**The Cosmological Distance Ladder**

Overlapping rungs:

1.Earth

2.Earth-Mars

3.Earth’s orbit

4.Parallax

5.Spectral “Parallax”

6.RR Lyrae variables

7.Cepheid variables

8.Type I Supernovae

9.Type II Supernovae

10.Galaxy brightness

#### Earth

Geo-Metry

#### Earth-Mars

Triangulation from Paris and Cayenne

#### Earth-Sun

If you know the Earth-Mars distance, Kepler’s law

RE3 = RM3

TE2 TM2

now lets you figure out the radius of Earth’s orbit.

#### Parallax

Triangulation of near stars using the Earth’s orbit about the sun as a baseline

#### Spectroscopic Parallax

H-R diagram, type of star, M, and m

Use m – M = 5log(d/10) (d in pc)


#### RR Lyrae

.They all have about the same absolute magnitude (0 < M < 1)

M and m, Use m – M = 5log(d/10) (d in pc)





#### Cepheids

1912, Henrietta

**Longer** period is **brighter**

M and m, Use m – M = 5log(d/10) (d in pc)



#### Type I Supernovae

Binary system

All same size

#### Type II Supernovae

Neutrino refrigeration

#### Galaxy Brightness