

Re: A Physics Lesson for the Contributors to this NG

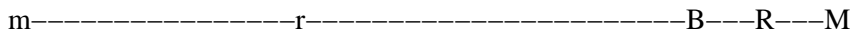
Source: <http://sci.tech-archive.net/Archive/sci.physics.relativity/2006-12/msg01159.html>

- *From:* "Sue..." <suzysewnshow@xxxxxxxxxxxxx>
- *Date:* 12 Dec 2006 01:43:14 -0800

Henri Wilson wrote:

Since few contributors here appear to have any knowledge of basic physics, it would be remiss of me if I didn't educate them on the very simple topic of centrifugal force.

Consider a pair of masses connected by a spring and which are rotating at a constant angular speed in remote space.



The point B is known as the barycentre. Its position is such that the moments around it are equal, ie., $mr = MR$.

Both the objects, m and M, rotate around the barycentre, no matter what their relative sizes. Even a small orbiting satellite will cause the Earth's C of G to rotate around their common barycentre.

(No single object can ever rotate in circular fashion without a second one doing the same, 180 degrees out of phase. In the case of a balanced flywheel, each unit mass will be opposed by an equal and opposite one. If it isn't balanced, the whole Earth will shake slightly when it spins)

At constant angular velocity, the spring will be extended at a constant length. That means it is under tension.

Assuming no lateral movement, a spring will extend when two equal and opposite forces 'pull' its ends away from each other...in this case AWAY FROM the barycentre, . The source of those forces is the constant directional change in the angular momentum vector of the two masses. Because they are confined BY THE SPRING to moving in a circle rather than tangentially as they would otherwise do, each mass exerts a continuous OUTWARD force on one end of the spring.

The values of hte forces are mw^2r and Mw^2R , which are equal. (note: a positive value indicates 'away from the barycentre')

The spring tension is also $-mw^2r$ (or $-Mw^2R$). It is negative because it acts

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INWARD, ie., CENTRIPETAL.

Concurrently, the two masses are forced to constantly accelerate towards the barycentre because of the INWARD radial force exerted on them by the spring tension.

That results in their circular movement around the barycentre at a common angular velocity 'w'....and $m\omega R = M\omega R$.

The 'inward' acceleration is on m is $-\omega^2 r$ and on M, $-\omega^2 R$.

The inward CENTRIPETAL forces on the two masses are $-m\omega^2 r$ and $-M\omega^2 R$.

<< NO OUTWARD FORCE IS EXERTED
ON THE MASSES THEMSELVES.>>

<< Already Newton recognized that the law of inertia is unsatisfactory in a context so far unmentioned in this exposition, namely that it gives no real cause for the special physical position of the states of motion of the inertial frames relative to all other states of motion. It makes the observable material bodies responsible for the gravitational behaviour of a material point, yet indicates no material cause for the inertial behaviour of the material point but devises the cause for it (absolute space or inertial ether). This is not logically inadmissible although it is unsatisfactory. For this reason E. Mach demanded a modification of the law of inertia in the sense that the inertia should be interpreted as an acceleration resistance of the bodies against one another and not against "space". This interpretation governs the expectation that accelerated bodies have concordant accelerating action in the same sense on other bodies (acceleration induction). This interpretation is even more plausible according to general relativity which eliminates the distinction between inertial and gravitational effects.

It amounts to stipulating that, apart from the arbitrariness governed by the free choice of coordinates, the $g_{\mu\nu}$ -field shall be completely determined by the matter. Mach's stipulation is favoured in general relativity by the circumstance that acceleration induction in accordance with the gravitational field equations really exists, although of such slight intensity that direct detection by mechanical experiments is out of the question. >>

http://nobelprize.org/nobel_prizes/physics/laureates/1921/einstein-lecture.html

<http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=PRBMD000070000021212502000001&idtype>
http://www.esa.int/SPECIALS/GSP/SEM0L6OVGJE_0.html

The centripetal force acts at the point where the spring is attached to the rotating objects. At constant speed, the spring tension balances the two centrifugal forces and so the spring remains constantly extended.

What is generally not understood is that the OUTWARD – or centrifugal – force exerted by one mass on the end of the spring is precisely the INWARD – or centripetal – force exerted by the other end of the spring on the other mass. It is exerted through the spring itself, which is effectively 'rigid'.

As is often the case, confusion arises when the rotating frame is considered. An observer rotating with the above objects will see just a spring that is extended for no apparent reason. If the spring is cut, he will see the objects fly off in a curved path and with an apparent acceleration. Both phenomena (which are different) have been explained by the existence of invisible – or virtual – outward forces.

These have been correctly termed 'fictitious centrifugal' forces. Note: the 'invisible' forces that keep the spring under tension are not the same as those which cause the masses to 'magically' move outwards because the former act in a straight line whereas the latter cause lateral as well as outward movements)

The confusion is one of definition. Many wrongly assume that the existence of a fictitious 'outward force' in the rotating frame automatically eliminates the existence of a REAL outward force in the inertial frame.

There is a REAL 'centrifugal' force in the inertial frame. Any old (ie, not written by a relativist indoctrinee) physics or mechanics text will tell you all about it.

" Mach's stipulation is favoured in general relativity
by the circumstance that acceleration induction in
accordance with the gravitational field equations really exists"
—A. Einstein [a relativist?]

Sue...

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HW.

www.users.bigpond.com/hewn/index.htm

Thank christ there is one genuine physicist on the NG.