**Astronomy Picture of the Day** (2007 Oct. 21)

**Will the Universe End in a Big Rip?**

# Advanced Question
# Chap. 6, Q34 in P155

Several groups of astronomers are making plans for large ground-based telescopes.

(a) What would be the diffraction limited angular resolution of a telescope with a 40-meter objective mirror?

(b) (b) Suppose this telescope is placed atop Mauna Kea. How will the actual angular resolution of the telescope compare to that of the 10-meter Keck 1 telescope? Asumme that adapative optics is not used.

# Advanced Question
# Chap. 6, Q34 in P155

Answer:

(a) 40-meter objective mirror at 500 nm. Using the formular of diffraction-limited angular resolution

$$\theta = 2.5\times10^{5}\,\frac{\lambda}{D} = 2.5\times10^{5}\,\frac{5.5\times10^{2}\,nm\times10^{-9}(m/nm)}{40m}$$

$$= 0.003(arc\,\mathrm{sec})$$

(b) 10-meter telescope, the diffraction-limited angular resolution will be 4 times poorer, which is 0.012 arcsec.

The seeing at Mauna Kea is 0.5 arcsec. Without adaptive optics (removing the effect of astomspheric turbulance), the 40-m does not preform better in terms of resolving power. Nevertheless, it is able to see deeper into space because of better light-gathering power

# Advanced Question
# Chap. 7, Q22 in P181

Mars has two small satellites, Phobos and Deimos.

Phobos circles Mars once every 0.31891 day at an average altitude of 5890 km above the planet's surface. The diameter of Mars is 6794 km. Using this information, calculate the mass and average density of Mars.

# Advanced Question
# Chap. 7, Q22 in P181

Answer:

Using the Newton's form of Kepler's third law:

$$P^2 = \frac{4\pi 2}{GM} a^3$$

The orbital size a = 5980+6794/2=9377km=9.375 X $10^6$ m

The orbital period = 0.31891 day = 2.755 X $10^4$ sec

The mass:

$$M = (\frac{4\pi^2}{G})\frac{a^3}{P^2}$$

$$= (\frac{4\times 3.14^2}{6.67\times 10^{-11}})\frac{(9.375\times 10^6)^3}{(2.755\times 10^4)^2}$$

$$= 6.43\times 10^{23} kg$$

# Advanced Question
# Chap. 7, Q22 in P181

Answer:

The density:

$$\rho = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi r^3}$$

$$= \frac{6.43\times10^{23}}{\frac{4}{3}\times3.14\times(6794\times10^3/2)^3}$$

$$= 3918(kg/m^3)$$