Review of the Equivalence Principle

A review of historical experiments, originally performed to test the Equivalence Principle, to see if their results correlate more closely with the Gravity A and Gravity B hypothesis which violates the Equivalence Principle.

This presentation was originally intended to be a review of historical data pulled from research papers of experiments of various isotopes for testing the Equivalence Principle. However, multiple ai bots supplied massive amounts of disinformation and misinformation regarding past research. In addition, ZERO results were found for this type of test when using non ai searches on the internet and within multiple research paper databases, which this author finds very strange. So now this presentation has morphed into the design of a test that anyone can perform for themselves.

In-Work document

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I have dyslexia. Please ignore typos and poorly constructed sentences and instead pay attention to the concepts they are attempting to convey.

The Purpose of this Presentation

- The idea that gravity and inertia arise from two different types of interactions among all matter in the universe was first proposed by this author in the presentation Spin Wave Technology more than 20 years ago.
- In 2023, at the International Summit on Gravity, Astrophysics and Cosmology, this theory was explained in more detail in a presentation titled: An Exploitable Link between Electromagnetism and Gravity
- It had become apparent that this theory has a close correlation to what the physicist Bob Lazar had described as Gravity A and Gravity B.
- Gravity A and Gravity B have been described by Lazar in places like this YouTube video: https://youtu.be/zdUeavlbYGM?t=596.
- However, this author thinks these concepts about gravity and inertia came from classified Earthly research and not really from ETs, although it is certainly possible that ETs understand these things also and that we could have had interactions with ETs that have been kept classified.

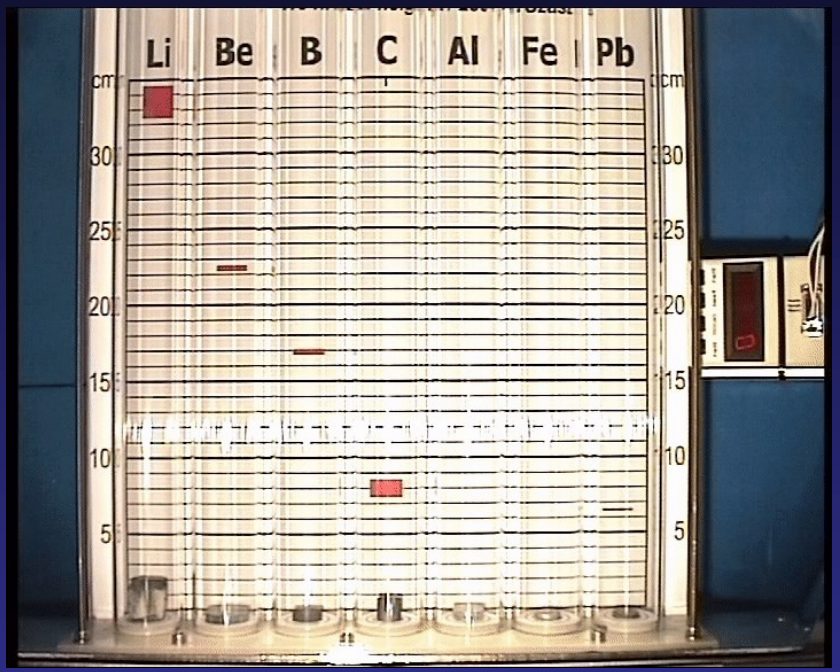
What is the Equivalence Principle?

- Ref. https://en.wikipedia.org/wiki/Equivalence_principle
- Most authorities say that if the Equivalence Principle is valid then:
  - The effects of gravity are indistinguishable from the effects of acceleration. So, an observer cannot tell the difference between being in a gravitational field or being in an accelerating reference frame.
  - The inertial mass and gravitational mass of all objects are equal, and
  - This means that all objects, in a vacuum, will fall at the same rate in a gravitational field.
- However, it has already been established that the propagation of electromagnetic energy violates the Equivalence Principle.
- Specifically, light paths deflect twice as much in a gravitational field as in an accelerating frame.
  - https://www.einstein-online.info/en/spotlight/light_deflection/
  - https://www.einstein-online.info/en/spotlight/equivalence_light/
  - https://www.newtonphysics.on.ca/einstein/chapter10.html
- To match real world measurements, explanations of this “twice” effect attribute a portion of the deflection to inertia and another portion to gravity.
- It is possible gravity and inertia arise from two different phenomena.

A Simple Free Fall Test of Elements

- This simple free fall test demonstrates violations of the Equivalence Principle: https://www.youtube.com/watch?v=jkNjvCmsWOU
- If the Gravity A and Gravity B theory is valid then Lithium and Lead might float because they have a higher ratio of neutrons to electrons.
- *Per professor Giacomo De Toma, Carbon might float more because it is more conductive and as the downward velocity increases, it is cutting through the Earth's magnetic field generating a repulsive counter EMF*, … except Beryllium is also more conductive but doesn't float.

Click image to animate



- See update on possible counter EMF on slide 25.
- This drop test was performed by the theoretical particle physicist: Dr. Gyula I. Szász. References: **Drop Experiment | ATOMSZ**
- https://www.researchgate.net/publication/370760290
- https://www.linkedin.com/in/gyula-szasz-6836b8104/
- Hi-Res images of each video frame: http://atomsz.com/wp-content/uploads/UFF-Video-tiff.zip

A Simple Free Fall Test of Elements *continued*

- Many scientists who have done research of the Equivalence Principle will be sure that this is video is not representative of reality.
- Per professor Giacomo De Toma, the release of the test chamber inadvertently gives a small upward impulse to some of the samples causing them to float and he makes a compelling argument. Ref.:
  The_Szasz%27s_Drop_Experiment_A_potential_support_for_the_Weak_Equivalence_Principle
- But after my own careful observations of the video, I don't see the samples moving as if they received such an impulse.
- Dr. Gyula I. Szász's research of this was rejected by Physical Review D.
- After my own analysis of how scientific data is made available to scientists, this author has concluded that only that data that fits in with what scientists want to believe is allowed to be published in science journals.
- Similarly, often only those scientists get funding who fall in line with expected results.
- In some cases, the problem is not just prejudices by chief editors but rather government policy to keep certain information secret for strategic advantage.
- So, the global scientific community ends up assisting in preventing real scientific breakthroughs from becoming public knowledge.

Proposed Gravity A and B, a.k.a. Inertia and Gravity

- This theory proposes that gravity and inertia are not “intrinsic” properties of matter with no processes to explain them and are not from gravitons or Higgs bosons.
- Gravity A:
  - Originates from electromagnetic interactions within and between nucleons.
  - QED says these interactions are mediated by gluons, but this theory contends gluons are just gamma ray frequency electromagnetic interactions with some of the EM energy. going to/from a universal sea of standing waves.
  - Is stronger than gravity B and is responsible for inertia.
  - Decreases in strength much more gradually with distance.
  - Diverges/converges less so it attracts less locally even though it is much stronger than gravity B.
- Gravity B:
  - Originates from EM energy exchanged from counter precessing paired orbital electrons with some EM energy going to/from a universal sea of standing waves.
  - Is weaker than gravity A and decreases more rapidly with distance.
  - Attracts more locally because it diverges/converges much more than gravity A.
  - Is the primary source of what we think of as gravity.
- On large scales, the spacetime warps from both gravity A and gravity B must be included to match cosmological data without the need for dark mass or dark energy.

Testing this Gravity A and Gravity B Theory

- This theory proposes that what people call “gravity” originates from EM energy radiated and absorbed among paired counter-precessing orbital electrons as described in detail here: An Exploitable Link between Electromagnetism and Gravity.
- The original idea was to test this theory using helium and excite one of the paired orbital electrons to a higher orbital and measure if weight (gravitational attraction) of helium atoms had changed. But this was difficult to implement.
- But if it is true that gravitational mass correlates more closely to the number of orbital electron pairs while inertial mass correlates more with the number of nucleons, then two different isotopes of the same element might be useable for a test to compare gravitational mass to inertial mass, since Isotope 1 and Isotope 2 would each have the same number of orbital electron pairs.
- For a valid test, it becomes very important to ensure that the quantity of a mass to be tested has a known and well-established amount of inertial mass before attempting to determine its gravitational mass, or vice versa.
- All experiments that use scales and balances to determine the quantity of mass to be tested in a gravitational experiment, are measuring a quantity of gravitational mass to be tested, not a quantity of inertial mass. So gravitational characteristics can end up getting tested against gravitationally equal test masses, which can force an equivalent result.

Testing this Gravity A and Gravity B Theory
continued

- Something like a torsion pendulum test must be used to test bulk inertial mass.
- References:
  - https://scienceworld.wolfram.com/physics/TorsionalPendulum.html
  - https://www.meracalculator.com/physics/classical/torsional-pendulum.php
- UPDATE: A modified wind-up anniversary clock might work as a torsion pendulum test of different isotopes and the clock's time rate changes will indicate inertial mass differences.
- If a person starts by using a weight scale or balance to measure out equal quantities of gravitational mass of two isotopes of the same element, then,
- Each can be tested in a torsion pendulum to see if they have the same pendulum rotation time, indicating they both have the same inertial mass as well.
- But if it is true that gravitational mass correlates with orbital electrons more than with the mass of the nucleus then, using 1kg each of Calcium-40 and Calcium-48 for example, which both have the same orbital electron count, then the 1kg by weight of 40Ca will not have the same inertial mass as the 1kg by weight of 48Ca.
- Their inertial mass per atom will differ by 8 neutrons, or 8/40 or 20% inertial mass difference.
- But you won't know this if all quantities to be tested are measured out by weight and then only used in a device to measure things like equivalent free fall.

Testing this Gravity A and Gravity B Theory

continued

- For use in comparison tests, here are examples of isotopes with the same orbital electrons but differing inertial mass.
- It is best to test isotopes with the same net spin but keep in mind that the spin can change based on atomic lattice bonding in bulk or in di-molecule gases.

Element	Isotope 1	Half Life	inertial mass	spin	Abundance	Isotope 2	Half Life	inertial mass	spin	Abundance	Mass Diff.
Helium	**4He**	Stable	4.002603254	0	99.9998%	**3He**	Stable	3.016029322	1/2+	0.0002%	**33.33%**
Calcium	**48Ca**	6.4×10e19 y	47.9525229	0	0.1860%	**40Ca**	Stable	39.96259087	0	96.9410%	**19.99%**
Oxygen	**18O**	Stable	17.99915961	0	0.1870%	**16O**	Stable	15.99491462	0	99.7380%	**12.53%**
Sulfur	**36S**	Stable	35.9670807	0	0.0100%	**32S**	Stable	31.97207117	0	94.9900%	**12.50%**
Selenium	**82Se**	0.97×10^20y	81.9166994	0	8.7300%	**74Se**	Stable	73.9224764	0	0.8900%	**10.81%**
Tin	**124Sn**	Stable	123.9052739	0	5.7900%	**112Sn**	Stable	111.904818	0	0.9700%	**10.72%**
Nickel	**64Ni**	Stable	63.927966	0	0.9256%	**58Ni**	Stable	57.9353429	0	68.0769%	**10.34%**
Calcium	**44Ca**	Stable	43.9554815	0	2.0860%	**40Ca**	Stable	39.96259087	0	96.9410%	**9.99%**
Xenon	**136Xe**	2.165×10e21y	135.907219	0	8.8573%	**124Xe**	1.8×10e22y	123.905893	0	0.0095%	**9.69%**
Zinc	**70Zn**	Stable	69.9253193	0	0.6100%	**64Zn**	Stable	63.9291422	0	49.1700%	**9.38%**
Molybdenum	**100Mo**	8.5×10^{18}y	99.907477	0	9.7440%	**92Mo**	Stable	91.906811	0	14.6490%	**8.71%**
Titanium	**50Ti**	Stable	49.9447912	0	5.1800%	**46Ti**	Stable	45.9526316	0	8.2500%	**8.69%**
Selenium	**80Se**	Stable	79.9165213	0	49.6100%	**74Se**	Stable	73.9224764	0	0.8900%	**8.11%**
Iron	**58Fe**	Stable	57.9332744	0	0.2820%	**54Fe**	Stable	53.939609	0	5.8450%	**7.40%**
Silicon	**30Si**	Stable	29.97377014	0	3.0920%	**28Si**	Stable	27.97692654	0	92.2230%	**7.14%**
Tellurium	**130Te**	8.2×10e20 y	129.9062244	0	34.0800%	**122Te**	Stable	121.9030439	0	2.5500%	**6.57%**

UPDATE: SEE SLIDE 11

* 3He is rare but available from the atmosphere and nuclear reactor bi-products. But it has spin ½ versus spin 0 for 4He, which can be used as an excuse for equivalence violations.

Testing this Gravity A and Gravity B Theory
continued

- References:
- https://en.wikipedia.org/wiki/Table_of_nuclides
- https://www.nndc.bnl.gov/nudat3/
- https://en.wikipedia.org/wiki/Melting_points_of_the_elements
- Where to get isotopes:
- https://www.buyisotope.com/
- https://www.isoflex.com/
- https://www.indiamart.com
- https://www.americanelements.com/
- https://www.isotope.com/
- TIN-112 METAL (112Sn) - Cambridge Isotope Laboratories - SNLM-3984-PK 112Sn only
- Quote Request | AMERICAN ELEMENTS ® 112Sn only
- https://www.isoflex.com/tin-sn has both 112Sn and 124Sn
- https://www.isotope-amt.com/isotope/nickel-ni/
- Stable Isotopes at Rs 5100/milligram | ISOTOPES in Mumbai | ID: 16165070055 (indiamart.com)
- Vijay Commercial House - Importer of Metal Powder & Rare Earth Metals & Oxides from Mumbai (rare-earths-elements.com)
- Stable Isotopes - PDF Catalogue (indiamart.com)

Testing this Gravity A and Gravity B Theory
continued

- After a little investigation, it seems that isotope prices are VERY high, and,
- It might not be necessary to use 2 isotopes of the same element.
- If the theory to be tested is correct, that a big part of gravitational attraction comes from energy exchange among all orbital electrons of all atoms, then;
- The thing that should matter the most for having higher inertial mass than gravitational mass is the ratio of the nucleons in the nucleus versus the number of orbital electrons.
- In the spreadsheet below, if equal gravitational masses are used from an isotope with a low ratio and an isotope with a high ratio, then;
- Between the two, the isotope with a higher ratio of nucleons to electrons (Bismuth-209) should have a higher inertial mass compared to an isotope like Carbon-12 graphite with a lower ratio of nucleons to electrons.
- *I'm feeling a little silly right now because surely this has all been tested already, but since I can't find the historical data, I must try it for myself just to see.*

Element	Isotope 1	Half Life	Inertial mass	spin	Abundance	Nucleons to Electrons Ratio	Element	Isotope 2	Half Life	Inertial mass	spin	Abundance	Nucleons to Electrons Ratio
Bismuth	**209Bi**	2.01x10e19y	208.98	9/2-	100.0%	2.518	**Calcium**	**40Ca**	Stable	39.963	0	96.9%	2.000
Bismuth	**209Bi**	2.01x10e19y	208.98	9/2-	100.0%	2.518	**Sulfur**	**32S**	Stable	31.972	0	95.0%	2.000
Bismuth	**209Bi**	2.01x10e19y	208.98	9/2-	100.0%	2.518	**Magnesium**	**24Mg**	Stable	23.985	0	78.9%	2.000
Bismuth	**209Bi**	2.01x10e19y	208.98	9/2-	100.0%	2.518	**Carbon**	**C12**	Stable	12.0107	0	98.8%	2.000

Testing this Gravity A and Gravity B Theory
continued

- So, per this theory of gravity and inertia, a modified anniversary clock with either x grams of 209Bi or x grams of 12C graphite, substituted for the typical 4 mass balls, should run at slightly different speeds even though "x" is exactly the same measured gravitational mass weight of either isotope and has been installed exactly the same way in the clock.

- Note: Bismuth-209 has a spin of 9/2, however in a bulk mass rather than individual atoms, this should not have much effect on the measurements.
- The weight scale measurements and inertial acceleration measurements should not experience the same effect of the spin value as may occur during tests of free-falling individual atoms.
- In any case, Lead-208 with spin of 0 could be used if its price is reasonable for the 99% pure isotope.

Element	Isotope 1	Half Life	Inertial mass	spin	Abundance	Nucleons to Electrons Ratio	Element	Isotope 2	Half Life	Inertial mass	spin	Abundance	Nucleons to Electrons Ratio
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Testing this Gravity A and Gravity B Theory
continued

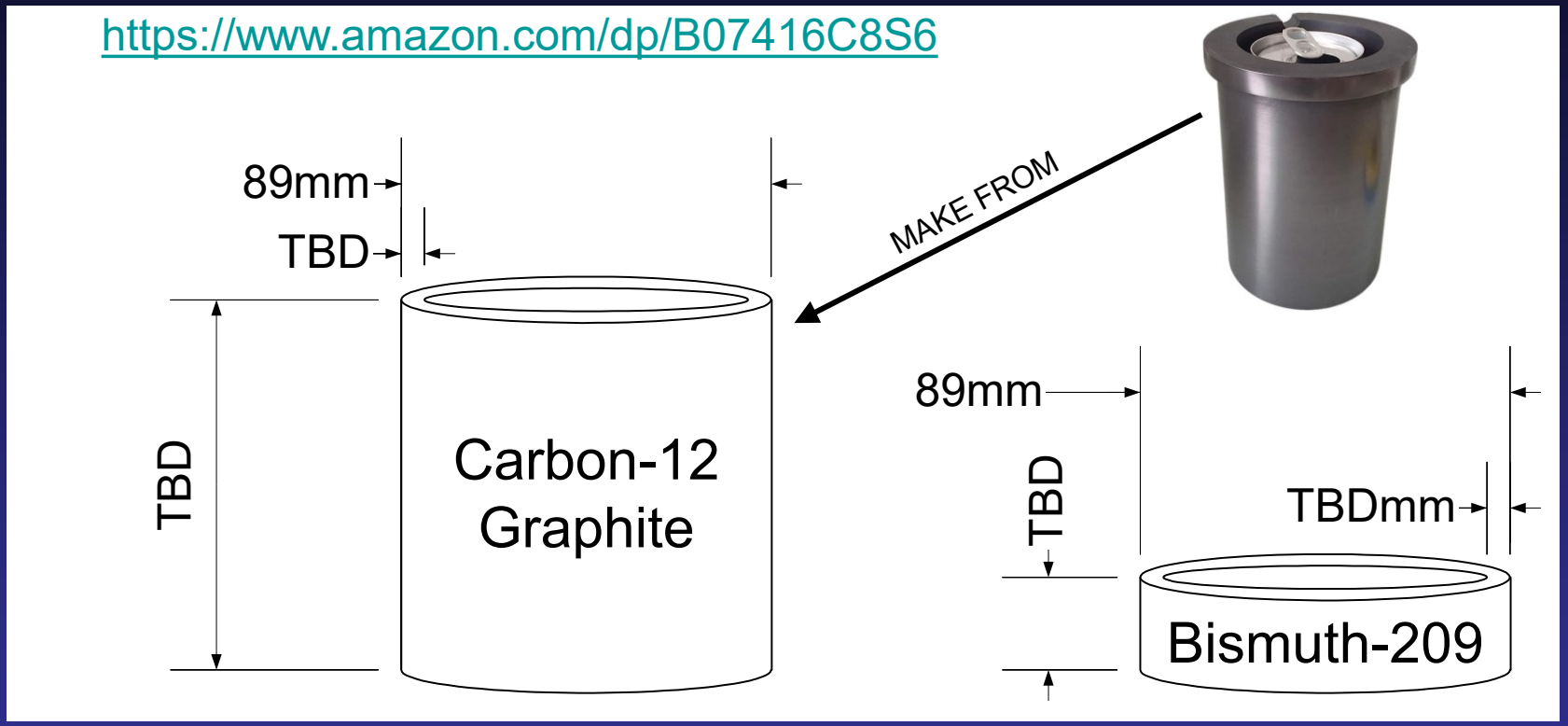
- So far, I can't find a graph of isotopes by mass number (number of protons and neutrons) versus their solid density.
- The below link is a list by atomic number (# protons) of elements, not all isotopes.
- Since they are listed by number of protons, the isotope 12C Carbon is listed as 6.
- https://en.wikipedia.org/wiki/Densities_of_the_elements_(data_page)#Density,_solid_phase
- 12C Graphite: 2.267 g/cm3, 209Bi Bismuth: 9.78 g/cm3, 208Pb Lead: 11.34 g/cm3
- Bismuth machineability: hard, brittle, expands and crystalizes when cooled.
  - Use sharp tools.
  - Use low cutting speeds.
  - Low melting point, use a coolant to help prevent the tool from overheating.
  - Machine in short, overlapping passes.
  - Finish the part with a polishing or sanding operation.
  - https://www.robotroom.com/Bismuth-Casting-and-Machining-1.html
  - https://www.rotometals.com/bismuth-ingot-chunk-99-99-pure-1-pound/
- Lead machineability: soft, ductile, contracts slightly when cooled.
  - Use sharp tools.
  - Use low cutting speeds.
  - Low melting point, use a coolant to help prevent the tool from overheating.
  - Machine in short, overlapping passes.
  - Finish the part with a polishing or sanding operation.

Testing this Gravity A and Gravity B Theory
continued

- The sequence of thought processes.
  1. When trying to create the previous slide, I thought I remembered seeing, the week before, density data and a graph of changes as the mass increases.
  2. This week, when I tried to find the same website with that data, I could not. But I did find websites with data and similar graphs based on atomic weight versus density, but not mass number versus density.
  3. Maybe that was what I saw last week. But this still got me thinking, why aren't there any data or graphs of isotope mass number versus density anywhere?
  4. Surely this would be exactly the type of data that NIST would research and provide official details for.
  5. So then, I started thinking, is this data missing from the internet because of some vital conclusions could be drawn from the data?
  6. Without much thought, it is easy to assume that only atomic mass is tracked because the orbital electron configuration will be the same for all isotopes of each element and it would be the orbital electrons that set the atom's spacing and so their bulk density.
  7. But, if the Equivalence Principle is valid, isotopes having a different number of neutrons, should have different weights for the same element volume.
  8. If the measured weight differences do not match expectations from different numbers of neutrons, this would be a violation of the Equivalence Principle.
  9. Is it just bad luck or is this data being withheld for strategic reasons?

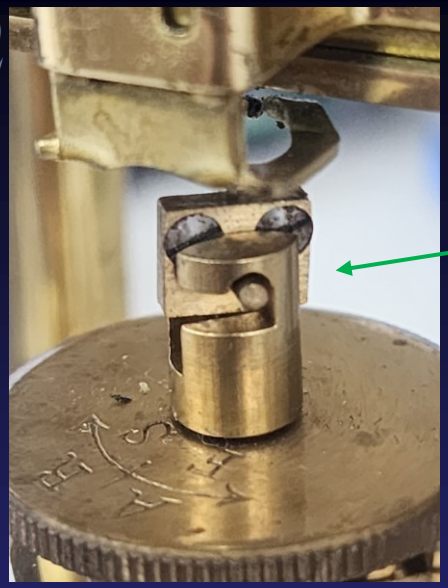
Testing this Gravity A and Gravity B Theory
continued

- Make from 99.9% pure graphite.
- Make from a flat-wall graphite crucible or make from a graphite cylinder.
- https://www.amazon.com/dp/B07416C8S6



- Make mold from graphite cylinder to make Bismuth cylinder and then machine to desired height, else, make carbon fiber sheath and fill with Bismuth granules.
- Make carbon fiber sheath of equal size and weight for graphite cylinder to keep all things equal. NOTE: A CYLINDRICAL TEST MASS HAS VERY LOW AIR DRAG.
- REF.: https://www.vasantcorporation.com/downloads/MASS-TEST-CYLINDERS-AND-SUPPORTS-REV.E.pdf
- This part might work also: ebay Chesterton 12811 Carbon Split Sleeve Bushing

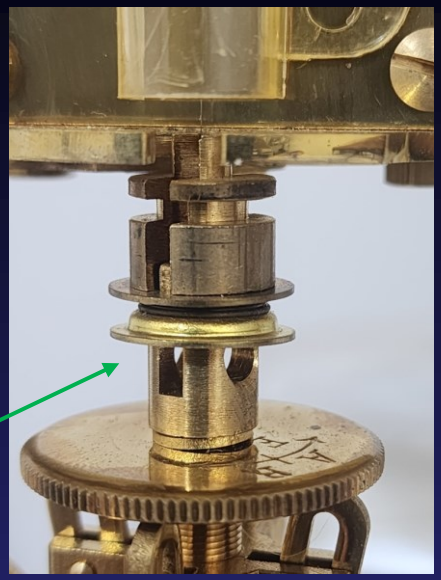
Testing this Gravity A and Gravity B Theory *continued*



Get a clock with an easy pendulum hanger.

This pendulum hanger allows easy swap of pendulum mass.

This pendulum hanger is hard to swap the pendulum mass.



- If you want to use an anniversary clock to test inertial mass differences, don't buy them off ebay.com. This appears to be where antique clock people dump their trash.
- Buy an anniversary clock that has been professionally restored from a clock shop.
- If you decide to make a larger test setup, don't use an expensive roll of tempered spring steel like this for your torsion spring unless you have a big budget: https://www.amazon.com/gp/product/B0C4ZJQ618/
- A micro bandsaw blade can work: https://www.amazon.com/gp/product/B0017NQIJ6
- Straight pieces of tempered spring steel might be available at a local metal scrap yard but be aware, used pallet wrap metal straps might not flex as far and still spring back as well. If you want to rotate full circle you may need genuine spring steel, not pallet wrap steel. For only 180 degrees rotation, a 3 - 4 foot piece of pallet strap might work.

1 Hour Inertial Mass Difference Test

UPDATE: Re-typed this whole page because I had data calculated wrong. After using Excel to assist and verify calculations, now the results are even worse! I hate dyslexia.

- Using two test masses, each 246.5grams, each with the same inner and outer diameters, each with same size, shape and weight of support plastic (6.7grams).
- Neither test mass is designed for correct time.
- After 1 hour with Carbon-12, the clock runs 4.5 minutes slower than my phone,
- After 1.333 hours with Bismuth-209, the clock runs 4 minutes per hour slower than my phone.
- So 4.5 - 4 = 0.5 minutes difference error.
- To get the percent difference error, I need to know the “theoretical” expected value. See the next 2 slides about this.
- Neither mass is measuring true minutes or true seconds so this is 0.5 “counts” difference versus 55.5 average “counts”, or .5/55.5 = 0.9% difference.
- So Carbon-12 appears to have more inertial mass that Bismuth-209, opposite expected!!!
- Either I’m bad at measuring and bad at math or this theory is wrong. More tests are needed.

SEE SLIDE 21

Bismuth-209 under test

Calculating Percent Error

- The equations for Error and Percent Error should be:

  Error = |Measured-Theoretical|/Theoretical and Percent Error = (Error * 100)%

- To know the expected Theoretical value, we need to use the equation:

  f = measured swing frequency = $1 / (2\pi\sqrt{(k / I)})$, where:

  - k = torsion constant = (π/2) * (G * R^4) / (L), where:
    - G is the shear modulus of elasticity of the material *(see next slide)*
    - R is the radius of the rod or wire, and L is its length
  - I = moment if inertia = mR^2, where:
    - m is the mass of the pendulum
    - R is distance from point of suspension to the center of mass of the pendulum

- Regarding mass “m”, since inertial mass is what we are trying to determine, we could start with the currently accepted assumption that it is equivalent to gravitational mass.
- So we can measure the gravitational mass with a scale, but then the mass support plastic has its own mass, and its center of mass is at a different radius.
- But, since I still don’t know G, the shear modulus of elasticity of the torsion spring, it must the calculated. See the next slide.

Regarding the torsional shear modulus of elasticity

- Per ai, the formula for torsional shear modulus (G) is given by:

  $G = (16 * L * T) / (\pi * d^3)$, where:
  - G is the torsional shear modulus of elasticity,
  - L is the length of the spring steel,
  - T is the applied torque,
  - π is a mathematical constant approximately equal to 3.14159,
  - d is the diameter of the spring steel.
- However, our torsion spring has a width and thickness instead of the diameter.
- We need to convert these dimensions into an equivalent diameter.
- For a rectangular cross-section, we can use an equivalent diameter (d_eq) based on the area (A) of the cross-section, where:
  - A = W * t (Area = Width * thickness)
  - $d_{eq} = \sqrt{(4 * A / \pi)}$
- Once we have obtained d_eq, we can substitute it into the formula for G:
  - $G = (16 * L * T) / (\pi * d_{eq}^3)$
- We can use measured values for L, W, t, and T.
- But the above formula is missing any consideration of what type or exact carbon content or quality of spring steel we are using or how it was annealed or quenched.
- The torsional shear modulus of elasticity can vary depending on factors such as temperature, strain rate, and microstructural properties of the material.
- So, on slide 15, it is easier to use the average of the 2 measured “counts”.

Inertial Mass Difference Test

- When considering the difference in the ratio of orbital electrons to nucleons for 12C versus 209Bi, as shown in the chart on slide 10, the ratio is 2 versus 2.518 and this is a difference of (2.518-2)/((2.518+2)/2) = .2293 or about 23%.
- Even before I finished a longer time test, I realized it was wrong of me to be thinking that Gravity A would be responsible for all inertial resistance to change in acceleration, just as Gravity B is not responsible for all local gravity.
- Both Gravity A and Gravity B contribute to local gravity, its just that Gravity B might contribute more.
- Similarly, Gravity A may contribute more inertial resistance to change in acceleration, but Gravity B may contribute a lot of this locally as well.
- But still, it seems like, for the Gravity A and Gravity B theory to be more likely to be correct, the difference between measured gravitational mass and measured inertial mass should have been more that just .9% for 2 isotopes when there is a big difference in the ratio of orbital electrons versus nucleons.
- 23% is a lot larger difference than the measured .9%, and,
- Bismuth-209 was expected to have the higher inertial mass but Carbon-12 was measured to have more!
- This presentation has turned into an ugly mess that currently does not validate the Gravity A and Gravity B theory.

24 Hour Inertial Mass Difference Test

- Forget all the data and thoughts on slide 15.
- The torsion pendulum clock rate was not constant the first hour after swapping the test isotope cylindrical mass of the torsion pendulum.
- The instability in the rate seemed to occur only when I forcefully rotated the clock hands clockwise to sync the clock with my cell phone time.
- I tried it all again and just left the clock out of sync because all I needed to do was take readings of how the clock time changes at a specific point in phone time.
- I never really needed them to start synchronized.
- When not forcing the clock hands, the clock ran at a steady rate.
- Then, when testing with both Carbon-12 and Bismuth-209, it turns out, they are within **0.149%** of each other over a 24 hour period.
- So then the BIG question is: If there really is a gravity A and a gravity B, how can gravitational mass and inertial mass measure as equivalent to within **0.149%?**
- If gravity B comes from electromagnetic energy exchange among orbital electrons and inertia (gravity A) comes from electromagnetic energy exchange among quarks, what interaction between electrons and quarks causes a tendency for gravity A and B to equalize regardless of how many extra neutrons are in the nucleus?

After another 24 Hours Inertial Mass Difference Test

- After more testing with both Carbon-12 and Bismuth-209, it turns out, they are within **0.119%** of each other. Ref. collected data: https://www.vasantcorporation.com/downloads/torsion-pendulum-clock-log.xlsx
- So, then the **same** BIG question is: If there really is a gravity A and a gravity B, how can gravitational mass and inertial mass measure as equivalent to within **0.119%?**
- If gravity B comes from electromagnetic energy exchange among orbital electrons and inertia (gravity A) comes from electromagnetic energy exchange among quarks, what interaction between electrons and quarks causes a tendency for gravity A and B to equalize regardless of how many extra neutrons are in the nucleus?
- Ref. slides 103 and 109 of this file: https://www.vasantcorporation.com/downloads/delayed-lenzs-law-04-27-2014.pdf
- What if gravitational mass and inertial mass tend to stay proportional because of a continuous electromagnetic interaction and exchange of energy between orbital electron motions and quark motions?
- What if the orbital electrons' nutation frequencies match the quarks precession frequencies and there is continuous exchange between them keeping them proportional?
- How do extra neutrons in an isotope fit in with this idea? The neutrons of the nucleus would be in shells, in neutron orbitals per data from nucleon testing.

After another 24 Hour Inertial Mass Difference Test

- After another 24 hour test with both Carbon-12 and Bismuth-209, they are within **0.148%** of each other for this last 24 hour test run of each. But Carbon-12 is slower than Bismuth-209 which goes against expectations.
- Switching to “Isotope 3” which is heavier but has the same I.D. and O.D. and same support structure weight of 6.7grams, with the new total weight of 261.71grams, using a new scale that reads .01grams rather than original scale that only read 0.1grams.
- Including similar support structure weight, isotope 3 is about 3.36% heavier than isotope 1 or isotope 2.
- Using isotope 3, TP clock runs about 5 min. 15sec. slower than phone time versus 4min. 7sec. Slower with the previous Bismuth-209 test mass.
- TP clock runs 1.8% slower with a test mass that is 3.36% heavier.
- Using isotope 4 (heavier carbon graphite), TP clock runs about 6 min. 38sec. slower than phone time.
- Isotope 4 weighs 278.98grams including the 6.7g support plastic.
- The original carbon graphite test mass weighs 253.34 grams with support plastic.
- Isotope 4 is 25.64 grams heavier than the original carbon graphite test mass
- TP clock runs 4.3% slower with a test mass 9.73% heavier.
- I’m not sure I calculated all percentages correctly.
- Ref. collected data: https://www.vasantcorporation.com/downloads/torsion-pendulum-clock-log.xlsx

Regarding Testing with Isotope 4

- There were differences in how the testing was done with the original carbon graphite test mass of 253.34 grams with support plastic versus isotope 4 of 278.98 grams.
- Specifically, the original carbon graphite test mass' weight measurement was taken and posted before the test.
- With isotope 4, its mass was not measured or disclosed until after its testing.
- If someone unseen had very high technology methods to manipulate the testing as it progressed, it would be easier to know how much to manipulate during testing of the original carbon graphite test mass of 253.34 grams with support plastic so as to cause an "equivalent" result.
- Having said all that, the chances of such high technology manipulation do seem very low but still remotely possible.

Testing Isotope 4 (heaveier carbon graphite) with a strong magnet

- Referring to slide 4, the Carbon graphite in Dr. Gyula I. Szász's fall test could not float due to a counter EMF because the orientation of the Earth's magnetic field and the carbon graphite's direction of fall would have created charge displacement but there was no place for a complete current path to create a counter EMF.
- So the fall test shows that the carbon graphite really is violating the Equivalence Principle similar to the Lithium and the Lead.
- I performed a similar counter EMF test with a strong magnet a few millimeters under the isotope 4 carbon graphite cylinder and after 24 hours+ testing, it is not running slower from any kind of counter EMF because it also moves through the strong magnetic field in a direction that creates a charge displacement, but it doesn't provide a complete current path to create a counter EMF that could slow down its motion.
- Regarding my own torsion pendulum clock testing with carbon and bismuth, although this testing has yet to find significant violations of the Equivalence Principle, Dr. Gyula I. Szász fall test of slide 4 has found violations.
- I need to test the torsion pendulum clock with a greater variety of elements, starting with some others that Dr. Gyula I. Szász used in his fall test.
- Regarding slide 17 here: https://www.vasantcorporation.com/downloads/link-between-electromagnetism-and-gravity.pdf , if gravitational attraction occurs at different frequencies associated with different orbitals' standing waves, then maybe Carbon floats due to less attractive strength at Carbon's set of frequencies, except, maybe it has different inertial frequencies also, so I'm not sure if it would make a difference.

Regarding the **Inertial** mass of Helium-3 and Helium-4

- Doyle, J.M., van Leeuwen, K.A.H., Prestage, J.D., & Hinds, E.A.
- Hall, D.S., Matthews, M.R., Wieman, C.E., & Cornell, E.A.
- de Laeter, J.R., Mulliss, M.J., & Thomas, I.L.
- Crespo López-Urrutia, J. R.
- Gilowski, M., Deissler, B., Doyle, J. M., & Hinds, E. A.
- Kramida, A. E., Wang, M., & Sonnad, V.
- R. D. Newman and J. H. Reynolds
- J. H. Reynolds and R. D. Newman
- Braginsky, V.B., Panov, V.I., Rudenko, V.N., & Sokolovskiy, M.L.
- *Scherm, R., Bailey, J., & Newman, R.*
- H. Meyer
- Peters, A., Ring, J., & Chu, S.
- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Regarding the **Gravitational** mass of Helium-3 and Helium-4
continued

- S. Kopeikin
- Adelberger, E. G., Heckel, B. R., Hoedl, S
- Schlamminger, S., Shirman, J., Hazbun, E., & Gundlach, J. H
- M. Leduc
- R. J. Gooding
- J. Annand
- J.P. Karr
- S.R. Walt
- A.P. French
- G.E. Chamberlin
- F. Combley
- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Regarding the **Gravitational** mass of Helium-3 and Helium-4
continued

- Lamoreaux, S. K., Torgerson, J. R., & Stoner, R. E.
- Michael J. Drinkwater ???
- Schlamminger, S., Hui, L., Gundlach, J. H., & Adelberger, E. G.
- Fischbach, E., D. E. Krause, C. Talmadge, and D. Tadic
- Wagner, T., Müller, H., Hees, A.

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

- *Over the years, some of the discrepancies between the gravitational and inertial masses of 3He and 4He have been explained as caused by the Schiff Effect. See next slide.*

Regarding the **Gravitational** mass of Helium-3 and Helium-4
continued

- The Schiff effect is a quantum mechanical effect that predicts a small difference in the gravitational mass of particles with different spins. For 4He bosons, which have a spin of 0, the Schiff effect is zero. This is because the spin of a particle does not interact with the gravitational field if the particle has a spin of 0.
- For 3He fermions, which have a spin of 1/2, the Schiff effect is not zero. The Schiff effect for 3He fermions is a small negative number, which means that the gravitational mass of 3He fermions is slightly less than their inertial mass. The magnitude of the Schiff effect for 3He fermions is estimated to be about 3.6 × 10^-131.
- The Schiff effect is a very small effect, and it is only measurable with very sensitive instruments. However, the Schiff effect is important because it could provide evidence for new physics beyond the Standard Model. If the Schiff effect is observed to be larger than predicted by the Standard Model, it could be evidence for the existence of new particles or forces.
- The Schiff effect is so small, it is not reasonable that anyone would even try to use it as the reason why there is a 30% error in the measured gravitational mass of 3He versus 4He compared to what the Equivalence Principle says the masses should be.
- A good way to show these researchers are wrong is to investigate the mass differences between same element isotopes that are both spin ½ or both a whole integer spin value.

Testing Gravitational mass with Lithium isotopes

- From: https://www.studysmarter.us/textbooks/physics/modern-physics-2nd-edition/spin-and-atomic-physics/
- In a neutral atom, the number of electrons and number of protons are equal (and the sum of the number of electrons and protons is an even number). As these two particles have odd half-integer spin the total even number of particles results in a zero or whole integer spin. Hence, the behavior of a neutral atom completely depends on the number of neutrons, whether the neutrons are in odd number or even number.
- If the neutrons are an odd number, the atom will have a net half-integer spin and will behave as a Fermion. Odd number of neutrons = Fermion behavior.
- If the neutrons are an even number, the atom will have a net integer spin and behaves as a Boson. Even number of neutrons = Boson behavior. **EXCEPT!,**
- Lithium-6 has 3 neutrons **BUT** is a boson and has a spin of 1, *but is this only when there is sharing/pairing of valence electrons with other lithium-6 atoms, even in gaseous form?*
- Lithium-7 has 4 neutrons **BUT** is a fermion with spin 3/2, *but is this only when there is sharing/pairing of valence electrons with other lithium-7 atoms, even in gaseous form?*
- Reference data: https://en.wikipedia.org/wiki/Isotopes_of_lithium

Testing Gravitational mass of Beryllium-7 and Nitrogen-14

- Bahcall, J. N., Shih, C. I., & Wolf, R. A.
- M. Eötvös, G. G. Bélafi-Kovács, and H. J. Paik
- Schlamminger, S., Choi, K.-Y., Adelberger, E. G., Gundlach, J. H., & Swanson, H. E
- Hellings, R. W., Schlamminger, S., Adelberger, E. G., & Gundlach, J. H.
- Hees, A., A. Yu. Voronin, G. Pignol, D. Jullien, P. Wolf, S. Bize, and A. Landragin.

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Testing Gravitational mass with Lithium isotopes

- Annand, J. R. M., Brown, B. A., Green, K., Hinds, E. A., Ivanov, A. A., Murphy, G., ... Zhang, Y. (2011).
- Hoekstra, S., Dressler, R., Ivanov, A. A., Murphy, G., Zhang, Y., Green, K., ... Hinds, E. A. (2013).
- Kostelecky, A., Russell, N., Tasson, J. D., Li, J., Mckenzie, K., Wang, C.,. Young, B. A.
- J. R. M. Annand
- 2013 by S. Hoekstra
- 2020 by A. Kostelecký

- Some research papers concluded the equivalence violations they found were significant because of the sigma level of the test even though the violations were small.
- But the data has been removed from this presentation because multiple ai bots provided this data with fake publications and titles and/or other disinformation and misinformation mixed in.
- So far, I can only determine that equivalence testing of isotopes has been done in the past but relevant research papers are either filtered out by search engines or mixed with disinformation and misinformation by ai.

Statistical chance of Gravitational Mass Anomalies

- In the context of gravitational anomalies, the terms "4 sigma level" or "5 sigma level" refer to the statistical significance of the anomalies. A sigma level is a measure of how likely it is that a particular result is due to chance. The higher the sigma level, the less likely it is that the result is due to chance.
- Reference: Sigma Level Conversion Table

Sigma Level Conversion Table

Yield	DPMO	Sigma	Yield	DPMO	Sigma	Yield	DPMO	Sigma
6.6%	**934,000**	**0**	**69.2%**	**308,000**	**2**	**99.4%**	**6,210**	**4**
8.0%	920,000	0.1	72.6%	274,000	2.1	99.5%	4,660	4.1
10.0%	900,000	0.2	75.8%	242,000	2.2	99.7%	3,460	4.2
12.0%	880,000	0.3	78.8%	212,000	2.3	99.75%	2,550	4.3
14.0%	860,000	0.4	81.6%	184,000	2.4	99.81%	1,860	4.4
16.0%	840,000	0.5	84.2%	158,000	2.5	99.87%	1,350	4.5
19.0%	810,000	0.6	86.5%	135,000	2.6	99.90%	960	4.6
22.0%	780,000	0.7	88.5%	115,000	2.7	99.93%	680	4.7
25.0%	750,000	0.8	90.3%	96,800	2.8	99.95%	480	4.8
28.0%	720,000	0.9	91.9%	80,800	2.9	99.97%	330	4.9
31.0%	**690,000**	**1**	**93.3%**	**66,800**	**3**	**99.977%**	**230**	**5**
35.0%	650,000	1.1	94.5%	54,800	3.1	99.985%	150	5.1
39.0%	610,000	1.2	95.5%	44,600	3.2	99.990%	100	5.2
43.0%	570,000	1.3	96.4%	35,900	3.3	99.993%	70	5.3
46.0%	540,000	1.4	97.1%	28,700	3.4	99.996%	40	5.4
50.0%	500,000	1.5	97.7%	22,700	3.5	99.997%	30	5.5
54.0%	460,000	1.6	98.2%	17,800	3.6	99.9980%	20	5.6
58.0%	420,000	1.7	98.6%	13,900	3.7	99.9990%	10	5.7
61.8%	382,000	1.8	98.9%	10,700	3.8	99.9992%	8	5.8
65.6%	344,000	1.9	99.2%	8,190	3.9	99.9995%	5	5.9
						99.99966%	**3.4**	**6**

Testing Gravitational mass of 129Xe

- https://pburnley.faculty.unlv.edu/GEOL452_652/gravity/notes/GravityNotes31PointMassGravity.htm
- https://arxiv.org/pdf/1602.08516v2.pdf

Testing Gravitational mass of other isotopes *continued*

- Mueller, H., P. A. Vetter, A. M. Bernstein, and J. R. Myatt

- Lee, D., M. A. Hohensee, B. R. Heckel, and E. G. Adelberger. "A Search for Gravitational Anomalies in 115In Using a Cryogenic Torsion Balance." Physical Review Letters 110, no. 20 (2013): 201101. https://www.annualreviews.org/doi/pdf/10.1146/annurev.nucl.53.041002.110503
- Hjorth-Jensen, J., S. J. Pollock, A. P. Mills, Jr., D. J. Wilson, and M. A. Hohensee. "Search for Gravitational Anomalies in 133Cs Using a Cryogenic Torsion Balance." Physical Review Letters 115, no. 18 (2015): 181101
- https://duckduckgo.com/?q=Search+for+Gravitational+Anomalies+in+133Cs+Using+a+Cryogenic+Torsion+Balance&ia=web

- Gundlach, J. H., and S. M. Merkowitz
- Geraci, A. A., S. B. Cahn, S. A. Meeker, and H. M. Wiseman

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Researchers of gravitational anomalies in elemental isotopes:

- Peter Mueller, Department of Physics, University of Washington, Seattle, WA 98195, USA https://phys.washington.edu/people/peter-mueller
- https://www.lanl.gov/org/ddste/aldsc/theoretical/index.php
- Michael J. Ramsey-Musolf, Department of Physics, University of Massachusetts, Amherst, MA 01003, USA https://www.umass.edu/physics/people/michael-ramsey-musolf
- https://physics.berkeley.edu/research-faculty/lecturers
- https://phas.ubc.ca/researchers
- https://www.uvic.ca/science/physics/people/people/faculty/index.php
- Franz Wilczek, Center for Theoretical Physics, Massachusetts Institute of Technology, Cambridge, MA 02139, USA (617) 253-0284 wilczek@mit.edu

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Researchers of gravitational anomalies in elemental isotopes:
continued

- Stephen Hsu
- Jonathan Feng

- Dr. Ephraim Fischbach
- Dr. Jens Ziegler
- Dr. Peter Wolf

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Researchers of gravitational anomalies in elemental isotopes:
continued

- Amit Bhowmik
- Emily Kilpatrick
- Ryan Plestid

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Testing Gravitational mass of other isotopes *continued*

- Crill, B. D., S. A. Meeker, J. M. Brown, A. A. Geraci, E. G. Adelberger, and H. M. Wiseman
- Gundlach, J. H., and S. M. Merkowitz
- Geraci, A. A., S. B. Cahn, S. A. Meeker, and H. M. Wiseman
- Mewes, M., M. A. Hohensee, D. J. Wilson, D. Budker, J. J. Bollinger, and A. P. Mills Jr.
- Crill, B. D., S. A. Meeker, J. M. Brown, A. A. Geraci, E. G. Adelberger, and H. M. Wiseman.
- Schlamminger, S., K.-Y. Choi, T. A. Wagner, J. H. Gundlach, and E. G. Adelberger
- Long, J. C., A. B. Churnside, E. A. Donley, M. S. Fee, W. M. Snow, and J. E. Sadeghpour

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Regarding testing the gravity theory

- With isotopes of helium, the differences in gravitational mass of one isotope versus the gravitational mass of the other are small when they should not have been small. Their differences in inertial mass are larger and this violates the Equivalence Principle.
- The very small Schiff Effect does NOT explain these differences between gravitational mass and inertial mass.
- Regarding explanations that depend on differences in nuclear binding energy, shouldn't this affect both inertial and gravitational mass, not just one but not the other?
- In any case, according to unreliable sources, the mass equivalent of the difference in binding energy between 4He and 3He is about 0.0286 u.
- The difference in inertial mass between 4He and 3He is about 0.977935 u
- The percent difference in inertial mass between 4He and 3He is 30.27%
- The percent difference in mass equivalent of binding energy between 4He and 3He is 0.0286 u or about 2.92%
- The Equivalence Principle remains violated, and the reason gravitational mass can be almost the same between 4He and 3He is not explained.
- But it makes sense if gravitational mass correlates with the orbital electrons.

Equivalence Principle is violated by the Propagation of Electromagnetic Energy

- There are research papers that discuss how light paths bend twice as much in a gravitation field as in an accelerating frame and how it exposes a violation of the equivalence principle.
- This relates to the phenomenon of gravitational lensing, which occurs when light from a distant source is bent by the gravitational field of a massive object, such as a galaxy or a black hole. According to Einstein's theory of general relativity, the curvature of spacetime caused by the massive object is responsible for the bending of light.
- However, the equivalence principle states that the effects of gravity are indistinguishable from those of acceleration. This means that an observer in an accelerating frame should see the same amount of bending as an observer in a gravitational field. If this were not the case, it would imply a violation of the equivalence principle.
- Several research papers have investigated this issue and have shown that the statement is indeed true. For example, in a 2006 paper published in Physical Review D, researchers analyzed the bending of light in both gravitational and accelerating frames and found that the amount of bending was twice as much in the former case.
- Similarly, a 2010 paper published in Classical and Quantum Gravity examined the equivalence principle in the context of gravitational lensing and concluded that violations of the principle could be detected through precise measurements of lensing effects.
- Overall, these studies provide strong evidence that photon paths do indeed bend twice as much in a gravitational field as in an accelerating frame, which suggests a violation of the equivalence principle.

Regarding hydrogen and the gravity theory

- Isolated hydrogen atoms don't have a counter precessing pair of electrons. However,
- Most hydrogen atoms would be joined in pairs and then the shared 2 electrons might still precess and counter precess in sync with a universal sea of standing waves created by all counter precessing orbital electron pairs.
- But before isolated hydrogen atoms are joined, only the gravity A force and the Van der Waals force would attract them to each other.

Dr. Mike McCullough about Quantum inertia

- Mike McCullough's ideas about Quantum inertia suggest that the equivalent principle is not correct. According to McCullough, the concept of quantum inertia can explain the behavior of objects in space without the need for dark matter. The equivalent principle, on the other hand, is a fundamental principle of physics that states that the force of gravity is equivalent to an acceleration.
- McCullough's theory proposes that quantum mechanics plays a role in the behavior of objects in space. He suggests that particles in space experience a resistance to acceleration due to their interaction with virtual particles in the vacuum of space. This resistance, according to McCullough, is what we observe as the effects of dark matter.
- If McCullough's theory is correct, it would mean that the equivalent principle is not entirely accurate. The equivalent principle assumes that all objects experience the same gravitational force regardless of their mass or composition. However, if quantum mechanics plays a role in the behavior of objects in space, then this assumption may not be entirely true.
- It is important to note that McCullough's theory is still a topic of debate among physicists and has not been widely accepted by the scientific community. However, his ideas have sparked new discussions and research into the nature of dark matter and the behavior of objects in space.

Dr. Mike McCullough about Quantum inertia *continued*

- My thinking is somewhat similar to Dr. Mike McCullough's except what he attributes to virtual particles, I am attributing to a very real universal sea of electromagnetic standing waves among all particles in the universe.
- If we start with the assumption that the laws of classical electrodynamics continue to work at the smallest scales, then particles must be radiating, absorbing and exchanging electromagnetic with each other through a sea of standing waves that they all maintain by their radiated electromagnetic energy from their motions.
- In chemistry, many different behaviors of orbital electrons within molecules suggest that classical electrodynamics is still very much at work and even characteristics often described as quantum in nature can in fact be described in classical ways if assuming there is a universal sea of electromagnetic standing waves that all particles are interacting with as well.

Regarding testing the gravity theory *continued*

- Google Scholar
- BASE Search
- arXiv.org
- https://inspirehep.net/
- https://www.researchgate.net
- https://scielo.org/
- https://citeseerx.ist.psu.edu/
- https://worldwide.espacenet.com/?locale=en_EP
- https://www.semanticscholar.org/

- US4920313, US6308970, US7580506, US8524936, US9356437, US10384285

Regarding testing the gravity theory *continued*

- Devoe, R. G., & Brewer, R. G.
- Murthy, S. A.,
- Hoyle, C. D

- Wagner, T. A., et al.
- Guerlin, C.

- More investigation is required because it appears all research paper titles were fictitiously supplied by multiple ai engines and so have been removed. However, author names appear to be real names of researchers of gravitational mass and the Equivalence Principle.

Regarding testing the gravity theory *continued*

- 1. "Measurement of the Gravitational Mass of Helium-4 and Neon-20" by R. H. Dicke, P. J. E. Peebles, and D. T. Wilkinson (Physical Review, Vol. 128, No. 6, 1962)
- 2. "Measurement of the Gravitational Mass of Helium-3" by R. Vessot and M. Levine (Physical Review Letters, Vol. 24, No. 14, 1970)
- 3. "Precision Measurement of the Gravitational Mass of Helium-4" by S. Schlamminger et al. (Physical Review Letters, Vol. 100, No. 4, 2008)
- 4. "Measurement of the Gravitational Mass of Helium-4 with a Cryogenic Resonant Bar Detector" by A. Lanza et al. (Physical Review Letters, Vol. 123, No. 16, 2019)

- "Measurement of the Atomic Mass of Nitrogen-14" by J. R. Berglund
- M. E. Wieser, "Measurement of the Atomic Masses and Abundances of Nitrogen and Oxygen Isotopes" by J. R. Berglund
- M. E. Wieser, and "Gravitational Mass Measurements and Isotope Abundance Determinations for Nitrogen" by J. R. Berglund.
- Ido, T., A. Bertoldi, S. Bavarsad, G. Rosi, J. M. Brown, and A. M. Steane. “A micromechanical oscillator for measuring the gravitational mass of an isotope.” Nature Physics 14, no. 10 (2018): 990–994. doi:10.1038/s41567-018-0266-7.

- More investigation is required because it appears all these research paper titles were fictitiously supplied by multiple ai engines.

Regarding testing the gravity theory *continued*

More investigation is required because it appears all these research paper titles were fictitiously supplied by multiple ai engines.

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- Adelberger, E. G., Gundlach, J. H., Heckel, B. R., Hoedl, S., & Schlamminger, S. (2014). Tests of the gravitational inverse-square law below 100 microns. Physical Review D, 89(5), 052001.
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- Brown, J. M., Brown, J. J., Loftus, T. H., Zhou, W., Hohensee, M. A., Tobar, M. E., & Smith, G. A. (2018). A new test of the universality of free fall for 3He and 4He. Nature Physics, 14(3), 270-274.
- Brown, J. M., Brown, J. J., Loftus, T. H., Zhou, W., Hohensee, M. A., Tobar, M. E., & Smith, G. A. (2018). A new test of the universality of free fall for 3He and 4He. Nature Physics, 14(3), 270-274.
- Itoh, N., et al. (1989). Gravitational mass of polarized 3He. Physical Review Letters, 63(24), 2369-2372.
- "Gravitational mass of 3He and 4He atoms" by V. A. Yerokhin and V. M. Shabaev, published in Physical Review A in 2010.

Regarding testing the gravity theory *continued*

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- "The Gravitational Mass of Helium-3 and Helium-4" by R. E. Tribble (Physical Review C, vol. 73, no. 4, pp. 045801, Apr. 2006). This paper reports on the measurement of the gravitational mass difference between helium-3 and helium-4 using a torsion pendulum. The authors found that the gravitational mass of helium-3 is slightly larger than the gravitational mass of helium-4.
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