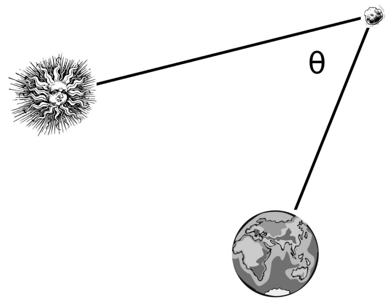
Absolute Magnitude, Size and Mass

The absolute magnitude (**H**) of a solar system object is the magnitude that it would have if it was 1 AU from the Earth and 1 AU from the Sun while having a phase angle of 0 degrees. Remember, astronomical magnitudes are “backwards”. The magnitude of a bright object is *less* than the magnitude of a dimmer object.

The phase angle (θ) in astronomical observations is the angle between the light incident onto an observed object and the light reflected from the object. In the context of astronomical observations, this is usually the angle $\angle$ Sun-object-observer.



It is actually impossible for an object to be 1 AU from the Earth and 1 AU from the Sun while having a phase angle of 0 degrees. The Sun and the Earth would occupy the same point. However, this is the definition of **H**. Please note, that the definition of absolute magnitude for solar system objects is *very* different from the definition of absolute magnitude used for stars.

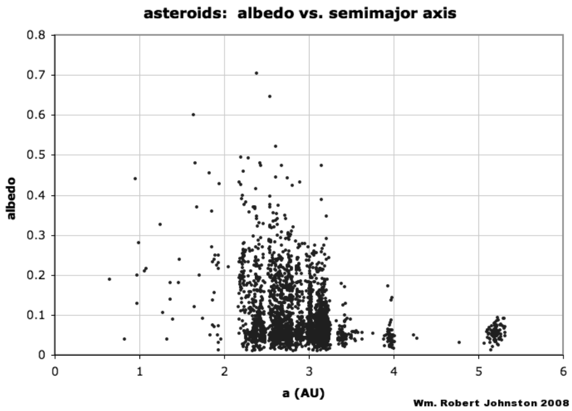
The Absolute magnitude of an object is related to the physical size of the object via the equation:

$$D = \frac{1329}{\sqrt{A}}\ 10^{-0.2H}$$

Where **D** is the diameter of the object in kilometers and **A** is the geometric albedo of the object.

The geometric albedo (**A**) of an astronomical body is the ratio of its actual brightness at zero phase angle (i.e., as seen from the light source) to that of an idealized flat, fully reflecting, diffusively scattering disk with the same cross-section.

Perfect reflectors of light have A = 1 and perfect absorbers have A = 0. Typical asteroids have a wide range of values: $0.02 < A < 0.8$ with (see graph).



Once we have the diameter of the object, we can determine the mass if we know the density (ρ). This assumes that the object is spherical (this is **not** a very good assumption for asteroids).

$$\text{Mass} = \rho \cdot \text{Volume} = \rho \cdot \frac{4}{3}\pi r^3 \;=\; \rho \cdot \frac{1}{6}\pi D^3$$