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Gravity can reverse direction: Moon falling away from the Earth is an example of anti-gravity

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We tend to think of gravity as always being attractive, but actually it changes its direction and can become repulsive. An example of this effect of gravity reversing direction is that the Moon falls away from us instead of towards us. In common usage of terminology, people tend to try to cover up in the words that they use the fact that anti-gravity exists, because their thinking processes are not geared to thinking of gravity as reversing direction. Of course, gravity being both attractive and repulsive is further example of the utility of Boscovich's theory.

Some people think that the moon orbiting the earth is falling towards us, this is not correct; the moon is falling away from us, and thus is an example of anti-gravity. In daily life we are very aware of the effect that gravity of earth causes things to fall down, and not so aware of things falling up, and the example of a thing falling up is the moon, and the effect is so small that we don't notice it until we make precise measurements. So basically in daily life we miss noticing anti-gravity because the effect is usually so small compared to the effect we are used too from gravity. And of course when we do precise measurements we are still locked into the mindset of thinking in terms what we learnt from daily life that when those measurements reveal the opposite we might have difficulty in appreciating what that really means, and might mistaken give it a different name.

The information I shall use is as follows:

NASA website [1] tells us:

"Data also indicate that ocean tides on Earth have a direct influence on the Moon's orbit. Measurements show that the Moon is receding from Earth at a rate of about 3.8

centimeters per year.”

Do-While Jones [2] says: “One of the first things NASA did when the Apollo 11 astronauts reached the Moon was to set up a laser reflector that would allow scientists on Earth to measure the distance from the Earth to the Moon. Over the 12-year period from 1969 to 1981, scientists kept track of the distance to the Moon and found it to be increasing approximately 4 cm per year. [snip] Many people are surprised that the Moon is falling away from the Earth. They quite naturally expect that gravity would pull the Moon down to Earth. But the measurements of the distance to the Moon are not controversial. Nobody disputes that the Moon is escaping from the Earth. Even before Apollo 11, radar measurements showed that the Moon was getting farther away from the Earth. The Apollo 11 laser experiment just improved the accuracy of the measurement.”

Definition of tidal force [3] is as follows:

“A secondary effect of the gravitational forces between two objects orbiting each other, such as the Earth and the Moon, that tends to elongate each body along the axis of a line connecting their centers. Tidal forces are responsible for the fluctuation of the tides as well as for the synchronous rotation of certain moons as they orbit their planets.”

The allegory story of Newton is that he came up with the idea of gravity from seeing an apple fall. From Educational website [4] describes it according to John Conduitt as follows:

“In the year 1666 he retired again from Cambridge ... to his mother in Lincolnshire & while he was musing in a garden it came into his thought that the power of gravity (which brought an apple from a tree to the ground) was not limited to a certain distance from earth, but that this power must extend much further than was usually thought. Why not as high as the Moon thought he to himself & that if so, that must influence her motion & perhaps retain her in her orbit, whereupon he fell a-calculating what would be the effect of that superposition...”

The Educational website adds:

“Newton went further and proposed that gravity was a "universal" force, and that the Sun's gravity was what held planets in their orbits. He was then able to show that Kepler's laws were a natural consequence of the "inverse squares law" and today all calculations of the orbits of planets and satellites follow in his footsteps.”

So what we have is the basic idea that there is a force of attraction causing the apple to fall to Earth, and that the Moon is also under this force. The natural tendency is to think the force on the Moon is the same as the force on the apple, but it isn't in the same direction; its in the opposite direction and hence anti-gravity. Its same force on the apple and the Moon just that force is in opposite directions and the anti-gravity bit is so small that we haven't noticed it until modern times, by which time we have got too used to thinking of gravity as only attractive, that many people have gone into mental block that they don't notice anti-gravity when it is pointed out to them by experiment.

Going over it again from Newton:

The moon is falling away from the earth and not towards it, this is an example of anti-gravity, where gravity is acting in the opposite direction to what we might expect. Newton considered that apple falling from tree was same force of gravity acting on it was acting on moon in orbit around earth; so by gravity both in such an idealised scenario should fall down. To find that moon falls up instead of down is equivalent to finding apple falls up instead of down. We think of gravity as force causing objects to fall towards centre of gravity. When force is repulsive causing object to fall away from centre of gravity we would call this opposite to gravity hence call it anti-gravity. The moon falls away from centre of gravity (of the earth) and it is only at a very small rate; so only small anti-gravity effect. But point made is still the same – force of gravity can act towards centre of gravity or away from centre of gravity. And this was what Boscovich was dealing with in his theory of attractive and repulsive forces – where unified force could switch between attractive and repulsive over varying scales of size. Gravity acts attractive and repulsive – just from experience we are more used to it only acting attractive because anti-gravity in cases like moon is very small effect.

So

1.. Gravity without considering tidal effect – moon falls down; call this “partial gravity effect.”
2.. Gravity including the secondary gravity effect of tidal effect and the moon falls up, call this “partial gravity effect plus secondary gravity effect” and in this context where not considering anything other than these two effects will call it the “full gravity effect” or “total gravity effect.”

Thus gravity is both gravity that we are familiar with plus this tidal effect. But we have become locked into thinking of gravity as the “partial gravity effect” instead of the “full gravity effect.”

Our thinking should really be along lines of “total gravity effect” that includes tidal force. And when we do that – talk of total gravity effect not just partial gravity effect, then gravity can act repulsive as well as attractive.

Thinking process of people has tended to be - to think of gravity as only a force of attraction and exclude secondary tidal effect of gravity. .i.e think of “partial gravity effect” instead of “total gravity effect.”

That has led them into error. And of course Boscovich dealt with universal force changing from attractive to repulsive. (See other articles)

Appendix

Dealing now with one person's difficulty:

One person made the following comment: “The tidal bulge on Earth has to deal with two opposing forces:
1. The friction with rotating earth's surface trying to move it eastward.
2. The pull of moon try to move it westward (with respect to earth).
By Newton's third law, Earth and Moon equally react to tidal forces. Point 1 slows down the eastward rotation of earth. Point 2 accelerates the moon more towards east. More the acceleration, higher would be the orbit that Moon with attain.”

Which is correct except that the friction (tidal force) and the downward force is the “total gravity effect.” And by that “total gravity effect” the Moon falls up, i.e. away from the Earth.

Further confusion came from that person when they wanted to define falling as increasing acceleration, and they said: “I would not say "Moon is falling away from Earth". A fall means increasing acceleration. But here moon is drifting away from Earth at constant speed. Our oceans make the earth bit elliptical with major axis 12 min eastward of moons direction. The non-spherical shape leads to speeding up of moon. In fact, its drift speed may reduce over time. It is possible few billion years later, moon will completely match earth's rotation so it will be visible from only one side of earth and possible stop drifting away further.”

Where their confusion here is – direction is changing, so velocity is changing and changing velocity is acceleration. So they confused themselves over the difference between speed and velocity. As to drift of Moon away from Earth. Boscovich's theory deals with universal force changing its direction; so treating gravity as attractive for apple and repulsive for Moon with that repulsive eventually disappearing; well

Boscovich is quite happy with all those changes of force.

To further illustrate how far that person was confused they went on to say: “We cannot mix directions here if we take earth as point of reference. We are talking about distance from center of earth i.e. height of moon. Change in direction does not change height of moon. From all the comments, I think you are bogged into wordings and not able to get the real picture.”

Such a comment “we cannot mix directions here” is just gibberish. The distance from Earth to Moon is increasing, but at a very small rate, and the Moon's position in the sky changes relative to a Cartesian coordinate system using earth centre, hence there is acceleration etc. The gibberish they uttered was just in other words mental blockage where they wanted to think in terms of gravity as always attractive, and were unable to mentally process the physical fact that it isn't always. The disintegration of the human mind to be able to handle certain information that is in conflict with its program is same as any computer would experience. (Consider Turing test.)

References

[1] from NASA website - measuring the moon's distance
http://eclipse.gsfc.nasa.gov/SEhelp/ApolloLaser.html

[2] ref: http://www.ridgenet.net/~do_while/sage/v2i2f.htm

[3] online dictionary http://www.thefreedictionary.com/tidal+force

[4] Educational Web Sites on Astronomy
http://www-spof.gsfc.nasa.gov/stargaze/Sgravity.htm