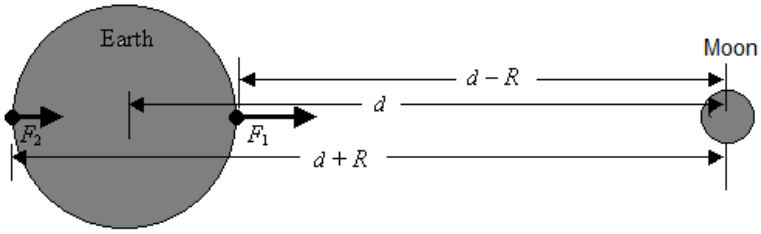
Answer on Question #69700, Physics / Astronomy | Astrophysics

Derive an Expression for the tidal force for the earth-moon system and show that its magnitude depends on the latitude. Explain tidal bulge on the basis of this expression.

Answer:

The Earth experiences two high tides per day because of the difference in the Moon's gravitational field at the Earth's surface and at its center. You could say that there is a high tide on the side nearest the Moon because the Moon pulls the water away from the Earth, and a high tide on the opposite side because the Moon pulls the Earth away from the water on the far side.



The Newton's law of gravity (G is the gravitational constant) gives the magnitude of the force attracting two bodies with masses m and M to each other

$$F_g = G\frac{mM}{r^2}$$

The tidal force called

$$F_t = \frac{GMm}{(d-R)^2} - \frac{GMm}{(d+R)^2} = GMm\left[\frac{(d+R)^2-(d-R)^2}{(d-R)^2\times(d+R)^2}\right] = GMm\frac{2dR}{d^4} = GMm\frac{2R}{d^3}$$

Tides generate a tidal bulge along the equator. As the object rotates, the bulge is dragged around the object opposite to the spin.

In the same place, the height of the tides changes daily, because the distance from the Moon to the Earth and the height of the Moon over the horizon in the area at the time of the culmination all the time are changing. Therefore, the size of the tidal forces did not become. The formula of the tidal force acting on a unit of mass on the Earth's surface now of the moon's culmination:

$$F_t = 2G\frac{MmR}{d^3}\sqrt{1-\frac{3}{4}\cos^2 h}$$

Where G is gravity, m is the mass of the moon, R is the radius of the Earth, M is the mass of the Earth, d is the distance from the moon to the earth, h is the height of the moon above the horizon now of culmination.