Newton versus Einstein

The "Physics" of Alec MacAndrew

This rebuttal addresses the recent paper written by Alec MacAndrew titled, "There He Goes Again."

Let's begin with MacAndrew's major thesis.

In his previous paper, MacAndrew admitted that both Einsteinian and Machian physics allows for a geocentric universe.

That is quite a step for MacAndrew. He is two-thirds of the way home.

To be sure, let's verify the basis for MacAndrew's admission. Here is Albert Einstein on the issue:

> We need not necessarily trace the existence of these centrifugal forces back to an absolute movement of K' [Earth]; we can instead just as well trace them back to the rotational movement of the distant ponderable masses [stars] in relation to K' whereby we treat K' as 'at rest.'…On the other hand, the following important argument speaks for the relativistic perspective. The centrifugal force that works on a body under given conditions is determined by precisely the same natural constants as the action of a gravitational field on the same body (*i.e.*, its mass), in such a way that we have no means to differentiate a 'centrifugal field' from a gravitational field.…This quite substantiates the view that we may regard the rotating system K' as at rest and the centrifugal field as a gravitational field.…The kinematic equivalence of two coordinate systems, namely, is not restricted to the case in which the two systems, K [the universe] and K' [the Earth] are in uniform relative translational motion. The equivalence exists just as well from the kinematic standpoint when for example the two systems rotate relative to one another.[1]
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> The struggle, so violent in the early days of science, between the views of Ptolemy and Copernicus would then be quite meaningless. Either coordinate system could be used with equal justification. The two sentences: "the sun is at rest and the Earth moves," or "the sun moves and the Earth is at rest," would simply mean two different conventions concerning two different coordinate systems.[2]

Here is Max Born reiterating Einstein's allowance for geocentrism:

> ...Thus we may return to Ptolemy's point of view of a 'motionless Earth.' This would mean that we use a system of reference rigidly fixed to the Earth in which all stars are performing a rotational motion with the same angular velocity around the Earth's axis…one has to

[1] Einstein's October 1914 paper titled: "Die formale Grundlage der allgemeinen Relativitätstheorie," trans. by Carl Hoefer, in *Mach's Principle: From Newton's Bucket to Quantum Gravity*, eds. Julian Barbour and Herbert Pfister, pp. 69, 71.

[2] *The Evolution of Physics: From Early Concepts to Relativity and Quanta*, Albert Einstein and Leopold Infeld, 1938, 1966, p. 212. In another sense, Relativity has no basis making such judgments, for as Einstein himself notes: "The theory of relativity states: 'The laws of nature are to be formulated free of any specific coordinates because a coordinate system does not conform to anything real'" (*Annalen der Physik* 69, 1922, 438, in *The Expanded Quotable Einstein*, p. 244).

> show that the transformed metric can be regarded as produced according to Einstein's field equations, by distant rotating masses. This has been done by Thirring. He calculated a field due to a rotating, hollow, thick-walled sphere and proved that inside the cavity it behaved as though there were centrifugal and other inertial forces usually attributed to absolute space. Thus from Einstein's point of view, Ptolemy and Copernicus are equally right. What point of view is chosen is a matter of expediency.[3]

Here is noted astronomer, Fred Hoyle on the same principle:

> We might hope therefore that the Einstein theory, which is well suited to such problems, would throw more light on the matter. But instead of adding further support to the heliocentric picture of the planetary motions, the Einstein theory goes in the opposite direction, giving increased respectability to the geocentric picture. The relation of the two pictures is reduced to a mere coordinate transformation, and it is the main tenet of the Einstein theory that any two ways of looking at the world which are related to each other by a coordinate transformation are entirely equivalent from a physical point of view.[4]

So, since MacAndrew cannot discredit geocentrism from two prominent physical systems that support it (Einstein and Mach), his last resort is to put Isaac Newton's laws of motion into the dubious position of denying geocentrism. Apparently, MacAndrew's logic is that if he can make it appear that at least one popular physical system disallows geocentrism, he feels safe in saying that geocentrism is not credible. Go figure.

But the only thing that is not credible here is Alex MacAndrew's reasoning. He wants us to believe that there is no contradiction in modern physical science when he says that two physical systems will allow geocentrism (Einstein and Mach) but that a third system will not allow it (Newton).

How much sense does that make?

None.

MacAndrew cannot have his cake and eat it, too. Logically, one side or the other of these two systems would have to be false.

If, on the one hand, MacAndrew's estimation that Newtonian physics cannot support geocentrism is correct, then that means both Einsteinian and Machian physics must be incorrect in allowing for geocentrism.

On the other hand, if Einsteinian and Machian physics is correct in allowing geocentrism, then Newton cannot be correct in denying geocentrism.

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[3] Max Born, *Einstein's Theory of Relativity*, 1962, 1965, pp. 344-345.
[4] Fred Hoyle, *Nicolaus Copernicus: An Essay on His Life and Work*, p. 87.

So what is the problem? The problem is that MacAndrew is unwilling to extend Newton's physics to the whole universe so that it can deal with the same issues with which Einstein and Mach deal.

In order to have any chance of credibility, MacAndrew must try his best to confine Newton to our solar system and ignore the rest of the universe. There is good reason for this ploy. Obviously, if there are no other gravitational or inertial forces from the rest of the universe to be concerned about, then we have a simple two-body problem (the sun and the Earth) and F = ma will force us to say that the Earth revolves around the sun.

But, of course, this just begs the question. Can we confine Newton's physics to a two-body problem and ignore the rest of the universe? According to modern physics the answer to that question is a categorical no. Keep in mind that Newton had no idea about the size and number of the stars. He had no idea of their dynamic effect on Earth. But as Fred Hoyle enlightens us:

> …we can take either the Earth or the Sun, or any other point for that matter, as the center of the solar system. This is certainly so for the purely kinematical problem of describing the planetary motions. It is also possible to take any point as the center even in dynamics, although recognition of this freedom of choice had to await the present century.[5]

Did you catch that? Not only can we make Earth the center geometrically (which was accomplished by Tycho Brahe in the 1600s), we can also make Earth the center in regards to gravity and inertial forces due to the discoveries of modern science in the 20th century. For the three hundred years since Newton published his *Principia Mathematica*, the whole world was under the impression that Newton's laws prohibited the Earth from being the dynamic center of the universe. And now we find out it was nothing but one big lie, and from one of the most respected astronomers of the 20th century. There is one thing I deeply appreciate about Fred Hoyle – he was an honest and dispassionate scientist.

Hoyle then shows how MacAndrew's argument is now obsolete:

> Although in the nineteenth century this argument was believed to be a satisfactory justification of the heliocentric theory, one found causes for disquiet if one looked into it a little more carefully. When we seek to improve on the accuracy of calculation by including mutual gravitational interactions between planets, we find – again in order to calculate correctly – that the center of the solar system must be placed at an abstract point known as the "center of mass," which is displaced quite appreciably from the center of the Sun. And if we imagine a star to pass moderately close to the solar system, in order to calculate the perturbing effect correctly, again using the inverse-square rule, it could be essential to use a "center of mass" which included the star. The "center" in this case would lie even farther away from the center of the Sun. It appears, then, that the "center" to be used for any set of bodies depends on the way in which the local system is considered to be isolated from

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[5] Fred Hoyle, *Nicolaus Copernicus: An Essay on his Life and Work,* p. 82. Also from the same book: "Today we cannot say that the Copernican theory is "right" and the Ptolemaic theory is "wrong" in any meaningful sense. The two theories are…physically equivalent to one another" (*ibid*, p. 88).

> the universe as a whole. If a new body is added to the set from outside, or if a body is taken away, the "center" changes.[6]

So, if MacAndrew has any chance of winning this dog fight, he must insist that we are dealing only with local bodies and ignore the rest of the universe. But in doing so, he puts Newton at odds with Einstein and Mach such that if he says Newton is correct in denying geocentrism, then obviously there must be some flaw in the physics of Einstein and Mach in using the whole universe to support geocentrism. This is the simple law of non-contradiction.

But MacAndrew must join the rest of modern science and stop limiting the field to a sun and planets. The only reason Newton, in 1667, had not done so is that he had little concept (since, as Hoyle told us, we only discovered it in the 20th century) of how the rest of the universe affects our Earth. Now that we know what effect the universe has, MacAndrew needs to expand Newton's laws to the universe as a whole. In other words, how can Newton's laws be applied if we agree with Einstein and Mach that the universe can rotate around a fixed Earth? If MacAndrew is unwilling to do this, then there is no use in talking to him. He will end up making Newton contradict Einstein and Mach and we will never be able to get him out of that blind alley.

Let's see if we can help MacAndrew. We've already made this suggestion to him, but he didn't follow up on it but we will repeat it here with emphasis.

Let's say we just take the Earth out of the equation for the moment. That is, let's say we have a universe that is rotating on a sidereal rate around its center of mass with no object occupying the center of mass. Obviously, MacAndrew cannot argue with this hypothetical model, for a rotating universe will certainly rotate around its center of mass. In essence, all we have done is expanded Newton's laws from a solar model to a spherical universe.

Now, to an observer located near the center of mass of a rotating universe, the stars and the sun will revolve in a circle around the observer on a daily basis. (Remember, we are keeping the Earth out of the picture for now. We are only dealing with an observer at the universe's center of mass).

In this model, the sun can be placed 93 million miles from the universe's center of mass and it can carry the planets with it. It will revolve around the universe's center of mass by moving with the rotating universe. In other words, the rotating universe is carrying the sun, and all the other celestial bodies, around the universe's center of mass. Likewise, Alpha Centauri can be placed 4 light years from the universe's center of mass and it will rotate with the universe around the universe's center of mass.

Is this universe possible? If MacAndrew says no, then this is tantamount to saying that Newton's physics is inadequate since it cannot deal with the scenario of a rotating universe. But in reality, it makes no difference to Newton whether the system in view is small (a sun) or large (a universe).

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[6] Fred Hoyle, *Nicolaus Copernicus*, 1973, p. 85.

They will all follow the same physical laws. All rotating systems will rotate around their centers of mass.

So, we must conclude then, that in using Newton's physics, it is possible to have a universe rotating daily around its center of mass, and it is also possible for our sun to be placed 93 million miles from the universe's center of mass and be carried around daily by the universe. MacAndrew simply cannot disagree with this scenario.

The only thing the geocentrist will add to this scenario is that the universe's center of mass could be occupied by a relatively small body – a body which would assume all the physical characteristics of a center of mass – without disturbing what it means to be a center of mass.

Relative to the size of the universe, how small would that body have to be? I dare say that a body that is 1×10^{-17} the size of the universe would qualify as such a body. If the universe is 93 billion light years in diameter, then the Earth is 1×10^{-17} the size of the universe. That's pretty small. It is so small that it is comparable to spitting in the ocean and wondering if the water level rises.

Since the Earth is so small compared to the universe that is rotating around it, then the Earth will assume all the characteristics of a center of mass. What are the characteristics of a center of mass?

Wikipedia states:

> In physics, the center of mass of a distribution of mass in space is the unique point where the weighted relative position of the distributed mass sums to zero. The distribution of mass is balanced around the center of mass and the average of the weighted position coordinates of the distributed mass defines its coordinates.
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> In the case of a single rigid body, the center of mass is fixed in relation to the body, and if the body has uniform density, it will be located at the centroid. The center of mass may be located outside the physical body, as is sometimes the case for hollow or open-shaped objects, such as a horseshoe. In the case of a distribution of separate bodies, such as the planets of the Solar System, the center of mass may not correspond to the position of any individual member of the system.
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> The center of mass is a useful reference point for calculations in mechanics that involve masses distributed in space, such as the linear and angular momentum of planetary bodies and rigid body dynamics. In orbital mechanics, the equations of motion of planets are formulated as point masses located at the centers of mass. The center of mass frame is an inertial frame in which the center of mass of a system is at rest with respect to the origin of the coordinate system.

Now, at this point, MacAndrew will try to object that if we put the Earth at the universe's center of mass, the Earth will be affected by the sun, and the sun will pull the Earth into the sun.

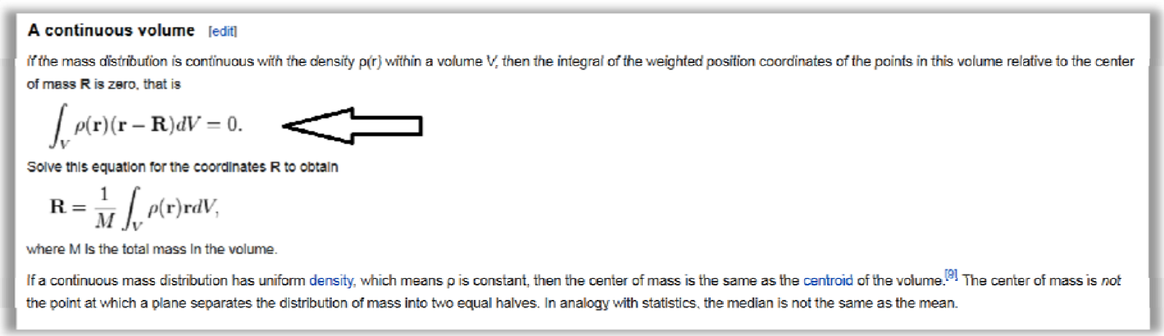
Is that true?

MacAndrew raised this objection in his latest paper:

> In attempting to counter the fact that the amplitude of the Sun's gravitational field at the Earth vastly exceeds that of all of the other bodies in the Universe, Sungenis insist wrongly that there must be zero gravitational force at the centre of mass of a set of bodies. He makes further embarrassing errors in trying to defend his basic mistake: for example, he appeals to a Wikipedia article that discusses the centre of gravity of a single extended body in a non-zero gravitational field. This section of the Wikipedia article concerns the effect of gravity on a single extended body in an external gravitational field and provides the rationale for treating the distributed mass of the body as concentrated at its center of gravity. The article shows that the centre of gravity is the location where torque on the body due to gravity vanishes and it derives the force acting on a body of non-uniform density in a gravitational field. However, it has absolutely nothing to do with whether the gravitational field at the centre of mass of a set of bodies must be zero or not.

The problem is that MacAndrew is trying to escape the problem by making an artificial distinction between the gravitational field and the mass as if they are two separate entities that can exist without one another. Not so. Wherever there is mass, there is gravity, and if there is no mass there is no gravity. In our case, where there is no effective mass (as in a center of mass where all the mass is balanced and thus adds to zero) then there is no effective gravity at that very point, and thus no gravitational field.

Wikipedia states:



A continuous volume [edit]

If the mass distribution is continuous with the density ρ(r) within a volume V, then the integral of the weighted position coordinates of the points in this volume relative to the center of mass **R** is zero, that is

$$\int_V \rho(\mathbf{r})(\mathbf{r}-\mathbf{R})dV = 0.$$

Solve this equation for the coordinates **R** to obtain

$$\mathbf{R} = \frac{1}{M}\int_V \rho(\mathbf{r})\mathbf{r}dV,$$

where M is the total mass in the volume.

If a continuous mass distribution has uniform density, which means ρ is constant, then the center of mass is the same as the centroid of the volume.[9] The center of mass is *not* the point at which a plane separates the distribution of mass into two equal halves. In analogy with statistics, the median is not the same as the mean.

Hence, using our model in the Wikipedia description of a "Continuous Volume" (i.e., the whole universe is a "continuous volume"), I will apply our model in brackets:

> "If the mass distribution [of the whole universe] is continuous with the density ρ(**r**) within a volume V, then the integral of the weighted position coordinates of the points in this volume [i.e., all the masses in the universe] relative to the center of mass **R** is zero.
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> "If a continuous mass distribution [of the whole universe] has uniform density, which means ρ is constant, then the center of mass is the same as the centroid the volume [the Earth can occupy the 'centroid' position of the whole universe]."

Wikipedia adds more. There is a reason that the terms "center of mass" and "center of gravity" are often interchangeable. Wiki explains:

Center of gravity [edit]

Center of gravity is the point in a body around which the resultant torque due to gravity forces vanish. Near the surface of the earth, where the gravity acts downward as a parallel force field, the center of gravity and the center of mass of an arbitrary body are the same.

The study of the dynamics of aircraft, vehicles and vessels assumes that the system moves in near-earth gravity, and therefore the terms center of gravity and center of mass are used interchangeably.

In physics the benefits of using the center of mass to model a mass distribution can be seen by considering the resultant of the gravity forces on a continuous body. Consider a body of volume V with density ρ(r) at each point **r** in the volume. In a parallel gravity field the force **f** at each point **r** is given by,

$$\mathbf{f}(\mathbf{r}) = -dm\, g\vec{k} = -\rho(\mathbf{r})dV\, g\vec{k},$$

where dm is the mass at the point **r**, g is the acceleration of gravity, and k is a unit vector defining the vertical direction. Choose a reference point **R** in the volume and compute the resultant force and torque at this point,

$$\mathbf{F} = \int_V \mathbf{f}(\mathbf{r}) = \int_V \rho(\mathbf{r})dV(-g\vec{k}) = -Mg\vec{k},$$

and

$$\mathbf{T} = \int_V (\mathbf{r}-\mathbf{R})\times\mathbf{f}(\mathbf{r}) = \int_V (\mathbf{r}-\mathbf{R})\times(-g\rho(\mathbf{r})dV\vec{k}) = \left(\int_V \rho(\mathbf{r})(\mathbf{r}-\mathbf{R})dV\right)\times(-g\vec{k}).$$

If the reference point **R** is chosen so that it is the center of mass, then

$$\int_V \rho(\mathbf{r})(\mathbf{r}-\mathbf{R})dV = 0,$$

which means the resultant torque **T**=0. Because the resultant torque is zero the body will move as though it is a particle with its mass concentrated at the center of mass.

By selecting the center of gravity as the reference point for a rigid body, the gravity forces will not cause the body to rotate, which means weight of the body can be considered to be concentrated at the center of mass.

Notice that the final equations for both the "center of mass" and the "center of gravity" are the same, namely:

$$\int_V \rho(\mathbf{r})(\mathbf{r}-\mathbf{R})dV = 0.$$

Wikipedia then states:

"Center of gravity is the point in a body around which the resultant torque due to gravity forces vanish."

In other words, if there is no torque, then there is no effective gravity. Zero gravity will produce zero torque.

This is why Wikipedia says…

> "which means the resultant torque **T**=0. Because the resultant torque is zero the body will move as though it is a particle with its mass concentrated at the center of mass."

We might also add this from Wikipedia:

> "By selecting the center of gravity as the reference point for a rigid body, the gravity forces will not cause the body to rotate, which means weight of the body can be considered to be concentrated at the center of mass."

What is our "rigid body"? It is none other than the whole universe rotating. We consider it "rigid" precisely because there is no haphazard movement of the celestial bodies in the universe as the universe rotates. All the celestial bodies are carried undisturbed in the rotating universe, which is why we always see the same constellations day after day and century after century. They are all "rigidly" placed in the universe, as it were. Except for some slight proper motion, they all move in unison. Only rigid bodies do that. Picture the universe as a mold of Jello rotating slowly, and the celestial bodies as raisins in the Jello mold. They will all rotate together.

In addition, the space between the celestial bodies is also part of the universe, and it also determines the universe's center of mass. Space is not empty in the sense that nothing exists there. Nothing cannot exist, therefore space is made up of a substance. It is composed of very small invisible particles, but it does exist. Our reason tells us so. Whatever it is, it is also part of the "rigid" universe. That is why we use a mold of Jello for the analogy, since there is no "empty space" in a Jello mold.

Since the universe is a rigid body, it will have both a center of gravity and a center of mass, and they will be indistinguishable. At that point, as long as the Earth is small enough, there will be no torque from the universe, and thus the Earth can remain motionless, neither rotating nor translating.

The sun cannot pull the Earth out of this position, since the Earth is held in its unique position by the whole universe. To move the Earth out of its position one would have to move the whole universe, and that certainly is impossible.

MacAndrew's difficulty in understanding this is that he tried to confine the problem to a "set of bodies," per his sentence: "However, it has absolutely nothing to do with whether the gravitational field at the centre of mass of a *set of bodies* must be zero or not" (emphasis his). But we don't have a "set of bodies" in the geocentric model. We have one big rigid body, the universe. It is doing the rotating, and thus it determines the center of mass.

Hence, if Newton's laws are applied to a rigid body universe that rotates, it will have a center of mass and center of gravity around which there are no gravitational forces, inertial forces, or torque forces.

Thus we have solved MacAndrew's conundrum, the conundrum of having Newton's laws at odds with Einstein's and Mach's laws. The problem was that MacAndrew, although willing to apply Einstein and Mach to the whole universe and thus allow geocentrism, was unwilling to expand Newton's laws to the whole universe. As we can see, when one does so, Newton does not contradict Einstein and Mach, that is, Newton allows geocentrism just as much as Einstein and Mach.

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