Timeline for Andromeda

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Agenda

General Information

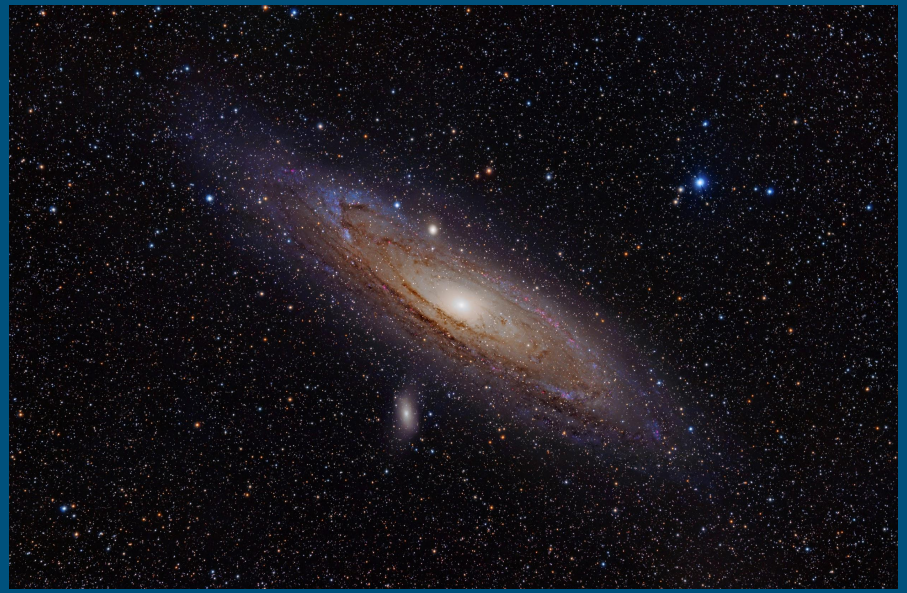
Early History

Early to Mid 1900’s

The Present

The future

Questions



General

Andromeda otherwise known as Messier 31 (M31) or NGC 224

Is the most dominant in the local group

Has two satellite galaxies known as Messier 32 & NGC 205

Andromeda is a spiral galaxy 780 kiloparsecs (2.5 million light years) from Earth

Andromeda's mass is 1.76 times that of the Milky Way

Discovery

964 AD

Abd al-Rahman al-Sufi characterized Andromeda as a “nebulous smear”

964 AD

Star charts labeled it as the little cloud

1612

Simon Marius re-discovered Andromeda giving a description similar to looking at a candle through a horn

1764

Charles Messier catalogued Andromeda

Early History

1785

William Herschel noted a red hue in the nucleus
He believed it to be the closest of the great nebulae

1864

The spectrum of andromeda is different from a gaseous nebula

1885

S Andromedae was discovered as the first Nova in its class

1899

The first photograph was taken by Isaac Roberts

1899- The first photograph of Andromeda taken by Isaac Roberts

Early 1900's

1914

Dr. V. M. Slipher photographed the spectra of the galaxies blue-shift at 190 miles per second

1917

The terms continent and island referring to the sizes of external galaxies was popularized (andromeda is an island universe in this situation)

1917

Heber Curtis discovered a nova in Andromeda -helped solidify the 'island' term

1917

2 new stars appear in Andromeda discovered by Ritchey

Early 1900's

1920

The Great Debate between Shapley and Curtis on if Andromeda was within the Milky Way

1925

Edwin Hubble settled the debate when he discovered cepheid variables therefore placing Andromeda far outside the Milky Way

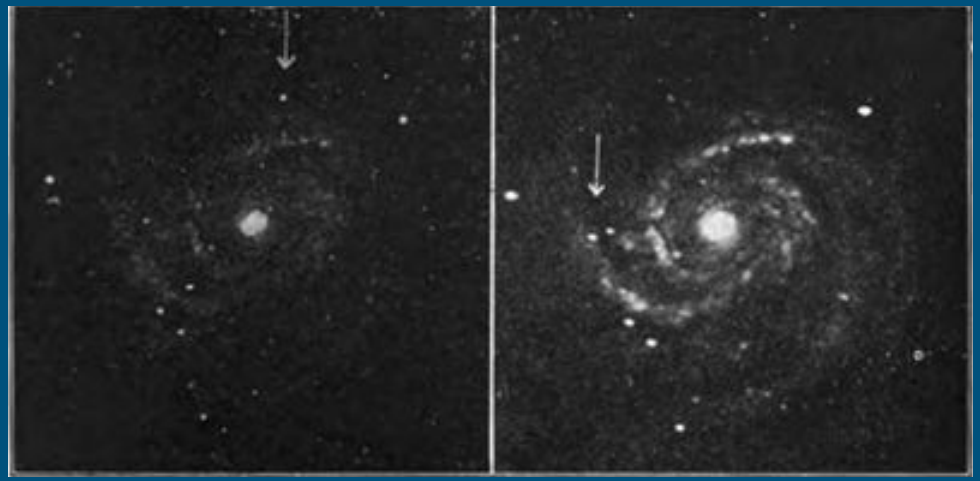
1927

Messier 33 and NGC 205 might be satellite galaxies but their exact distance is not known

1929

40 cepheids discovered, periods ranging from 10-45 days

1901 1914



Observed from the Lick Observatory

How Far is Andromeda?

1917

Harlow Shapley calculated the distance to Andromeda to be 1 million light years, he considered that an overestimate

1922

Ernest Öpik placed Andromeda 1.5 million light years away

1925

Gray documented that Andromeda was 925,000 light years away

1929

900,000 light years but later changed to 750,000 due to obscuring matter (Andromeda not as large as Milky Way)

Rate of Rotation

Francis G. Pease has “determined from spectroscopic observations that the rate of of rotation is 0.48x km/sec. where x is the distance from the center, measured in seconds of an arc. Thus at a distance of 150” from the center, the nebula rotates at the rate of 45 miles per second, and all parts of the nuclear region rotates at the same angular rate, once around in 16 million years.”

(Baker,1933)

Center of the Universe

1933

Every external galaxy was considered 10-100x smaller than the Milky Way therefore they were considered island galaxies.

Andromeda was considered 1/5th the size of the Milky Way

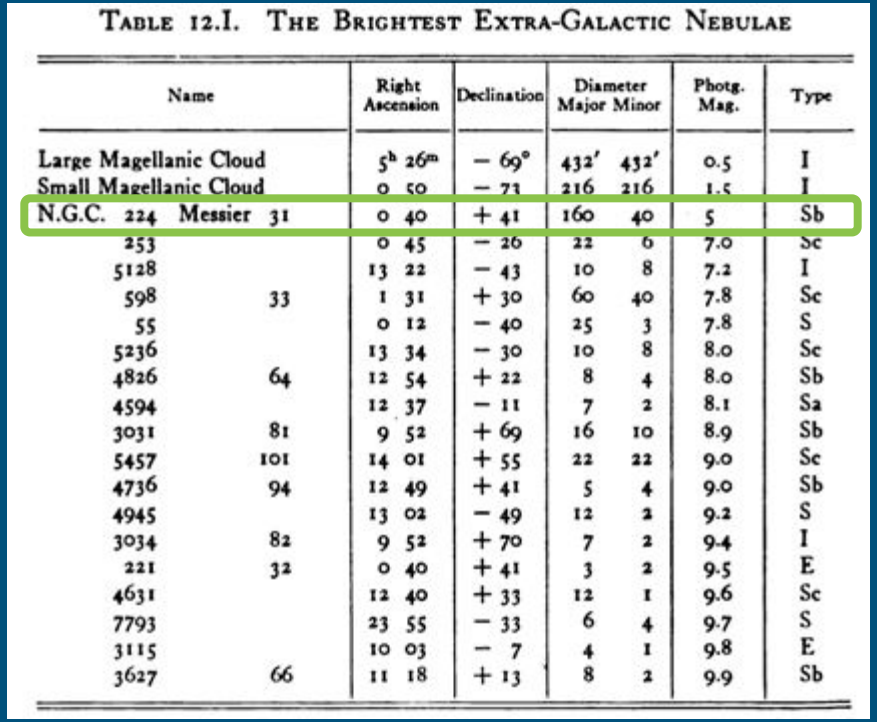


TABLE 12.I. THE BRIGHTEST EXTRA-GALACTIC NEBULAE

Name	Right Ascension	Declination	Diameter Major	Diameter Minor	Photg. Mag.	Type
Large Magellanic Cloud	$5^h\ 26^m$	$-69°$	432′	432′	0.5	I
Small Magellanic Cloud	0 50	−73	216	216	1.5	I
N.G.C. 224 Messier 31	0 40	+41	160	40	5	Sb
253	0 45	−26	22	6	7.0	Sc
5128	13 22	−43	10	8	7.2	I
598 33	1 31	+30	60	40	7.8	Sc
55	0 12	−40	25	3	7.8	S
5236	13 34	−30	10	8	8.0	Sc
4826 64	12 54	+22	8	4	8.0	Sb
4594	12 37	−11	7	2	8.1	Sa
3031 81	9 52	+69	16	10	8.9	Sb
5457 101	14 01	+55	22	22	9.0	Sc
4736 94	12 49	+41	5	4	9.0	Sb
4945	13 02	−49	12	2	9.2	S
3034 82	9 52	+70	7	2	9.4	I
221 32	0 40	+41	3	2	9.5	E
4631	12 40	+33	12	1	9.6	Sc
7793	23 55	−33	6	4	9.7	S
3115	10 03	−7	4	1	9.8	E
3627 66	11 18	+13	8	2	9.9	Sb

1933

List of the 20 photographically brightest galaxies

Harvard Observatory

Photographed by E. E. Barnard
Lick Observatory
1933

The Great Nebula in Andromeda.—Yerkes Observatory.

1935

Photographed by G. W. Ritchey with a 24” refractor showing the complex structure

Yerkes Observatory

Mid 1900's

1950

Radio emissions were detected by Hanbury Brown & Cyril Hazard

1950's

Radio maps created by John Baldwin and the Cambridge Radio Astronomy Group

1952

750,000 light years generally accepted until 200 inch telescope was employed and noticed some peculiarities

1952

Baade discovered there were 2 types of cephids therefore doubling the distance to Andromeda (still needed to be confirmed)

2000’s to present

2003

Estimates of distance were increased to 2.51 million light years

2005

Distance was measured again, but using an eclipsing star to confirm a distance of 2.53 million light years

2005

Distance was measured again and found to be 2.56 million light years away

2018

Andromeda galaxy is found to have twice the mass of the Milky Way

Eventual collision

4,000,000,000 AD

Andromeda and Milky way galaxy are expected to collide in 4 billion years

Both are hurtling towards each other at a speed of about 402,000 km/h

Current Galaxies shape

Andromeda

Spiral nebulae have a central mass with two arms spiraling immediately after leaving the core

Milky Way

A weird looking spiral galaxy

Outcomes

Likely outcome is the two galaxies will merge and become one

- Two possible shapes for this new galaxy (Milkomeda)
  - Elliptical galaxy
  - Disc Galaxy

Elliptical Galaxy example

Elliptical galaxy m87

Disc Galaxy

The spindle galaxy

Picture was taken by Hubble in 2006

Possible events to note

A black hole collision between two supermassive black holes will occur when the galaxies collide.

Likely will merge the two black holes, which has the chance to create a quasar that releases a lot of energy.

Quasar concept drawing

Picture was created by NASA/ESA

Fate of our solar system

Three possible outcomes

- Ejected out of the “Milkomeda” galaxy
- Continue inside of the new galaxy but moved more towards outer edge
- Our solar system leaves Milky Way and joins Andromeda

Thank you

Questions?