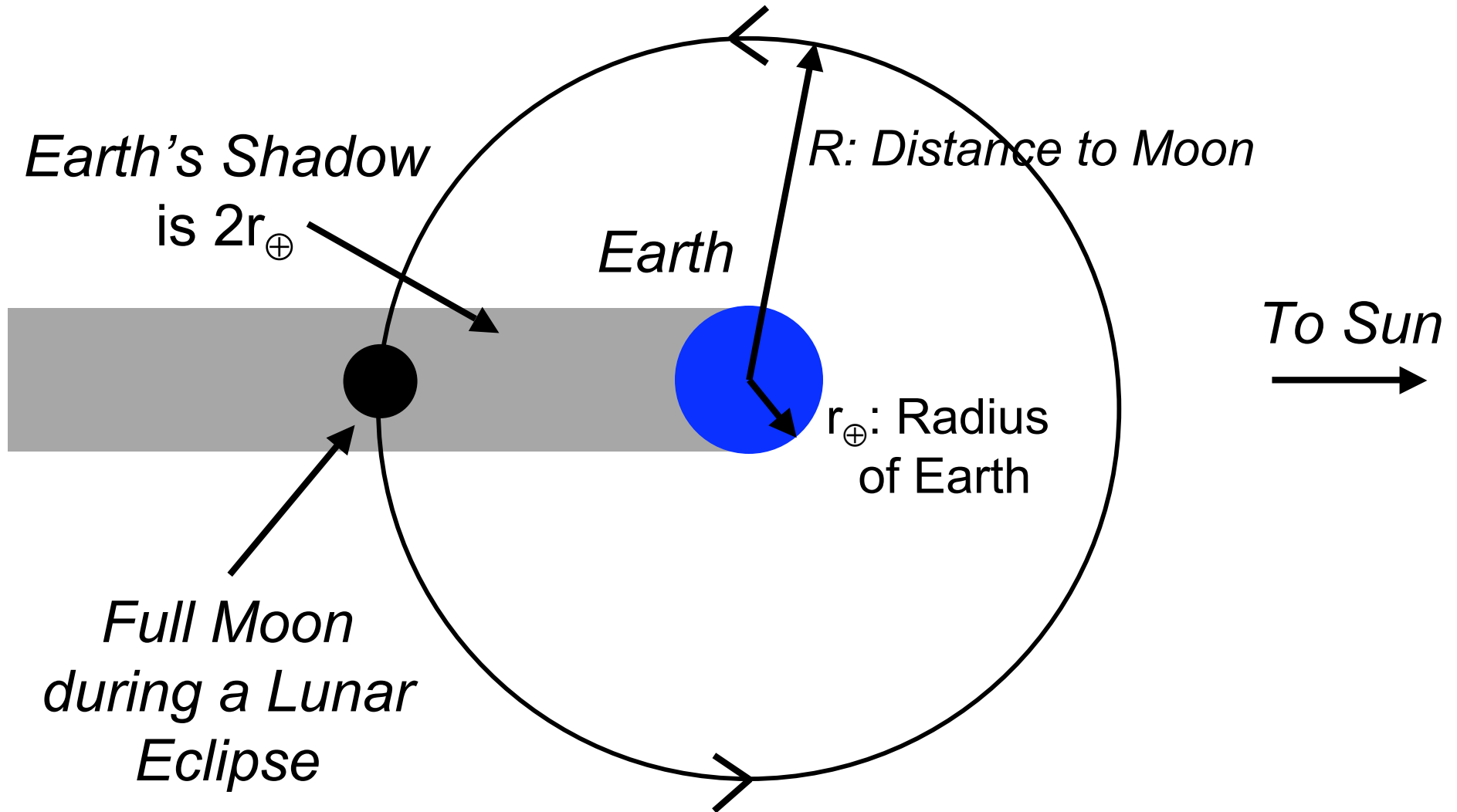
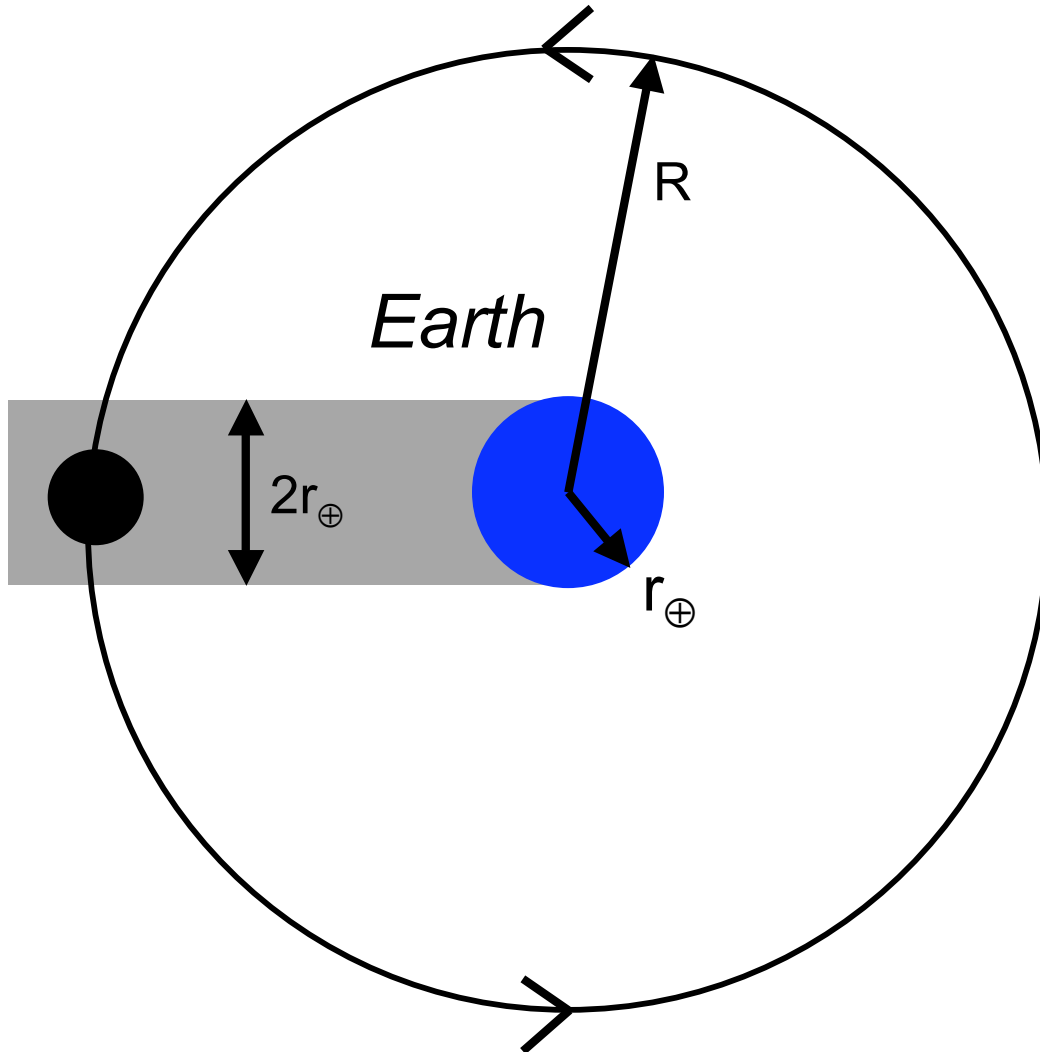


Aristarchus and the Moon



The center of the Moon takes 3 hours to cross the Earth's shadow, compared to 27.3 days to orbit the Earth

Distance to the Moon



Aristarchus assumed that the Earth's shadow was equal to $2r_{\oplus}$
Moon's orbit around Earth = $2\pi R$

Aristarchus hypothesized that the Moon moves $2r_{\oplus}$ in 3 hours and the Moon moves $2\pi R$ in 655 hours (27.3 days x 24 hrs/day = 655 hours)

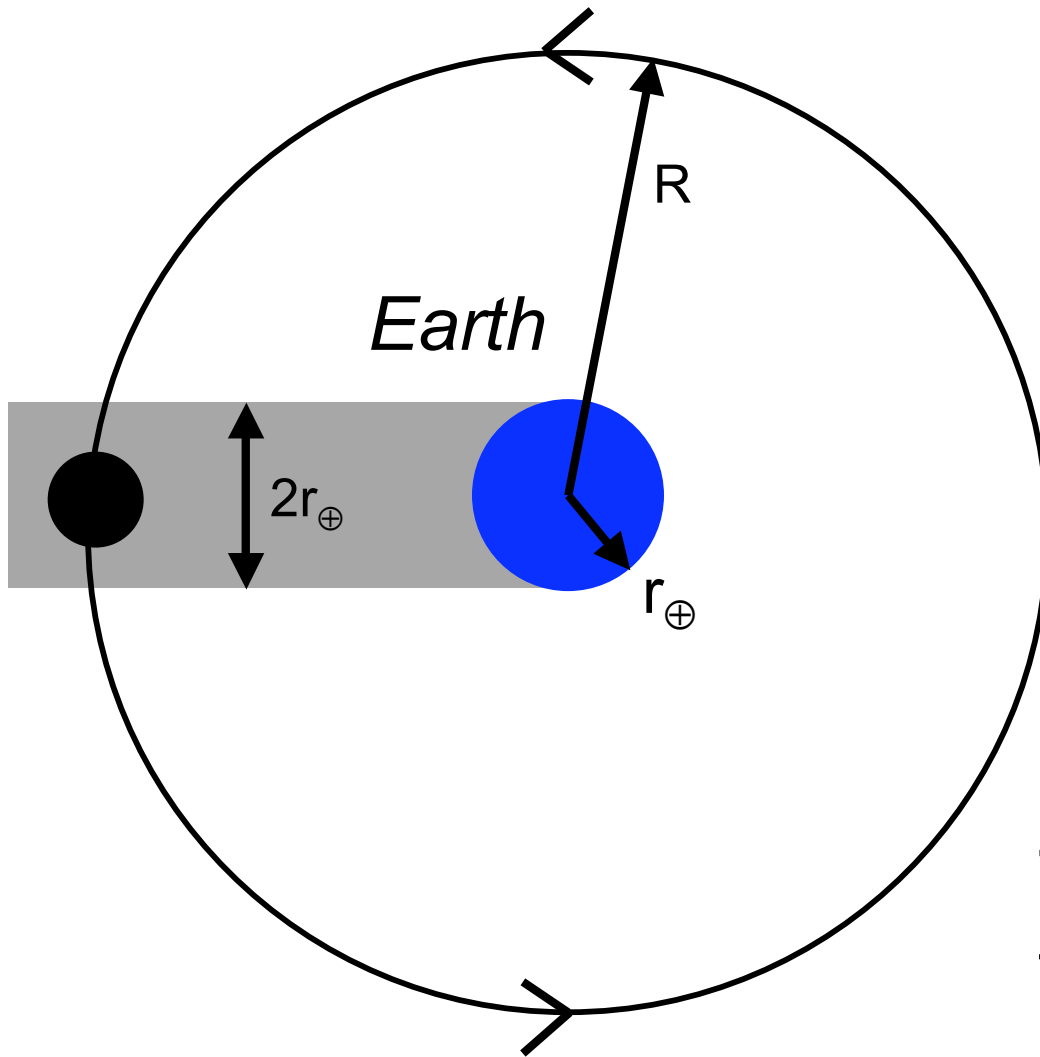
The size of the Earth relative to the distance to the Moon is:

$$\frac{2\pi R}{2r_{\oplus}} = 655/3 = 218$$

or

$$R = (218/\pi) r_{\oplus} = \mathbf{70 \text{ times } r_{\oplus}}$$

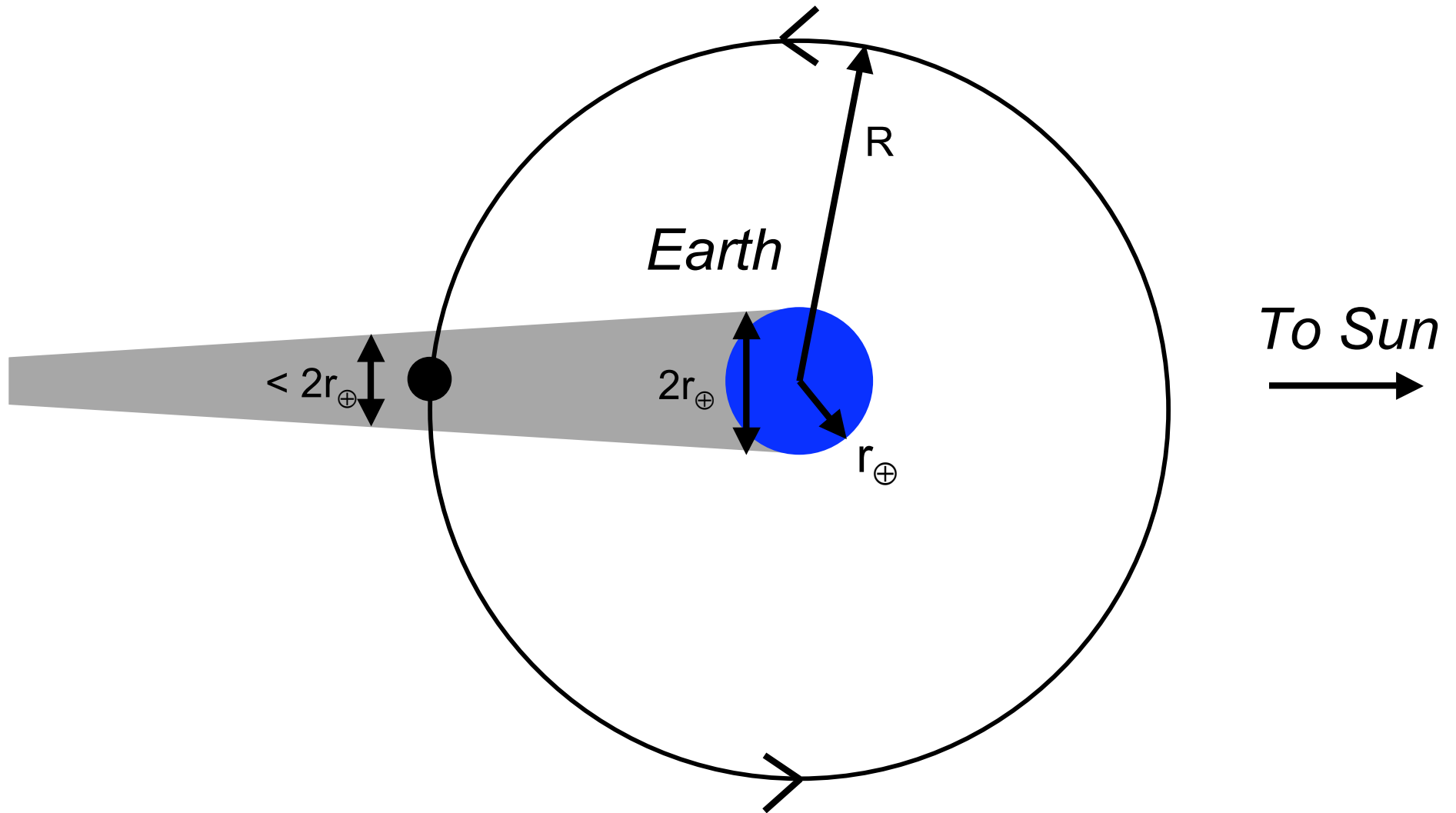
Size of the Moon



Aristarchus also observed that the Moon was half as large as the Earth's shadow

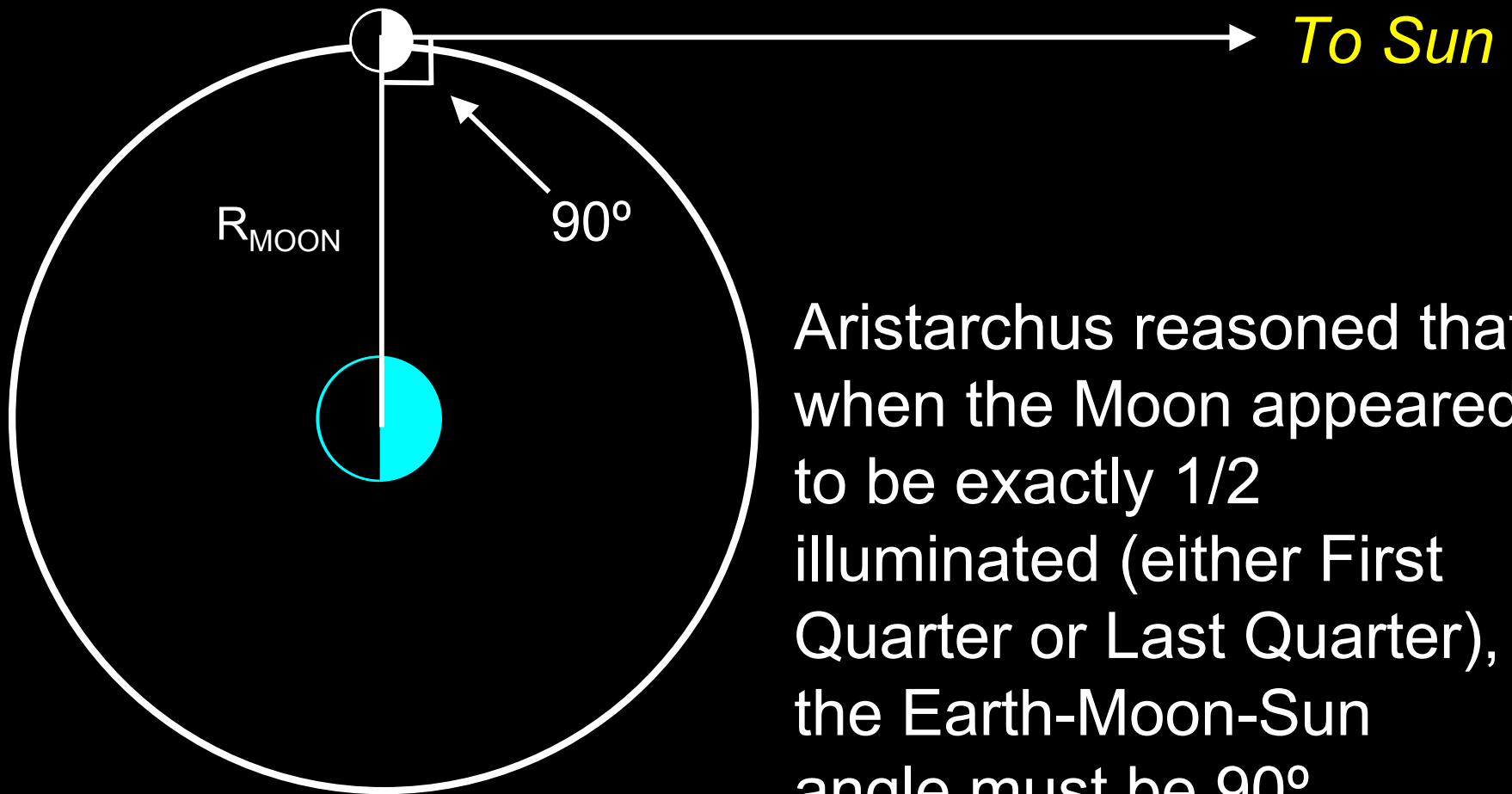
To Sun
→

The Earth is therefore twice as large as the Moon!

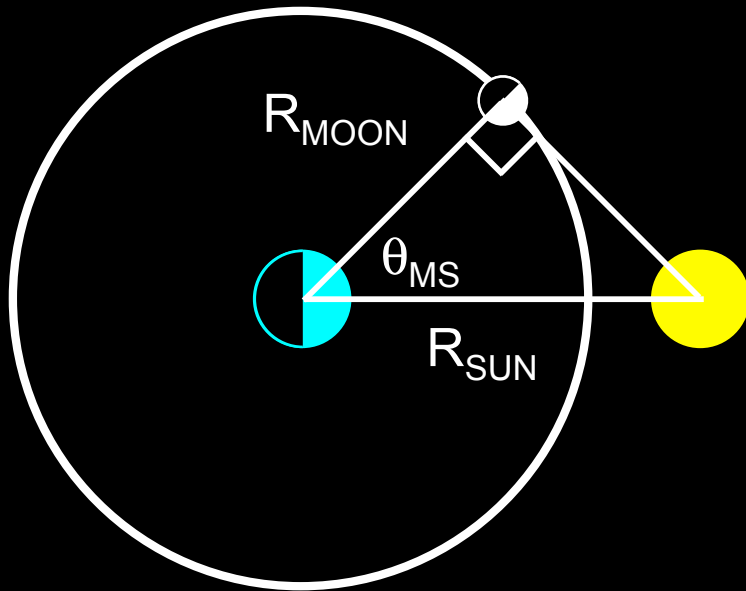


Aristarchus was slightly off because the Sun is not a point light source at an infinite distance - the Earth's shadow is cone, rather than a cylinder. The true distance is 60 Earth radii (not 70) and the true size of the Moon is 0.27 Earth radii (not 0.5).

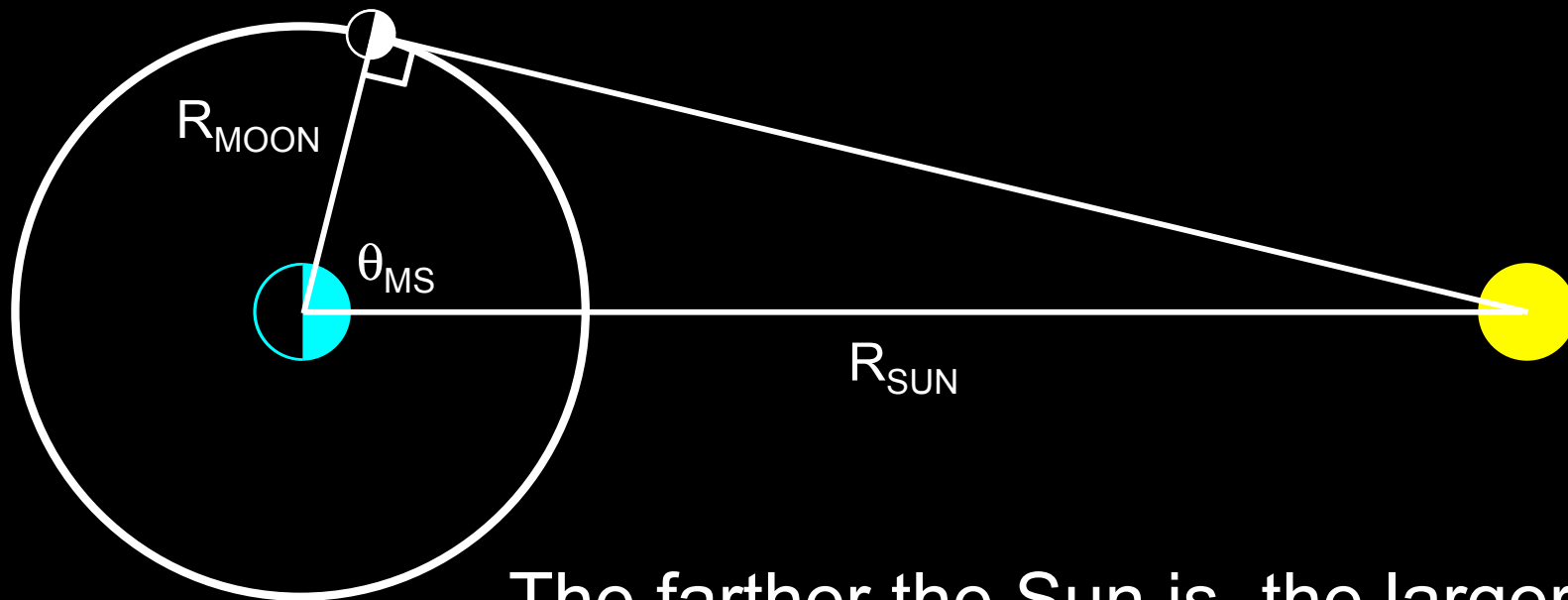
Aristarchus and the Sun



Aristarchus reasoned that when the Moon appeared to be exactly 1/2 illuminated (either First Quarter or Last Quarter), the Earth-Moon-Sun angle must be 90°



If the Sun is close to the Earth, the Moon will not be far from the Sun in the sky at First Quarter



The farther the Sun is, the larger the angle θ_{MS} between the Moon and Sun

Distance to the Sun

Aristarchus measured the angle $\theta_{MS} = 87^\circ$ between the Moon and Sun

He determined that the Sun is 18-20 times further away than the Moon

This was done without trigonometry, which had not been invented yet!

Aristarchus actually measured too small an angle

Modern measurements show that $\theta_{MS} = 89^\circ 50'$ and the Sun is actually 400 times further away than the Moon