** with one hundred trillion stars; most galaxies in the Universe appear to contain only a few billion stars.

(Hubble) Galaxy Types

Have *black holes* at their centers!

EVOLUTION?

Spiral

May have
“wandering”
black holes...

Irregular

Elliptical



Elliptical galaxies have smooth, featureless light distributions and appear as *ellipses* in images; they consist mostly of **old stars**.



Spiral galaxies consist of a flat, rotating disc of two or more *spiral arms* containing mostly **young stars**, gas and dust, and a central *bulge* of older stars.



Irregular galaxies do not have any distinct regular shape.

Together they make **~60%** of all galaxies in the observable Universe.

Hubble “tuning-fork” diagram

Normal Spirals

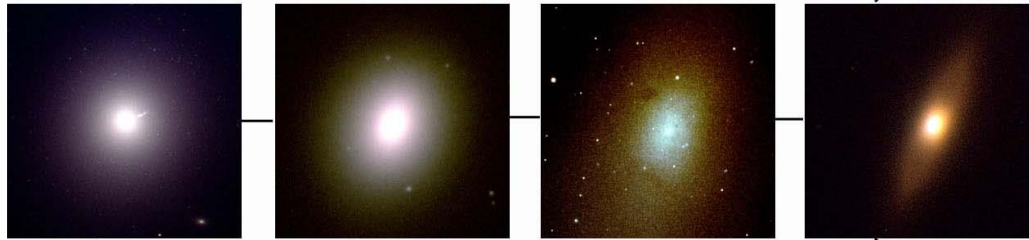


Sa

Sb

Sc

Ellipticals



E0

E2

E5

SO - lenticulars

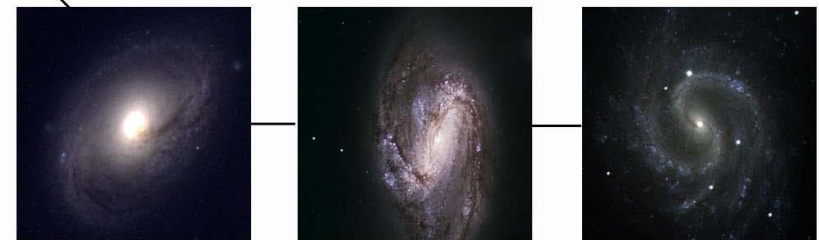
Morphological classification system based on visual appearance of galaxies;

DOES NOT represent EVOLUTION!

SBa

SBb

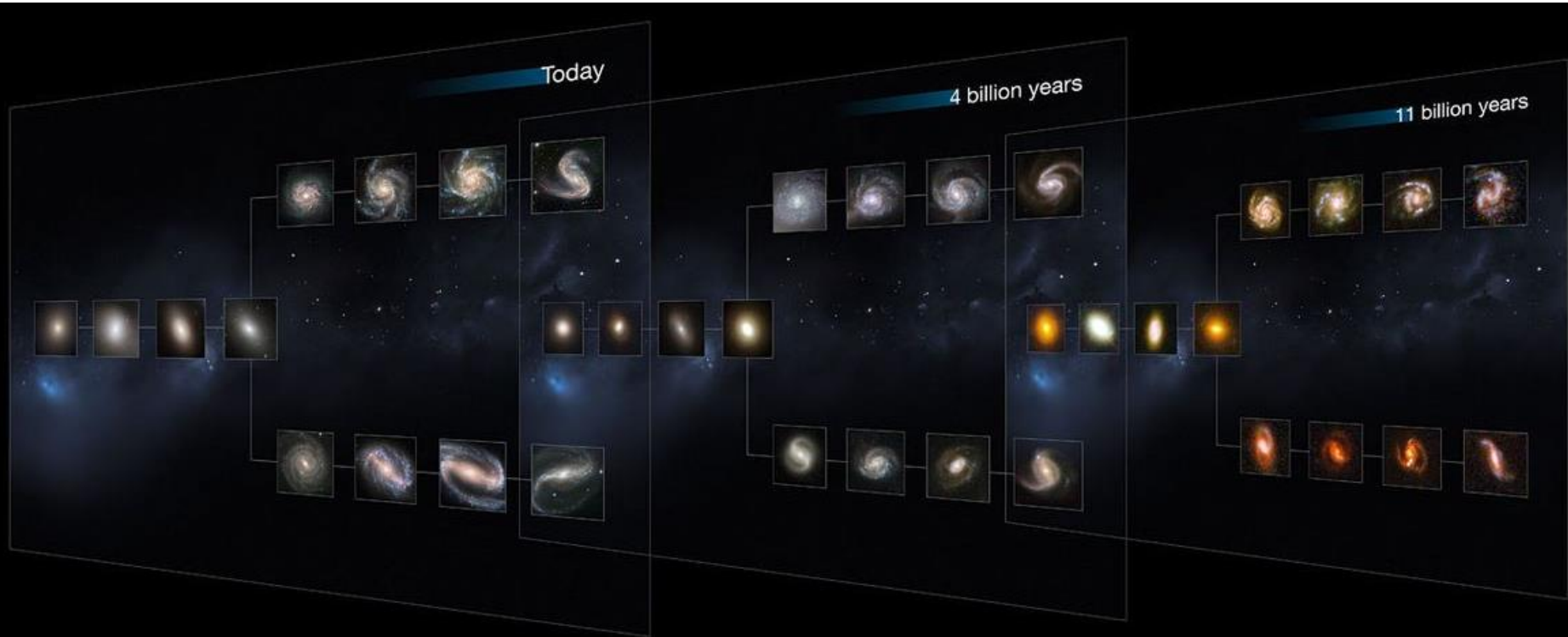
SBc



Barred Spirals

Diversity of Galaxies

throughout the history of the Universe



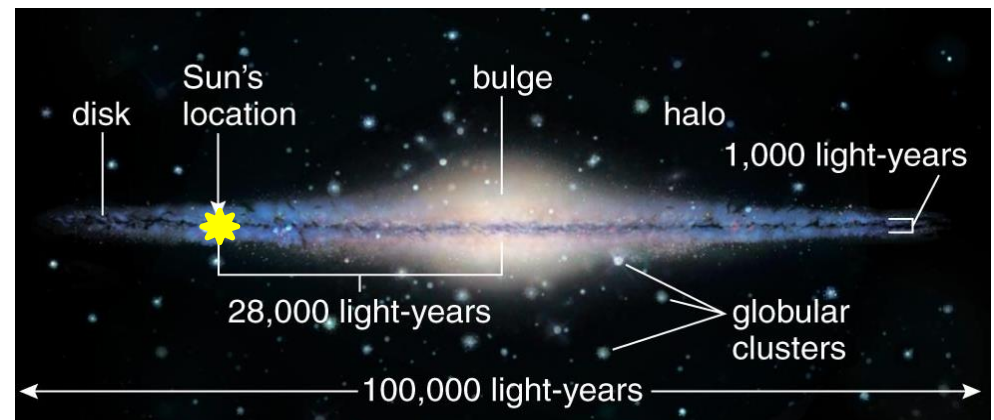
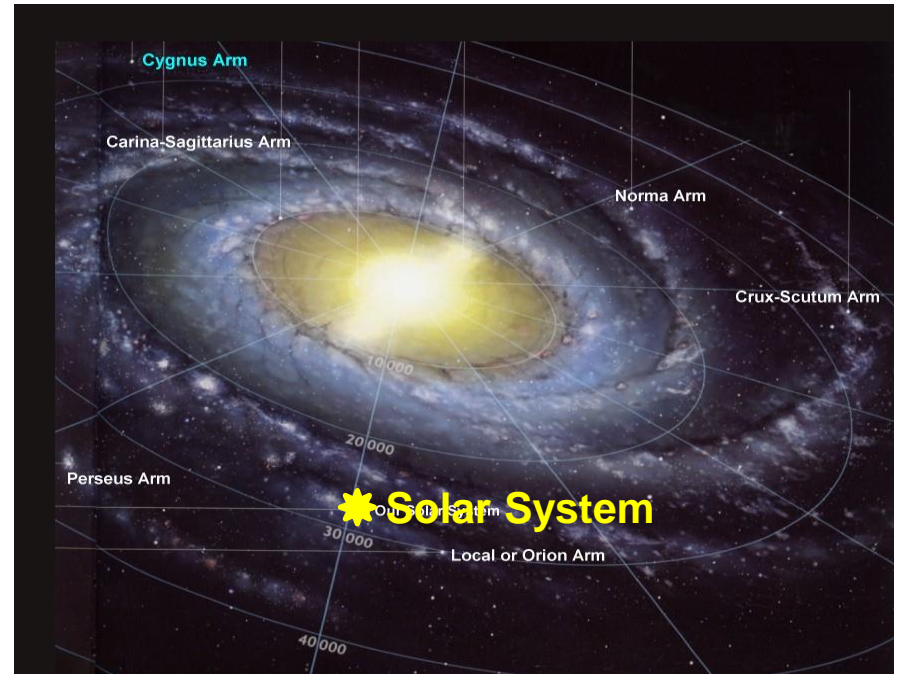
The **Hubble photo survey** found that the assorted range of galaxy types seen today (*“cosmic zoo”*) were also present about 11 billion years ago, meaning that the types of galaxies seen today have been around for at least 80 percent of the universe’s lifespan of 13.8 BY.

Our Galaxy: the Milky Way

The Milky Way is a large **barred spiral galaxy** (we think!) some **~100,000 light-years** in diameter, which contains **100–400 billion stars**. It may contain at least as many planets as well.



Every star we see in the night sky is in our own galaxy. We cannot see stars in other galaxies because they are too far away.



Our Local Group of Galaxies

The total size of the Local Group is **10 million light-years across.**



It contains **more than 50** (mostly *dwarf*) **galaxies.**



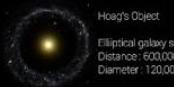
UGC 10214 - "The Tadpole"
Disturbed spiral galaxy with a very long tail
Distance: 420,000,000 LY
Total length: 390,000 LY



NGC 1316 - "Fornax A"
Dusty elliptical galaxy
Distance: 62,000,000 LY
Diameter: 220,000 LY



NGC 908
Starbursting galaxy with disturbed spiral arms
Distance: 55,000,000 LY
Diameter: 75,000 LY



Hoag's Object
Elliptical galaxy surrounded by a ring of blue stars
Distance: 600,000,000 LY
Diameter: 120,000 LY (of outer ring)

Hercules A

Giant elliptical galaxy with powerful radio jets (shown in pink) powered by a supermassive black hole at the galaxy's center
Distance: 2,100,000,000 LY
Diameter: 1,500,000 LY (jets)



M100
Spiral galaxy in the Virgo Cluster
Distance: 55,000,000 LY
Diameter: 160,000 LY



NGC 6670
Two intersecting galaxies seen edge-on
Distance: 400,000,000 LY
Diameter: 120,000 LY



The Milky Way
It's us!
Diameter about 100,000 LY
Artist's impression (Nick Rafter)



M31 - "Andromeda"
Nearby spiral in our Local Group
About as massive as the Milky Way
It's headed straight for us! Collision in about 4 billion years
Distance: 2,500,000 LY
The main stellar disc is about the same size as the Milky Way but an extended, fainter disc spans about 220,000 LY



M104 - "Sombrero"
Spiral galaxy with a prominent bulge and dust ring
Distance: 28,000,000 LY
Diameter: 50,000 LY



M33 - "Triangulum"
Smaller spiral in our Local Group
Distance: 2,700,000 LY
Diameter: 50,000 LY

Main 1

Arguably the largest spiral
Normal stellar disc embedded in a huge, very faint halo
Distance: 1,400,000,000 LY
Diameter: 30,000 LY (inner disc)
Diameter: 650,000 LY (outer disc)
(image is an original artist's impression, not a real observation of Main 1)

ESO 350-40 - "Cartwheel"



Everyone's favourite ring galaxy (well, probably)
Distance: 500,000,000 LY
Diameter: 150,000 LY

Centaurus A

Elliptical galaxy with a prominent dust lane. It also possesses radio jets (not shown) of a similar size to those of Hercules A
Distance: 130,000,000 LY
Diameter: 97,000 LY

M87

A giant elliptical at the center of the Virgo Cluster. At its center, material falling onto a supermassive black hole is emitting powerful jets
Distance: 53,000,000 LY
Diameter: 980,000 LY



NGC 4921
A spiral galaxy in the Coma Cluster, it has lost much of its gas and can longer form many new, blue stars, giving it an unusually pale appearance
Distance: 320,000,000 LY
Diameter: 230,000 LY



Arp 81
Two merging galaxies
Distance: 280,000,000 LY
Diameter: 200,000 LY



NGC 1365
Barred spiral galaxy in the Fornax Cluster
Distance: 81,000,000 LY
Diameter: 200,000 LY



NGC 7049
Elliptical galaxy with an unusual dust ring
Distance: 90,000,000 LY
Diameter: 150,000 LY

Galaxy sizes comparison

**The largest
known galaxy**



IC 1101

would fit over 50 Milky Ways!