

XVI. GALAXY QUEST

- A. Home in the Milky Way
 - 1. Shape:
 - 2. Size:
 - 3. Number of Stars:
 - 4. What we see from Earth:
 - 5. Interstellar medium in the spiral arms: The nebulae
 - a. Emission Nebula (HII region):
 - b. Reflection Nebula:
 - c. Dark (absorption) Nebula:
 - 6. Interstellar Extinction or Galactic Smog:
 - a. Harlow Shapley (1917) and the spatial distribution in the Milky Way:
 - b. Dimming Effect correction:
 - c. Radio Observations:
- B. Galaxy Quest History:
 - 1. Shapley and Curtis debate (1920) of the spiral nebulae distance:
 - 2. Edwin Hubble at the Mt. Wilson Observatory in the 1920's:
 - a. Cepheids:
 - i) In the Milky Way:
 - ii) In the Andromeda Spiral Nebula:
 - iii) In other Nebulae/Galaxies
- C. Galaxy Types:
 - 1. Hubble types:
 - a. Spiral galaxies:
 - b. Elliptical galaxies:
 - 2. Irregular galaxies:
 - 3. Peculiar galaxies:
 - 4. Lenticular galaxies:
- D. Galaxy Groupings:
 - 1. Binary:
 - 2. Multiple:
 - a. Local Group:
 - b. Virgo Cluster:
 - c. Coma Cluster:
 - 3. Super clusters:
 - 4. Galaxy Merging:
- E. Spiral-Galaxy Dynamics:
 - 1. The rotation curve: (A plot of orbital speed vs. distance from the center)
 - 2. Mass distribution:
 - 3. Dark Matter Question:

4. Differential Rotation and Density Waves:
- F. Gravitational Lensing:
 1. Einstein Ring:
 2. Deviations from Symmetry:
 3. MACHOs
- G. Galaxy Evolution:
 1. The Doppler red-shifted spectra of Galaxies demonstrate that the Universe is expanding:
 2. Vesto Slipher (early 20th Century)
 3. Edwin Hubble (1929) using Cepheid variable stars, discovered that the displacement of a given line is proportional to the galaxy distance.
 - a. Milton Humason and the Doppler shift.
 - b. Hubble's Law:
 - c. Hubble's Constant:
 - d. Using Hubble's law to determine galaxy distances.
 - e. Hubble's law to *look-back time*.
 4. Hubble Space Telescope—"Hubble Deep Field"
 5. Spiral Galaxy Age:
 6. Elliptical Galaxy Age:
 7. Wilkinson Microwave Anisotropy Probe(WMAP) at determining the age of the Universe.
 8. Active Galaxies and Quasars:
 - a. Radio Telescope images and explorations.
 - b. QSO's
 9. The optical spectra of quasars:
 - a. The redshift question:
 - b. The distance question:
 - c. The age question:
 - d. The brightness variation question:
 10. What powers the quasar?
 - a. Gravitational Lensing of quasars:
 - b. The relationship of quasars and supermassive black-holes:
 - c. The relationship of quasars in the relationship of galaxy evolution.
- H. The accelerating expansion of the Universe.
 1. Brian Schmidt and Adam Riess (1998)
 - a. The Type Ia supernova data:
 2. Anti-gravity:
 3. Einstein's Cosmological Constant:
 4. Dark Energy:
 5. The Inflationary Universe:
 6. The Multi-Universe: