Our Galaxy

The Distribution of Stars

Count them!

Measure all stars of a given intrinsic luminosity L. At a distance r_0, such a star has apparent brightness $f_0 = L/4\pi r_0^2$. If the number density $n(L)$ does not depend on distance, expect the number of observed stars with $f > f_0$ to be

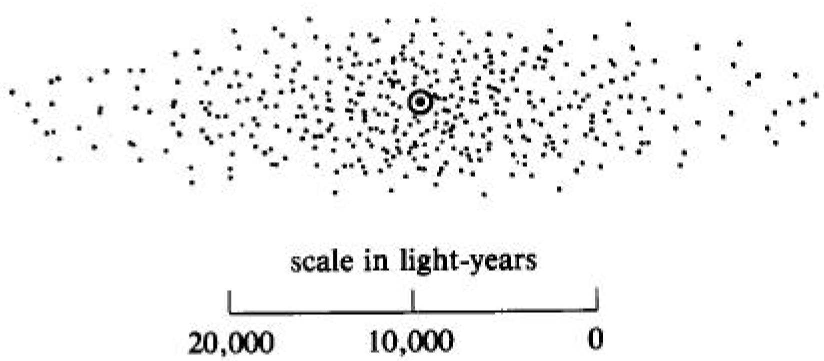
$$N_L(f > f_0) = n(L)\frac{4}{3}p\, r_0^3 = \frac{n(L)L^{3/2}}{3(4p)^{1/2}} f_0^{-3/2}.$$

So if $N = 1000$ stars brighter than some f_0, then the number of stars brighter than $f_0/4$ should be $N' = (1/4)^{-3/2} * 1000 = 8000$.

The Distribution of Stars

J. C. Kapteyn (1922) culminated the work of many astronomers, and deduced a spatial distribution of stars. The previous model was found to work only if $n(L)$ was allowed to decrease with distance r, and more quickly in some directions than in others.

Best fit: an oblate spheroidal model, with the Sun at the center.

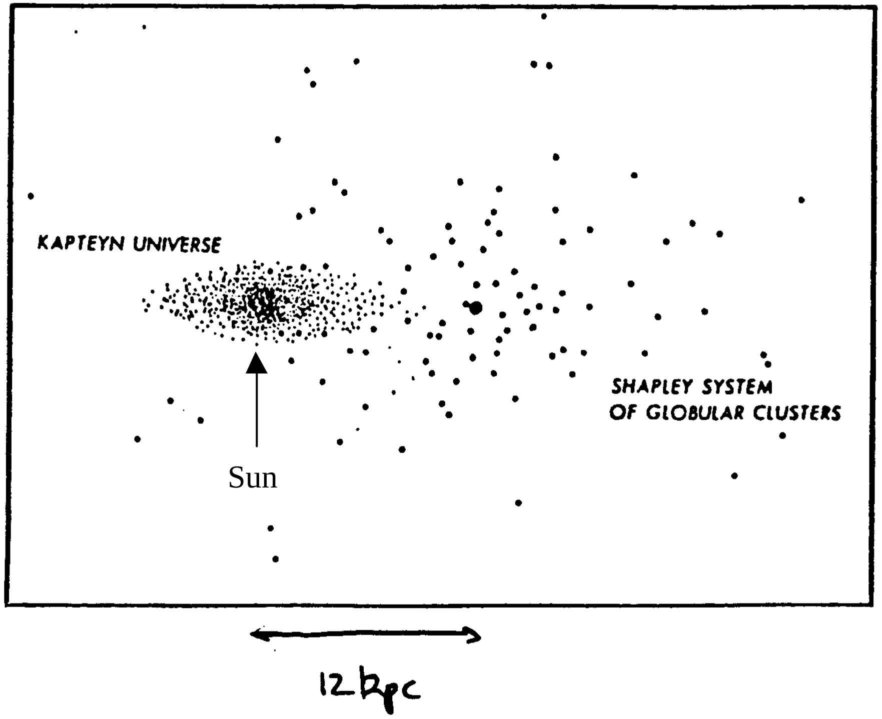


The “Kapteyn Universe”

The True Size and Shape of our Galaxy

Shapley (1917) - Uses a period-luminosity relation for RR Lyrae pulsators to get the distances to globular cluster (GC) systems.

Result: GC's form a spheroidal system. The Sun is *not* at the center.



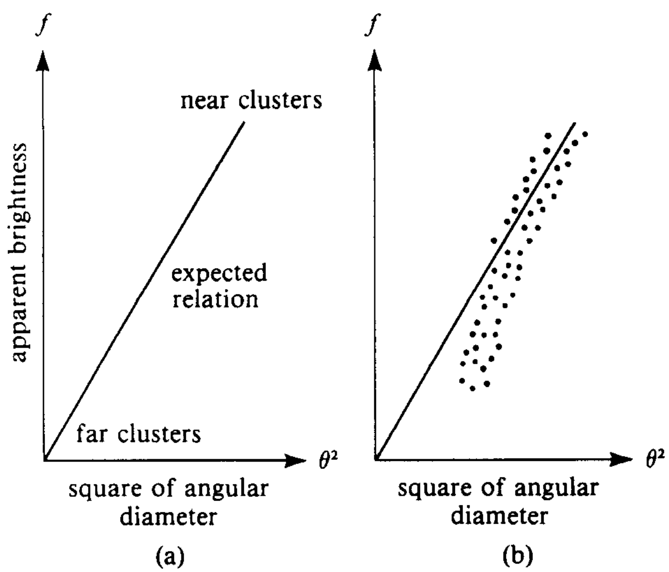
Similar to Copernicus' dethronement of the Earth from the center of our planetary system.

The Discovery of Interstellar Dust

Trumpler (1930) - evidence for absorption of light from distant open clusters. Measure

$$\theta = \frac{D}{r} \text{ and } f = \frac{L}{4\pi r^2} \quad \Rightarrow \quad f = \left(\frac{L}{4\pi D^2}\right)\theta^2,$$

where D is the intrinsic diameter and r is the distance. Expect straight-line correlation on a log-log plot, with scatter due to variations in D and L about mean values.



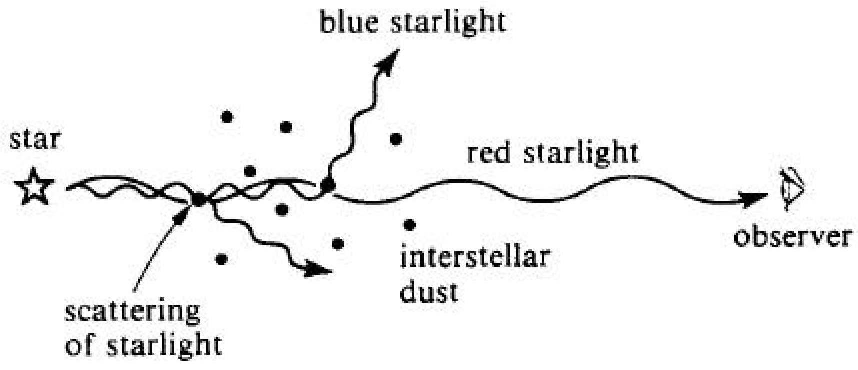
Systematic change at small θ; f too small.

Evidence for <u>extinction</u>.

The Discovery of Interstellar Dust

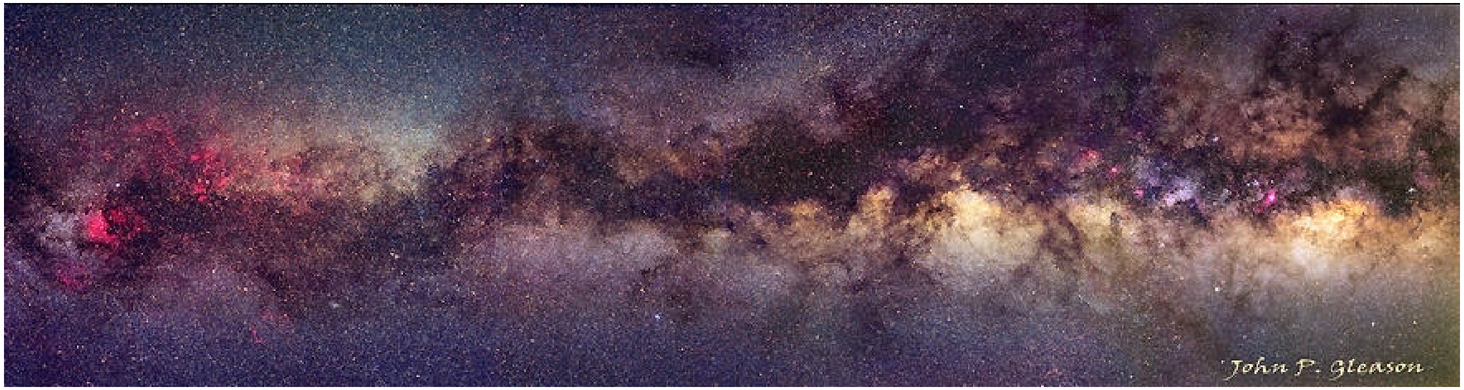
Also, detect reddening.

Short wavelengths more likely to be scattered - similar to Earth's atmosphere.



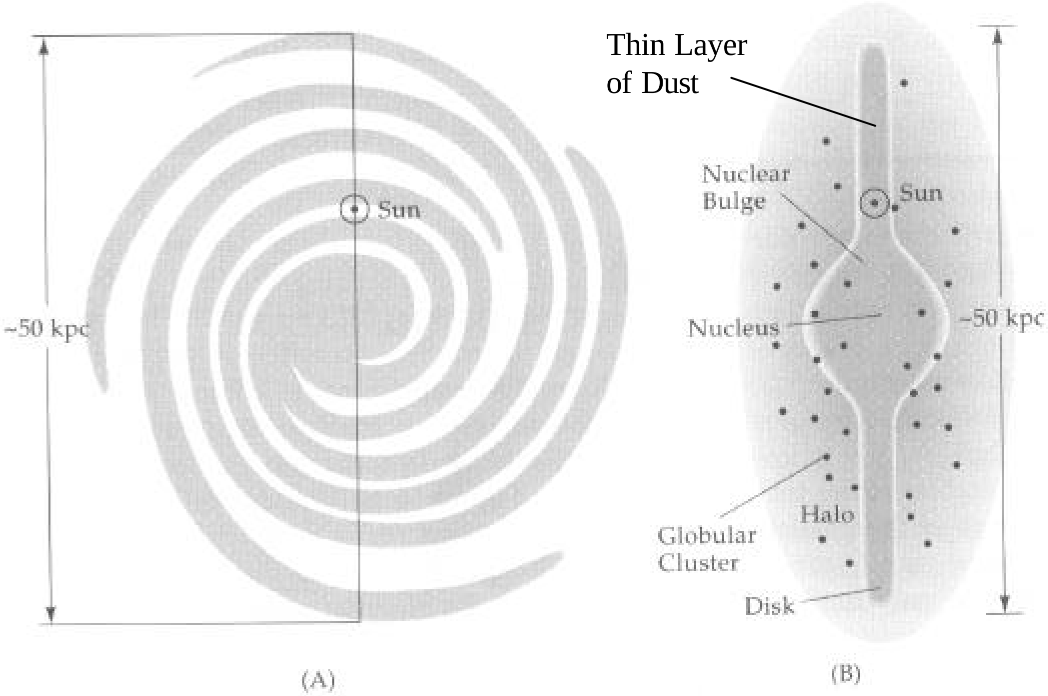
The mechanism of interstellar reddening.

Extinction and reddening attributed to interstellar dust.



The Milky Way viewed from the Southern hemisphere

A Modern View of our Galaxy



Components:

disk - gas and dust and stars (pop I). Spiral arm structure. Circular speeds >> random speeds => flattened shape

bulge - pop I and pop II stars. No strong sense of rotation.

halo - pop II stars (older, lower Z). Many globular clusters. Large random speeds. Less tightly bound than bulge. Contains dark matter?