

Universal Physics Journal

Question 3: Would a non-rotating Earth still bulge?

Good morning Sir: I was wondering if the earth's rotation were halted and instead all other objects in the universe rotated the other way around earth's axis at the rate of one rotation every 24 hours, do you know if the earth would continue to maintain the bulge around its equator?
Rhanson

Hello rhanson:

Historically, your question may be found amongst the many imaginary thought experiments of Ernst Mach and Albert Einstein. Perhaps they once tried lying on a rotating playground turntable and imagined what it would be like if the turntable was not rotating in one direction but instead the entire Universe was rotating in the opposite direction, just as you describe.

From imaginations such as these, Albert Einstein reached the conclusion that there is no difference between the outward-directed "centrifugal" forces present during an event where the Universe is fixed and the turntable is rotating, or the turntable is fixed and the Universe is rotating. He referred to the "sensible" outward-directed force being experienced by an off-center observer in each case as being due to an outward-directed "gravitational effect" resulting in an outward-directed "gravitational field" not recognized by Isaac Newton's law of gravitation.

It is apparent that both Ernst Mach and Albert Einstein did not recognize the generation of this outward-directed acceleration/Reaction force within a rotating object as having anything to do with the object's inward-directed acceleration as it is being forced to orbit the turntable's axis of rotation. So they looked to the distant stars for the answer. (See Article VI: Gravitation = Acceleration?)

In reality, there does exist a supporting reaction force from within an object's matter that is equal in magnitude and opposite in direction to every type of action force that is causing acceleration for that object. If it were not for the presence of this acceleration/Reaction force of matter, in a frictionless environment, it would not even be possible to apply an external acceleration/Action force against the object's surface. Newton's LAW III and Rule 7 of Article X, Universal Physics Rules for Force and Motion predict this to be so. (For an in-depth look at the nature of reaction forces read Article XI, Reaction Forces.)

We know from Article III that one cannot push against an object with more or less force than the object pushes back in response. Thus the forces present between two contacting objects are always mutual. In a linear event when you are riding as a passenger in a car, or on an airplane, that is speeding up (positive acceleration) along horizontal pavement, as much as the back of your seat is applying a forward-directed acceleration/Action force against your body, your body is applying a rearward-directed acceleration/Reaction force in response. Insert a compression scale between the seat and your back and a helper will be able to observe the scale's compression between these two equal and opposite forces. I labor over this point because the rearward-directed force is not currently recognized as your body's a/R force that it truly is, always has been, and always will be.

With a rotating turntable, the outward-directed force the observer is sensing is this same acceleration/Reaction force you sense while accelerating horizontally in any one direction in a vehicle. Only here on the rotating turntable, the direction of the observer's acceleration keeps changing to always remain pointed toward the turntable's axis of rotation. It is no coincidence that the acceleration/Action force the observer is experiencing is also directed toward this same axis of rotation. Thus here on the rotating turntable, the inward-directed acceleration/Action force impressed as an external (contact) force on the observer that is the cause of this event is equally supported by the outward-directed acceleration/Reaction force being reactively and internally generated within each component of the observer's accelerating matter. Recognition and understanding of this common, everyday action/reaction pair of accelerational forces is paramount in understanding this turntable event.

Rotation is an absolute event as proved long ago by Newton's rotating bucket of water experiment which is well described in PRINCIPIA. When the turntable is rotating, a/A forces and mutually supporting a/R forces are both present. When the turntable is not rotating, a/A forces and mutual a/R forces are both absent, regardless of whether the rest of the matter in the Universe is "whirling" or not "whirling", or even present or not present.

Since acceleration/Reaction forces are present during examples of linear acceleration, there is every reason to recognize these same a/R forces as being present during rotational examples of centripetal acceleration. In both types of accelerational events it is crucial to recognize that the acceleration/Reaction forces present are always directed opposite to the direction of the acceleration. Thus we may correctly conclude that the acceleration/Reaction forces testably present are never the cause of any accelerational event. Thus it is never correct to say in a linear accelerational event, that the backward-directed acceleration/Reaction force present is the cause of the test object's forward-directed acceleration. Equally so, it is never correct to say in an inward-directed (centripetal) accelerational event, that the outward-directed (centrifugal) acceleration/Reaction force present is the cause of the test object's inward-directed acceleration. Such acceleration/Reaction forces are merely supporting the acceleration/Action forces present which always stand firm as the cause of the forward-directed acceleration in the linear event and the inward-directed acceleration in the circular event. With our new understanding and recognition of an object's a/R force that is testably present during rotational events, there is simply no role left for imaginary "dynamic gravitational effect" forces to fill.

As Earth rotates in an absolute manner about its own axis, an inward-directed acceleration occurs to Earth's matter that reaches a maximum along the surface of Earth's equator. The force causing this inward-directed acceleration is but a small portion of the matter's action force of gravitation that is inward-directed toward Earth's center of matter. This small, inward-directed, gravitational, internal acceleration/Action force is supported by and terminates against an equally small, outward-directed, internal acceleration/Reaction force effectively reducing the external (contact) force of the object's equatorial weight as compared to its polar weight by a ratio of about 1/330. Thus Earth's matter bulges outward around the equator since the equatorial matter is a little lighter in weight-force reducing the compression of the column of matter all the way down to Earth's core. So this nearly 4000 mile tall column of equatorial matter stands higher above

Earth's core as it is balanced by the lesser quantity of the heavier and shorter column of matter located at both of Earth's poles.

Reserving the short answer to the end, no equatorial bulging of Earth's matter will occur if Earth's rate of rotation is reduced to zero, regardless of whether the rest of the Universe is whirling or not whirling, or for that matter, present or not present. Since rotation is an absolute event, as well-proven by Newton's Bucket, Earth's current rotation along with its equatorial bulge need only be compared to Earth when it is not rotating and its bulge is absent. No other object in space is required to exist in order for this determination to be made of the absolute nature of Earth's rotation.

Thanks rhanson for the fine question about the absolute nature of centripetal acceleration.

Ethan Skyler

P.S. Be careful of those playground turntables. My son Robert fell off one and rolled underneath. A piece of steel angle iron under the turntable struck him on the hip causing a painful injury.

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