



Introductory Astronomy

Week 7: Galaxies

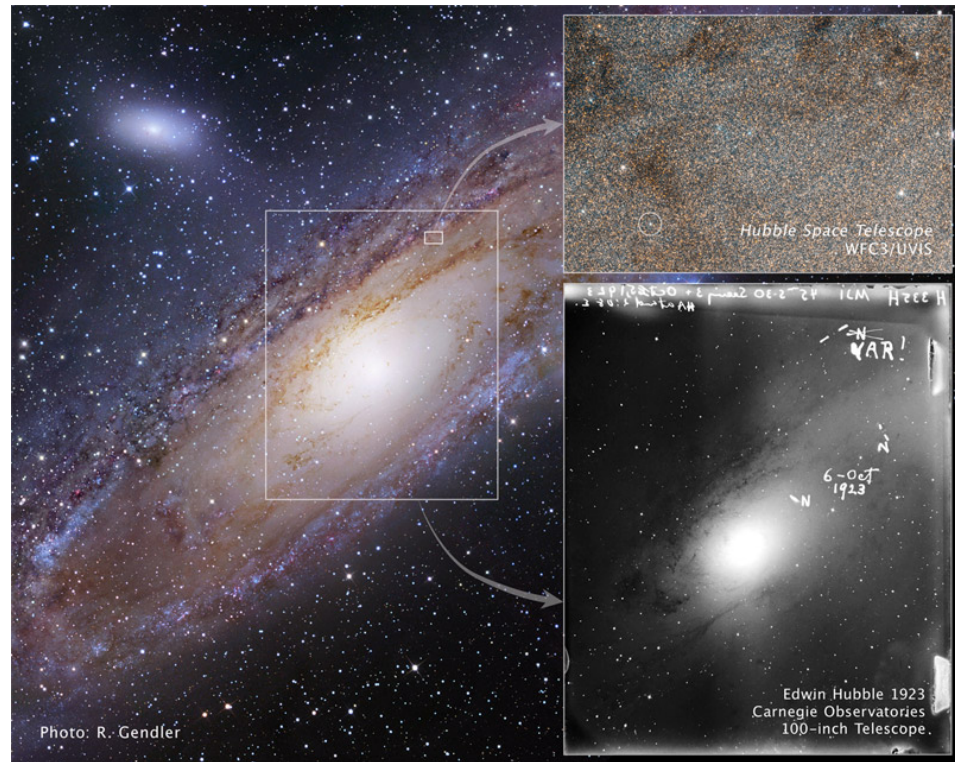
Clip 8: VAR!

Shapley vs. Curtis 1920

- Spiral nebulae are gas clouds in Milky Way
- If M31 is 100kpc (Shapley) across it is far – 2Mpc
- Novae in M31 brighter than in Milky Way
- M101 rotates too fast
- Spiral nebulae are island universes
- Novae imply M31 at least 150kpc away so its size is 7.5kpc (Kapteyn)
- Spirals have large radial velocities but small proper motion

VAR!

- Hubble 1923:
suspected Nova in
M31 is a Cepheid!
- Period-Luminosity
shows M31 is 285kpc
away: island universe

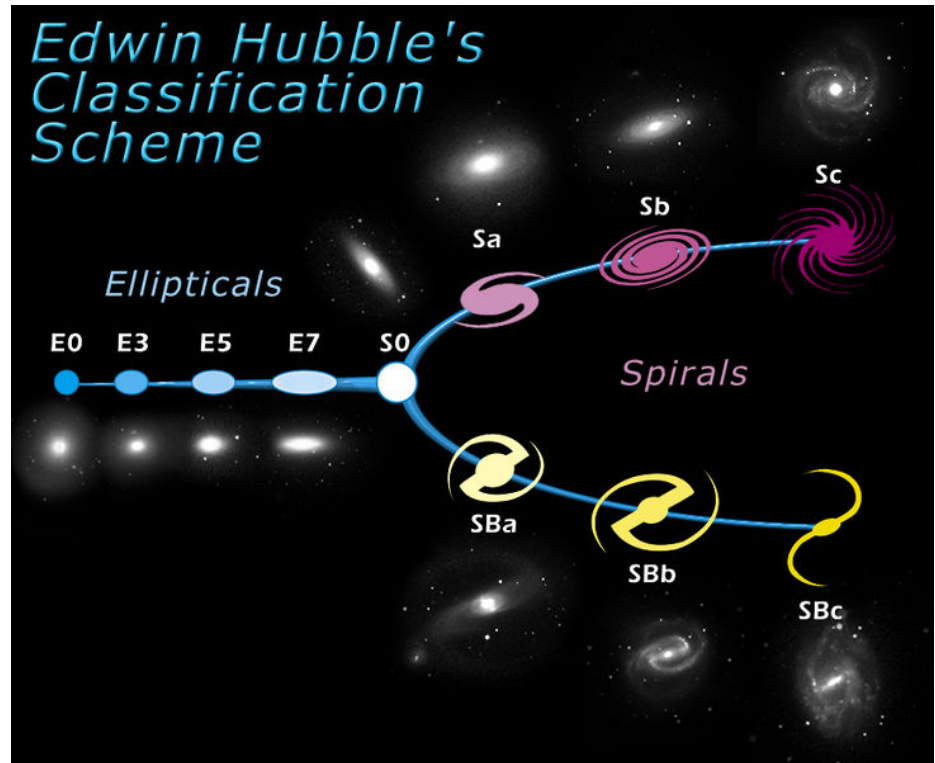


Distances and Sizes

- **Period-Luminosity** relation discovered in **LMC Cepheids**
- Hertzsprung, Shapley calibrate using nearby **Cepheids** ignoring **4×** extinction
- Hubble applies this to find distance to **M31** underestimates by **2×**
- **Globular Cluster** variables were **W Virginis** stars – **4×** less luminous
- **Shapley** overestimated distance to clusters by ignoring extinction
- **Trumpler 1930**: diffuse extinction
- **Baade 1952**: Distinction between **Population I,II** variables
- **Hipparchos 1990s**: Calibrate from **parallax**. Still subject to extinction used to **29 Mpc**

Lots of Galaxies

- Hubble classifies Galaxies by **apparent shape E,S,Ir**
- Later: **Sd(SBd), Sm (SBm),Im** and **class (I-V)** for spirals
- **Milky Way: SBbcl-II**
- **M31: SbI-II**
- **M101: ScI**



Credits

- M31: R. Gendler
<http://www.robgendlerastropics.com/M31Page.html>
- VAR!: E. Hubble, NASA, ESA, R. Gendler, Z. Levay and the Hubble Heritage Team
<http://apod.nasa.gov/apod/ap110701.html>