Two Ideas about the Universe

1750 Immanuel Kant
Island Universes

1755 Johann Lambert
Nebular Hypothesis

Island Universes – There are many galaxies

Nebular Hypothesis - The spiral and elliptical nebulae are condensing to form stars. There is only one universe (galaxy).

1864 William Huggins

- Finds spectra of nebula
  - Emission lines = gas has to be present
    - Nebula is the beginning of stars

Nebula are places where stars form.

1885 Supernova in Andromeda

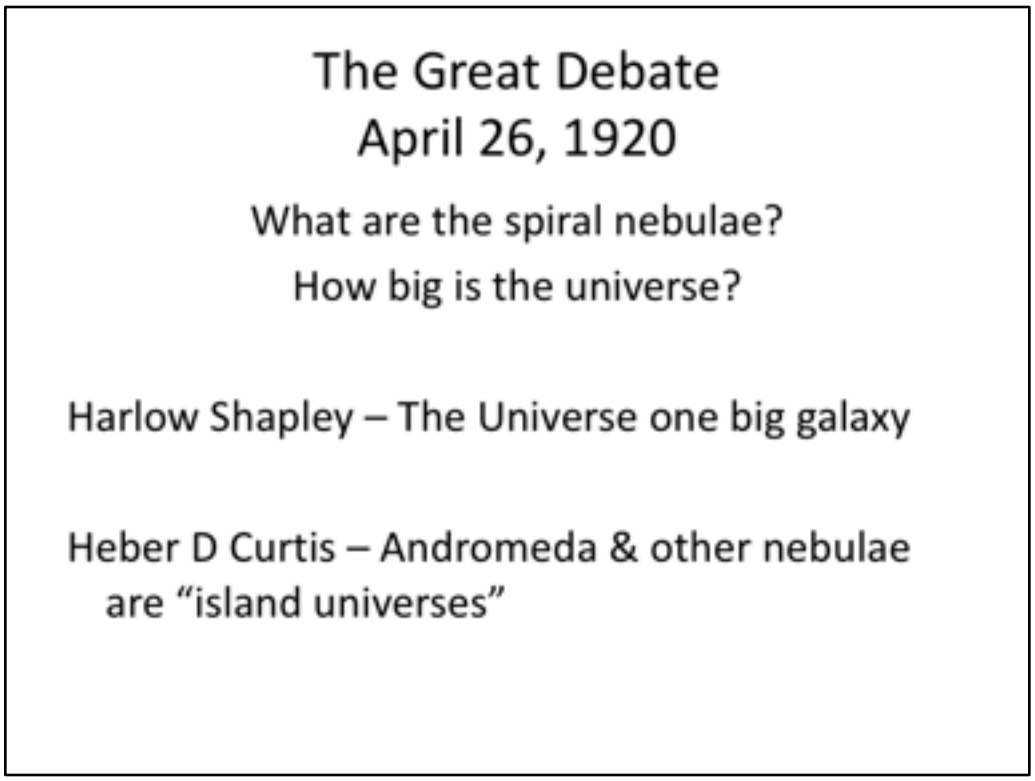
1888 Julius Scheiner gets spectra of Andromeda Nebula = Just like stars

S Andromedae (also SN 1885A) was a supernova in the Andromeda Galaxy, the only one seen in that galaxy so far by astronomers, and the first ever noted outside the Milky Way. It is also known as "Supernova 1885".It was discovered on August 19, 1885, by the Irish amateur astronomer Isaac Ward in Belfast,[1] and independently the following day by Ernst Hartwig at Dorpat (Tartu) Observatory in Estonia. It reached magnitude 6, but faded to magnitude 16 by 1 st February 1886.The star was reported to be reddish in color and declined very rapidly in brightness, which is atypical for Type Ia supernovae. Unfortunately no spectroscopic data is available.

1917
Harlow Shapley

- Studies star clusters & finds they are in a sphere BUT the Sun is not at the center
- "The Big Galaxy Hypothesis" – The universe is one big galaxy

Shapley championed the Big Galaxy Hypothesis.

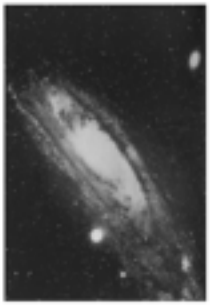


Shapley was up for job at Harvard Observatory. Curtis is said to have done better in the debate. Shapley still got the job and did a great job at Harvard – focused on education, gave women jobs and 1st doctorate.

By end of debate, no consensus of which theory was correct.

1924 Edwin Hubble

Using a new telescope (100”), photographed M33 & M31 = nebula are stars

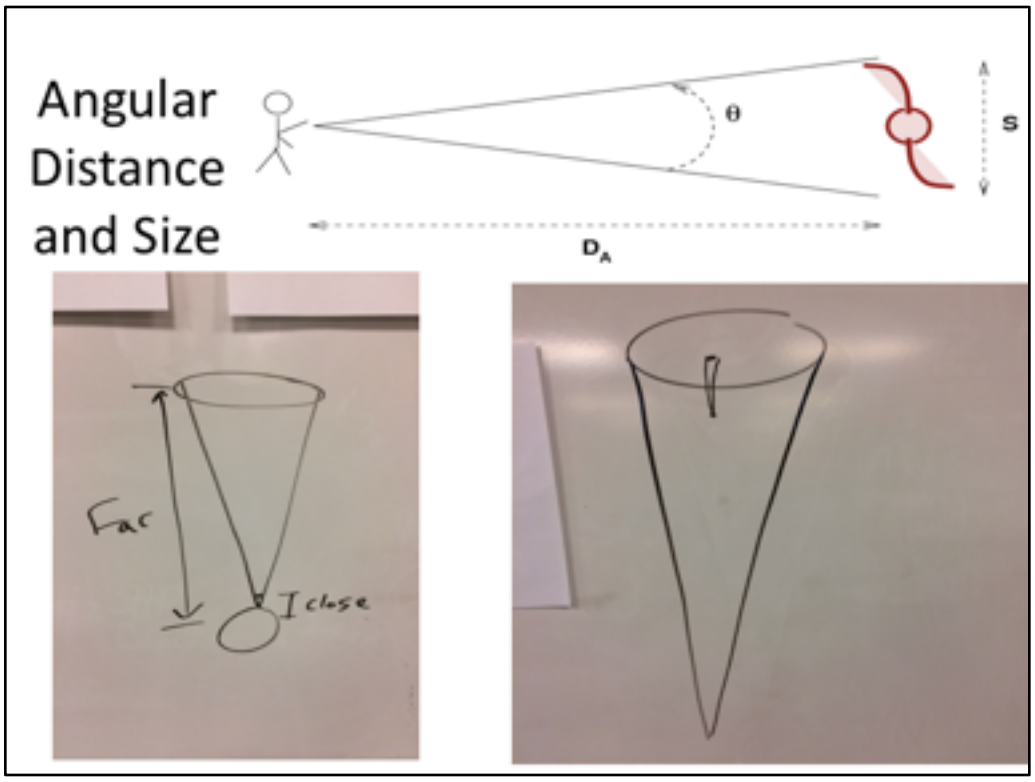


Measured distance to Andromeda Nebula (M31)

1,000,000 light years

Spiral Nebula are other Galaxies

Used Cepheid variable to calculate distance to Andromeda. This distance indicated Andromeda’s size was HUGE. Way too big to be nebula with a forming star/stars. It had to be another galaxy! Island Universe is the right theory.



What we though was very small, was really very, very big. Angular distance and geometry tell us this. Hubble was able to figure out the distance to Andromeda, so he could figure out the size. It was way, way too big to be just a nebula.