

Problem 9.31 A microwave telescope consisting of a very sensitive receiver connected to a 100-m parabolic-dish antenna is used to measure the energy radiated by astronomical objects at 20 GHz. If the antenna beam is directed toward the moon and the moon extends over a planar angle of 0.5° from Earth, what fraction of the moon's cross-section will be occupied by the beam?

Solution:

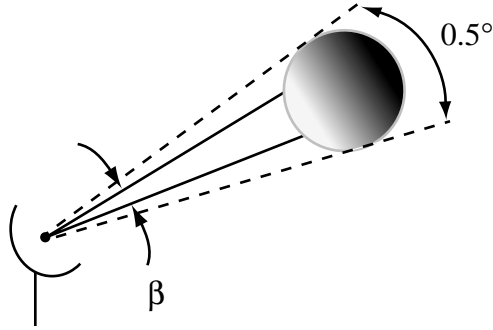


Figure P9.31: Antenna beam viewing the moon.

$$\beta_{\text{ant}} = \frac{\lambda}{d} = \frac{1.5 \times 10^{-2}}{100} = 1.5 \times 10^{-4} \text{ rad.}$$

For the moon, $\beta_{\text{moon}} = 0.5^\circ \times \pi/180^\circ = 8.73 \times 10^{-3} \text{ rad}$. Fraction of the moon's cross section occupied by the beam is

$$\left(\frac{\beta_{\text{ant}}}{\beta_{\text{moon}}} \right)^2 = \left(\frac{1.5 \times 10^{-4}}{8.73 \times 10^{-3}} \right)^2 = 0.3 \times 10^{-3}, \text{ or } 0.03\%.$$
