There He Goes Again

By Alec MacAndrew

I recently wrote an article[1] pointing out a number of fundamental errors made by the neo-geocentrists. Bob Sungenis has now replied to that article, more or less line by line[2], which makes for an excruciatingly long and repetitive read. Although there are literally dozens of mistakes and misunderstandings committed by Sungenis in it, I have no intention of creating a similar unreadable reply. However, I want to point out a number of places where his arguments are based on ignorance of physics, mathematical errors, logical fallacies, or all three.

Sungenis claims that I was "hired"[3] to write the article, which is absurd. I have no idea how he can possibly pretend to know that, but like many of the assertions he makes, it is entirely a figment of his imagination. He focuses repeatedly on my atheism, in a blatant attempt to poison the well. My points were and are confined to science and have nothing whatever to do with my religious beliefs. He states that my scientific position is entirely a consequence of my atheism, implying that good Catholics do not agree with me about the science. Indeed, he effectively claims that modern science is an atheistic project. The hundreds or thousands of Catholic scientists working in cosmology and astrophysics, not to mention the many thousands working in other branches of science, would not agree.

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Throughout his reply, Sungenis repeats ad nauseam his cherished fundamental misunderstanding of elementary classical mechanics. His error is the idea that there would be no gravitational force at the putative centre of mass of the Universe, which he claims is "occupied" by the Earth[4]. In my original article I explained that he confuses two entirely different concepts: 1) the centre of mass of a set of bodies and 2) a point in space where the sum of the gravitational fields of those bodies is zero (i.e. a point where an object will experience no gravitational force and hence no acceleration). The locations of these two do not generally coincide. In Appendix 1 of the original article[1], I illustrated this in simple mathematical terms – a proof that Sungenis has obviously failed to understand; otherwise he wouldn't have compounded his error as he has. By his continued refusal to learn the physics involved and by repeating this basic error, Sungenis has shown us that he is really not interested in the truth of the matter, but merely in rhetoric and propaganda in support of his prejudiced opinion.

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 insists 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[5] 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 centre 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. Sungenis can't even tell the difference between a Wikipedia article that is relevant to the argument and one that is not.

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[1] http://www.geocentrismdebunked.org/wp-content/uploads/2014/04/Here-Comes-the-Sun-Alec-MacAndrew.pdf
[2] http://galileowaswrong.com/wp-content/uploads/2014/06/There_Goes_the_Sun_Rebuttal_to_Alec_MacAndrew1.pdf
[3] The definition of 'to hire' from the OED: 'to employ (someone) for wages'
[4] In fact, Sungenis never offers any evidence that the Earth is at the centre of mass of the Universe (should there be one) – he just assumes it.
[5] http://en.wikipedia.org/wiki/Center_of_mass#Center_of_gravity

So, if getting the two distinct concepts 1) and 2) above hopelessly muddled isn't bad enough, he appeals to sources that are irrelevant to the question and that he obviously fails to understand. It is essential to Sungenis's case that the resultant gravitational field from any set of bodies must be zero at their centre of mass and this is simply not so. That it is not so, is a matter of fact, not a matter of opinion or debate. I'm sure that if he consults either of his friends, Luka Popov or John Hartnett, they would set him right. I fully expect Sungenis to come back with some trumped-up and fallacious response to this, rather than to admit his mistake, because that is his normal *modus operandi*. Nevertheless, he is simply wrong about this and the more he argues the point, the more his lack of knowledge is revealed.

My analysis of the gravitational field at the Earth was correct in the original article[1]. The Earth's situation is very close to a massive body, the Sun, with the next equivalent massive body, Proxima Centauri, 270,000 times further away, which puts the Earth gravitationally at a non-symmetrical place, especially when we consider the inverse square law of gravity. The Sun's gravitational field overwhelmingly dominates at the Earth, whether the Earth is at the putative centre of mass of the Universe or not, and therefore the gravitational field at the Earth is non-zero, and so the Earth must be undergoing acceleration. As we have seen, Sungenis's only counter to this is based on his woeful ignorance of the physics and the erroneous claim above.

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In his reply, Sungenis confirms yet again that he doesn't understand or care about the Great Inconsistency at the scientific heart of his position. If he accepts that General Relativity is a good description of reality then his case collapses, because, in a GR framework, the statement "the Earth is static, and non-rotating at the centre of the Universe" is completely meaningless. It's like saying "the colour of the sky is rectangular" – syntactically correct but semantically empty. If he rejects General Relativity, then he is stuck with Newtonian Mechanics in which the Earth is unequivocally rotating and accelerating, and so not at rest. It's a dilemma for him. As it happens, he rather violently rejects General Relativity[6]. Now an honest scientist who rejects a particular theory, doesn't turn round in the next sentence and use it to support his case – by rejecting it, he is proclaiming that it is not a good description of reality, so how can he logically and fairly use it in support of his idea, which presumably he believes does reflect reality? Of course he can't – or shouldn't. The fact that the neo-geocentrists rely on a theory they detest and reject is the fundamental Great Inconsistency at the heart of neo-geocentrism that has always been there and that they have never succeeded in resolving.

Stuck on the horns of this dilemma, Sungenis proclaims that he only references GR so that those opposed to him can see that geocentrism is *allowed* in our preferred theory of gravity[7]. Well, first of all the claim that he only references GR for that reason is patently false because he and other geocentrists frequently reference GR to attempt to explain the Coriolis and centrifugal forces that appear at the Earth's surface (which otherwise can only be caused by a rotating Earth). Secondly, geocentrism isn't *allowed* according to GR, and GR isn't evidence for geocentrism, because in GR the proposition of geocentrism is meaningless.

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In his original article Sungenis made the ludicrous claim that Newtonian mechanics is valid only for two bodies. In my reply I showed why that is not so, and explained that Newtonian mechanics is valid for any arbitrary number of bodies. I also pointed out that analytical solutions are not generally found for more than two bodies but that numerical solutions are available. Sungenis responded with a rant

[6] He does so for very poor reasons, including the fact that he clearly lacks the mathematical skills to understand GR in the first place. You can't logically accept or reject a theory that you don't understand. He also says things like "there isn't one test GRT has passed", which is patently untrue. It would be accurate to say there isn't one test GR has failed.

[7] Sungenis: "Let me say it again for the umpteenth time to MacAndrew: we don't believe in General Relativity. We appeal to it only because YOU believe it is the correct way to view the universe."

about the impotence of physics based on the unavailability of analytical solutions for n-body problems, completely missing the fact that precise numerical solutions are available and used all the time. In support of all this I referenced a document[8] that he characterised thus:

> *"The footnote MacAndrew gives is nothing more than a 200-page obtuse and pedantic display of mathematic gobbledygook that proves my point about what GRT actually produces."*

The "obtuse and pedantic display of mathematic gobbledygook" that Sungenis dismisses with such easy contempt[9] is not a product of GR, but the technical basis of a joint NASA and private industry tool for planning space missions based almost entirely on classical mechanics:

> *"GMAT is developed by a team of NASA, private industry, and public and private contributors. It is used for real-world engineering studies, as a tool for education and public engagement, and (after completion of final acceptance testing in Sept. 2013) to fly operational spacecraft."*[10]

It demonstrates quite clearly that Sungenis's idea that Newtonian mechanics is valid only for two-body systems is ignorant and silly. I direct him in particular to equations 4.17 to 4.24 of the document, although he probably won't have a clue what he's looking at. The GMAT framework demonstrates that one application of n-body solutions of Newtonian mechanics is good enough to put men on the moon, land rovers on Mars, and place satellites at the Sun-Earth L2 point.

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When I used the annual Doppler shift of celestial bodies to query whether it is reasonable to believe that the Earth is static with the measured annual in-phase Doppler shift arising from an elliptical motion of the cosmos stretching back billions of years, Sungenis responded with an absurd claim that the most distant cosmic features could just as easily be 10,000 light years away as 13 billion plus light years away. He based this claim on a disgraceful misrepresentation of the evidence for the age of the Universe and the use of an over-simplified formula for relating the age of an object to its red-shift. He made the mistake of thinking that distances of objects both within and outside the galaxy are measured purely by their redshift. In reality, the distances of these objects are measured by a wide range of techniques, which are appropriate for various distance ranges and these techniques overlap, allowing calibration of one to the next. The nearest distances are covered by annual parallax using the Earth's orbit as a baseline, with increasing distances measured by other kinds of parallax, the use of standard candles, such as Cepheid variables, RR Lyrae variables and Type 1a supernovae, and many other techniques such as those associated with main sequence star evolution and galactic structure. Taken together these techniques are known as the Cosmic Distance Ladder. The Wikipedia entry on this subject is particularly comprehensive[11]. No-one claims, of course, that these techniques are accurate to the last one percent, particularly for objects further away. However, the idea that they are wrong by a factor of more than a million, and that the Universe is 20,000 light years across when our own galaxy (one of hundred billion in the observable Universe) is known to be five times bigger than that, is beyond absurd. There is a simple relationship between the size of a main sequence star[12], like the Sun, and the amount of light it gives out (its luminosity) – there is also a simple relationship between the distance of a star, its luminosity and how bright it appears to us (its apparent magnitude). If the Universe is only 10,000 light years across then the dimmer stars making up the more distant galaxies would have to have a luminosity up to a trillion times less than that of the Sun – in other words, they would not be stars at all.

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[8] http://gmat.sourceforge.net/docs/R2013a/GMATMathSpec.pdf

[9] Dismissing the use of maths in physics and claiming that it is pedantic and gobbledegook is one good diagnostic sign of a physics crank.

[10] http://gmat.gsfc.nasa.gov/

[11] http://en.wikipedia.org/wiki/Cosmic_distance_ladder

[12] Main sequence stars fuse hydrogen in their core and there is a clear relationship between their mass, their luminosity, their colour and how long-lived they are.

The case of Type II supernova SN 1987A shows how grotesquely wrong Sungenis is - simple geometry and the time the supernova light took to reach its circumstellar ring prove that the supernova is 167,000 light years away[13]. SN 1987A is located in a dwarf galaxy, called the Large Magellanic Cloud, neighbouring the Milky Way, which, cosmically speaking, is in our backyard. The distance of the Large Magellanic Cloud using the appropriate techniques of the Cosmic Distance Ladder matches this geometric measurement perfectly. The concept of a small (10,000 light years radius) Universe is an abject non-starter.

But even if we grant him the 10,000 light years, he's still wrong because he's stuck with two problems – a) the idea, which has no basis in Newtonian dynamics, that the cosmos just happens to move around the static Earth with exactly the same elliptical orbit that Newtonian mechanics predicts for the Earth's orbit, and with all its features such as variations in the orbital eccentricity and ecliptic obliquity, apsidal precession and ecliptic precession and, b) the finite speed of light means that if the annual Doppler shift is caused by a cosmos that moves as a whole then the phase of the Doppler shift will depend on the distance of each star and galaxy, and this problem exists whether the universe is 13.7 billion years old or one year old. So, for example, an object 5 light years away will appear to move in anti-phase with an object 5.5 light years away – when one is red-shifted the other will be blue-shifted as the light will have taken six months longer to come from the latter. We don't observe this out-of-phase behaviour, so either it is the Earth's movement that causes the Doppler shift, or all the celestial objects are exactly the same distance from the Earth, or they are all moving independently but orchestrated in such a way that after allowing for the light time of flight they all appear to be exactly in phase. The latter two explanations are not supported by observation to the extent of being ridiculous; hence we can conclude that the first is correct.[14]

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I also used the case of the Pioneer anomaly to illustrate how the daily Doppler shift based on the motion of the rotating Earth was taken into account in measuring the anomaly. It doesn't matter what caused the anomaly (although Sungenis doesn't seem to be up to date with the fact that it has been explained and is anomalous no longer), because the point is that in order to measure the anomaly, which is a tiny effect, extremely accurate measurements of the position of the Pioneer craft were made from the Earth, and corrections for the daily movement of the earth station, which include terrestrial phenomena, were critical. In other words, when measuring the position of Pioneer craft either the Earth is rotating or the two Pioneer space craft were bobbing about on a daily basis with a movement that includes phenomena that can only be reasonably explained by earth's rotation, such as precession, nutation and polar motion. Sungenis missed the point entirely and responded with an entirely irrelevant cut and paste that fails to address the point.

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Turning now to the series of copied papers at the end of the original Sungenis piece, I remarked that the first two weren't referenced - and indeed they weren't. He protests that he referenced their author in footnote 6. Footnote 6 is attached to what is clearly a quotation in an indented paragraph. So far, so good. There immediately follows a non-indented paragraph, plainly written by Sungenis where he boasts:

> *"Now, for those who really want to see the details of the math, allow me to give you what is presently in Galileo Was Wrong, the 9th edition. In the upcoming 10th edition, we include the calculation of the geocentric Lagrange Points using potentials."*

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[13] Panagia et al, Properties of the SN 1987A circumstellar ring and the distance to the Large Magellanic Cloud, ApJ 380;L23 – L26, available here: http://adsabs.harvard.edu/full/1991ApJ...380L..23P

[14] Sungenis wrote: "I'll leave it to the reader to reason that if the universe is moving the stars and the CMB at an equal speed in relation to the Earth, then we are not going to see any phase difference in the light that comes to us". He's wrong because he clearly fails to understand the physics.

He then inserts complete copies of the two Popov papers (less the Introduction section of the first paper), without any indication that they have anything to do with footnote 6. The two papers cover *eleven* pages and are formatted identically to the rest of the body of his reply, and include the same section numbers that the stand-alone papers do. The second paper follows on from the first without any indication that it is a separate document and without reference, even though it is available on the arXiv pre-print server. The first statement in the paragraph immediately following the end of the second Popov paper, clearly written by Sungenis, is:

> *"Now that **we** have analyzed geocentric mathematics by use of the dynamical approach using potential formalism, **we** will now demonstrate the mathematics by the kinematical approach, primarily using vectors."* [My bolding]

Those are the facts. There's a word for copying others' work without proper reference that applies whether or not the others are friends and whether or not they have given permission for their use. Furthermore, his practice of copying multiple pages of others' work[15] into his own is dubious at best, whether referenced or not.

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Luka Popov himself responded to my critique. His explanation for his first paper being published in an educational rather than a research journal and his second paper remaining unpublished was, in effect, that the papers contain nothing new and so the community does not find them interesting or important. Well, indeed. Since the first is basically a co-ordinate transformation and the second merely plucks a vector potential out of thin air to give the desired answer, I'm not surprised the community finds them trivial. As for the error in the Sun orbiting Earth Lagrangian that I noted, Dr Popov refuses to discuss it on the basis that the paper has been peer reviewed, as though that is a talisman against error. I commented on the apparent error merely in passing anyway and it does not affect the assessment that these papers are a trivial rehashing of well-understood physics. And the error remains whether Dr Popov is willing to discuss it or not and whether the paper has been peer reviewed or not. See footnote [47] in my original article[1].

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In the next copied "paper" written by Sungenis or Bouw or both (Sungenis doesn't clarify this even in his reply) there is a fundamental mistake in their conclusion at equation 12. A superfluous and incorrect Coriolis-like term appears in their expression for the force required to accelerate a star in a diurnal orbit around the Earth's polar axis. Their bungled derivation provides us with a perfect demonstration of their ineptitude.

In his reply, Sungenis argues that the term ought to be there and that I misunderstand the equation. In support of this he prattles about "absolute inertial fields" (whatever they might be – does Sungenis actually know what a field is?), an "all-pervasive Planck medium" (whatever *that* might be) and "preventing the star falling to earth's equatorial plane"[16], all of which is pure hogwash. Now, it's difficult in a situation like this to avoid the "Yes it is" - "No it isn't" mode of argument, but the fact is that I really, really do understand the vector algebra and the physics here – these calculations are very simple and the Sungenis-Bouw team sets up the physics exercise perfectly clearly.

The conceptual mistake they make is to conflate the speed of the star in the Earth frame with the velocity that is used to calculate a Coriolis force, which should be referred to the rotating frame. In the

[15] For example, in his article on the BICEP2 experiment here http://galileowaswrong.com/wp-content/uploads/2014/03/BICEP2-June-2014.pdf pages 17 to 31 are exact copies of others' work – mostly people whom he doesn't know. Fair use of quotations as part of a discussion or debate is one thing; reproducing others' work wholesale, referenced or unreferenced, is quite another.

[16] Furthermore, where does the 20 billion year rotational period for the Universe with respect to the "Firmament" that Sungenis produces like a rabbit out of a hat come from? And what is its relevance? In his reply, he has turned what he originally billed as physics into farce and fantasy.

National Weather Service derivation of the Coriolis force at the Earth's surface, the velocity $\vec{v}$ is referred to the Earth, i.e. the rotating frame, and is independent of the Earth's rotational velocity – it represents a particle (specifically in the NWS case, the wind) moving with respect to the rotating Earth frame. In Sungenis's arrangement, the Earth is static and it's the stars that are rotating about the Earth's polar axis. In order to have a non-zero Coriolis force at the star, the star must have non-zero velocity *with respect to the rotating frame*. According to their arrangement, this motion is zero and so the Coriolis force must be zero.

Since their algebra culminates in an erroneous expression, there must, therefore, be errors in the algebra – where are they? To begin with, their equation 5 doesn't follow from their equation 4 (correctly differentiating the right hand side of their equation 4 gives $= -{}^{d\boldsymbol{\omega}}/_{dt} \times \boldsymbol{R} - \boldsymbol{\omega} \times {}^{d\boldsymbol{R}}/_{dt}$, and not what they give in their equation 5. Equation 8, $\boldsymbol{a} = \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \boldsymbol{R})$, then follows directly from this since $\boldsymbol{\omega}$ is constant making ${}^{d\boldsymbol{\omega}}/_{dt}$ zero; and the second term $-\boldsymbol{\omega} \times {}^{d\boldsymbol{R}}/_{dt} = \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \boldsymbol{R})$). Their equation 5 seems to be copied from the NWS derivation and contains the confusion over which frame the star's velocity is referred to as we have already discussed above. Their equation 8 is correct (you can get there directly from the *corrected* equation 5 given above), which gives the star's acceleration as: $\boldsymbol{a} = \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \boldsymbol{R})$. Since $\boldsymbol{\omega}$ and $\boldsymbol{R}$ are orthogonal, it is obvious from this that the vector triple product will be antiparallel to $\boldsymbol{R}$; in other words orthogonal to the polar axis with *no* component parallel to it - so you'd think, if they understood what they were doing, that they would question their final expression in equations 10 and 12 which *does* have a component parallel to the polar axis. But they don't question it – in fact, Sungenis attempts to defend the indefensible. They then write down correctly, in their equation 9, the scalar product expansion of the vector triple product: $\boldsymbol{a} = \boldsymbol{\omega}(\boldsymbol{\omega} \cdot \boldsymbol{R}) - \boldsymbol{R}(\boldsymbol{\omega} \cdot \boldsymbol{\omega})$. Since $\boldsymbol{\omega}$ and $\boldsymbol{R}$ are orthogonal, the scalar product $\boldsymbol{\omega} \cdot \boldsymbol{R}$ must be zero and so the $\boldsymbol{\omega}(\boldsymbol{\omega} \cdot \boldsymbol{R})$ term should disappear leaving just the $-\boldsymbol{R}(\boldsymbol{\omega} \cdot \boldsymbol{\omega})$ term. Their equation 10 should then be $\boldsymbol{a} = -\omega^2 \boldsymbol{R}$ exactly as I pointed out in my original article. The term $D\hat{\omega}\sin(\delta)$ that appears in their equations 10 and 12 is entirely spurious[17] and no amount of babbling on Sungenis's part can justify it. This is linear algebra that bright 16 year olds can do correctly, and yet these guys, who seek to overturn all of modern physics, cannot. Their entire "paper" is a disgraceful shambles.

My original point, about the incredibly vast centripetal force that is required for stars to have daily orbits around earth's polar axis and for which there is no source, stands.

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The fourth paper copied wholesale into the article, is written, at least in part, by Dr Milenko Bernadic and is about the derivation of Sun-Earth Lagrange points. Dr Bernadic's reply to my comments prompted me to look again at his work. I think I now understand his claim better than I did when I wrote the original article and I see that it contains a fundamental misconception as well as a basic geometric mistake. It appears that he is claiming that, if the Earth-static and Sun-static systems are dynamically equivalent (which, of course, they are not), then calculating the L4 and L5 points in the Earth-static and Sun-static cases must yield the same result, so that the L4 and L5 points must lie on the intersection of the two ellipses that can be drawn to represent the orbits in the two cases: the Sun orbiting the Earth and the Earth orbiting the Sun. (He doesn't explain why this construction fails to give the positions of L1, L2 and L3 - it should if his reasoning is correct.) He calculates the angle between the lines joining the Sun to the Earth, and the Earth to the L4 point, by considering two intersecting identical ellipses, of the dimensions of the orbits, with the circumference of each one passing through the focus of the other. He gets something close to but not exactly 60°. The calculation of this angle using the correct physical considerations gives exactly 60° regardless of the

[17] Their statement: "Since the star is located at declination δ, then (ω x **R**) equals Dωsin(δ)" is gibberish. Their vector notation is screwed up and their algebra is irremediably wrong.

eccentricity of the orbit[18]. His construction only gets close to the correct angle for the Earth because the Earth's orbit has very low eccentricity (i.e. it's almost circular), and his construction happens to give 60° for a circular orbit.

And, in fact, his geometry is wrong. For the numerical example of the Sun-Earth system, he actually quotes less than 60° (59°35'1.3'' to be precise), because he makes a mistake in his equation 8 where the denominator should be $a(1-\varepsilon)$ not $a(1+\varepsilon)$. (Note that $a(1+\varepsilon)$ is the distance between centres of the ellipses; $a(1-\varepsilon)$ is the distance between their foci, which is the base of the isosceles triangle in question.) He gets near to the correct 60° because in his Earth example, ε is very nearly zero and so his mistake isn't obvious (at least to him). I am amused by the fact that he quotes his (incorrectly derived) angle to a precision of 0.1'' having made the blunder (and an approximation). The correct geometrical answer for the angle in his construction is 60.4°, but that's physically wrong as the angle defining the position of L4 and L5 derived by the correct dynamics yields 60° exactly.

There are two problems here. The more serious one is the erroneous idea that the positions of the Lagrange points can be derived by assuming that Earth orbiting Sun and vice versa are dynamically equivalent. The less serious one is the obvious geometric boo-boo; since Dr Bernadic is supposed to be a mathematics professor, we can assume that that is simple carelessness, but it does say something about how little importance the geocentrists give to getting their facts and thinking right.

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So things have not gone well for Sungenis and his friends. His attempt at a rebuttal has been an even bigger disaster than his original article. The Great Inconsistency at the heart of the geocentrists' case refused to go away. Sungenis insisted on repeating his schoolboy gaffe where he claimed that the gravitational field must be zero at the centre of mass of a set of bodies, and attempted to justify it with an irrelevant Wikipedia article. He showed his contempt for maths used in physics and for physics itself. He made it clear that he doesn't understand the Doppler effect, and how the annual Doppler modulation of celestial bodies and the daily Doppler modulation of the Pioneer spacecraft is evidence against him. He has been caught copying others' work without reference. He and his colleagues have made embarrassing mistakes in their rather elementary attempts to introduce mathematically based arguments, demonstrating an astonishing degree of incompetence for people who pretend that they can teach others and debate with professionals. He has shown that his ignorance of physics and maths is profound, and yet he claims to know better than the entire professional physics community, which is the sort of unjustified arrogance that is typical of the neo-geocentrists and their misleading rhetoric.

This is a warning to those who wonder whether the neo-geocentrists might actually have a case. It is obvious from the catalogue of errors and misrepresentations which Sungenis and the rest have made that they are not people who can be trusted by non-scientists to describe the science fairly and accurately, nor to help them understand physics and cosmology.

[18] The correct derivation is given in Neil Cornish's tutorial here: http://www.physics.montana.edu/faculty/cornish/lagrange.pdf The content in Sungenis's paper starting on page 21 "Using Kepler's Law…" all the way through to and including the colour diagram on the next page is an unacknowledged copy of Cornish's work; the text is somewhat changed but the mathematical derivation and algebraic notation is identical to Cornish's as is the colour figure and its associated, arbitrarily chosen, illustrative values. The mathematical notation changes abruptly after the figure and the work thereafter is not related to Cornish. My guess is that the (incorrect) derivation of the position of L4 and L5 is Dr Bernadic's own work, whereas the derivation preceding it has been plagiarised from Cornish by someone else.