Professor Matt Strassler

HARVARD UNIVERSITY

POST and SELECTED COMMENTS on the Professor's Blog:

OF PARTICULAR SIGNIFICANCE

Dark Matter: How Could the Large Hadron Collider Discover It?

April 13 – 17, 2015

PREFACE

Strassler's impressive CV includes education at Princeton, Stanford, and Rutgers. He was a visiting professor at Harvard when the following discussion took place. Comments by other participants have been excluded or grayed out. A hard copy of my Mr Natural postcard (p. 9/13a) was evidently received by Strassler at Harvard, as he alludes to it (with mixed feelings) in the exchange.

Strassler's initial blog post is included here even though it mentions the importance of gravity only once (near the top, colored red). I then skip to the Comments section where I chimed in two days later. Stressing the importance of testing our gravity models where they have not yet been tested, my comment is similar in spirit to those of prior commenters, who also emphasized the importance of gravity.

In the interest of both fairness and completeness, I have reinserted parts of my comments that were deleted (censored) by Strassler. This sometimes makes the document a bit choppy, typographically. But readers who follow along will then get a more accurate impression of the contentious communication Strassler and I were engaged in. I consistently argued for the importance of providing empirical evidence to support our theories. Whereas Strassler consistently argued for the importance of looking like an accomplished tough-guy authority who refuses to be impressed by an amateur who dares point out the fact that the Professor doesn't really know something he and his colleagues routinely *pretend* to know.

As a theorist working mostly within the framework of the "Standard Model of Particles," Strassler's research and popular postings typically involve his thoughts on the activities at the *Large Hadron Collider* at CERN. This sometimes involves cosmological puzzles such as that of *Dark Matter*, and gravitational theories such as *General Relativity*. Strassler also spent some time in 2014 teaching at the *Galileo Galilei Institute* in Florence, Italy. A few of Strassler's blog posts discuss the concept of *Naturalness*—one of them being from an international conference devoted to the subject (at the *Weizmann Institute of Science* in Israel, November 2014).

I don't know for sure why Strassler treated me and my work with such disrespect and presumptuousness. Maybe it's because the Mr Natural card makes some fun of Naturalness (ego, insecurity issues). Maybe it's because I've proposed a non-collider experiment to fill a gap in our empirical knowledge of gravity whose importance Strassler would arrogantly deny (face-saving knee-jerk reaction on behalf of the collective) or both. By the end, Strassler does calm down a little, but he remains steadfastly non-commital, if not opposed to endorsing the idea that someone really ought to perform the experiment proposed 387 years ago by the "Father of Modern Science."

I've added some after-the-fact commentary at key junctures (in red and yellow). I should perhaps address one issue straight away: On p. 7 Strassler advises me to not call the Galileo-inspired experimental apparatus a *Small Low-Energy Non-Collider* (SLENC). He claims that "almost every" experiment in his department could be given that name. This may be true for *some* experiments in which there is no test object following a trajectory to be observed, and the huge mass of planet Earth plays no role. But the word *non-collider* obviously implies a collision-free *path through space*. Virtually all experiments exhibiting friction, interactions with light, or non-zero accelerometer readings involve considerable size, energy, and/or collisions.

Experiments that come closest to satisfying the description are gravity-related falling experiments: orbital motion or radial falling. If the direction of fall is not radial, then initiating the trajectory requires an input of highly energetic collisions (propulsion). Insofar as most laboratory experiments involve some kind of mechanical or electromagnetic phenomena, they involve energies many orders of magnitude greater than those of a SLENC. Radial falling experiments in which a test body is obstructed from proceeding all the way to the center of the source-mass involve collisions (landing or bouncing). All rolling, or suspended pendulum experiments involve the hugeness of planet Earth, non-zero accelerometer readings and friction damping (collisions).

For the above reasons and because an ideal SLENC's test object permanently exhibits a *zero* accelerometer reading, the device is actually ***unique*** among physics apparatus. The thing itself and its name represent a patently *extreme case*, making it a highly desirable apparatus to study. Instead of ackowledging this and promoting the need to build and operate one, Strassler chooses to trivialize and misrepresent its significance. Why? I would guess that Strassler is *embarrassed*, personally, and as a member of a society which collectively *pretends to know* the result of an experiment they should have done long ago.* A SLENC is common as dirt and/or a crackpot waste of time to Strassler only, I guess, because he didn't think of how cool it would be to build and operate one himself.

Similarly adolescent thinking patterns are on display in what follows. Finally, Strassler claims to be "an empiricist…[who] always think[s] about the data." The empirical fact he insists on overlooking is that, for Galileo's experiment, *we have* ***NO DATA!*** We have *no data* to think about. Why must Strassler be so blind and hypocritical about this simple experiment?

*Note also the contrast between Strassler's harsh objection to calling the apparatus a Small Low-Energy Non-Collider and Carlo Rovelli's lighthearted take: "well, just the name *non-collider* would be a good enough reason for trying the experiment."

Figure A: Gravity-induced collision experiment. What happens when the ball's trajectory is not interrupted even by the ground, as though it were a pop-fly that *never* gets caught, but *falls forever?* Nobody knows. This is why we need to build and operate humanity's very first Small Low-Energy Non-Collider.

NOTE: Since this discussion begins with and is dominated by particle physics, readers may want to skip to p 5, at which point the role of gravity takes center stage.

Dark Matter: How Could the Large Hadron Collider Discover It?

Posted on April 13, 2015 | 79 Comments

Dark Matter. Its existence is still not 100% certain, but if it exists, it is exceedingly dark, both in the usual sense — it doesn't emit light or reflect light or scatter light — and in a more general sense — it doesn't interact much, in **any** way, with ordinary stuff, like tables or floors or planets or humans. So not only is it invisible (air is too, after all, so that's not so remarkable), it's actually extremely difficult to detect, even with the best scientific instruments. How difficult? We don't even know, but certainly more difficult than neutrinos, the most elusive of the known particles. The only way we've been able to detect dark matter so far is through the pull it exerts via gravity, which is big only because there's so much dark matter out there, and because it has slow but inexorable and remarkable effects on things that we **can** see, such as stars, interstellar gas, and even light itself.

About a week ago, the mainstream press was reporting, inaccurately, that the leading aim of the Large Hadron Collider [LHC], after its two-year upgrade, is to discover dark matter. *[By the way, on Friday the LHC operators made the first beams with energy-per-proton of 6.5 TeV, a new record and a major milestone in the LHC's restart.]* There are many problems with such a statement, as I commented in my last post, but let's leave all that aside today… because it ***is*** true that the LHC can look for dark matter.   How?

When people suggest that the LHC can discover dark matter, they are implicitly assuming

- that dark matter exists (very likely, but perhaps still with some loopholes),
- that dark matter is made from particles (which isn't established yet) and
- that dark matter particles can be commonly produced by the LHC's proton-proton collisions (which need not be the case).

You can question these assumptions, but let's accept them for now. The question for today is this: since dark matter barely interacts with ordinary matter, how can scientists at an LHC experiment like ATLAS or CMS, which is made from ordinary matter of course, have any hope of ***figuring out that they've made dark matter particles?*** What would have to happen before we could see a BBC or New York Times headline that reads, "Large Hadron Collider Scientists Claim Discovery of Dark Matter"?

Well, to address this issue, I'm writing an article in three stages. Each stage answers one of the following questions:

1. How can scientists working at ATLAS or CMS be confident that an LHC proton-proton collision has ***produced an undetected particle*** — whether this be simply a neutrino or something unfamiliar?
2. How can ATLAS or CMS scientists tell whether they are ***making something new and Nobel-Prizeworthy***, such as dark matter particles, as opposed to making neutrinos, which they do every day, many times a second?
3. How can we be sure, if ATLAS or CMS discovers they are making undetected particles through a new and unknown process, that they are actually ***making dark matter particles***?

My answer to the first question is finished; you can read it now if you like. The second and third answers will be posted later during the week.

But if you're impatient, here are highly compressed versions of the answers, in a form which is accurate, but admittedly not very clear or precise.

1. Dark matter particles, like neutrinos, would not be observed directly. Instead their presence would be **indirectly inferred**, by observing the behavior of other particles that are produced alongside them.
2. It is impossible to directly distinguish dark matter particles from neutrinos or from any other new, equally

undetectable particle. But the equations used to describe the known elementary particles (the "Standard Model") predict how often neutrinos are produced at the LHC. If the number of neutrino-like objects is larger that the predictions, that will mean **something new is being produced**.
3. To confirm that dark matter is made from LHC's new undetectable particles will require many steps and possibly many decades. Detailed study of LHC data can allow properties of the new particles to be inferred. Then, **if other types of experiments** (e.g. LUX or COGENT or Fermi) **detect dark matter itself, they can check whether it shares the same properties as LHC's new particles**. *Only then* can we know if LHC discovered dark matter.

I realize these brief answers are cryptic at best, so if you want to learn more, please check out my new article.

RELATED

Questions and Answers About Dark Matter post-LUX
In "Astronomy"

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In "Higgs"

At a CMS/Theory Workshop in Princeton
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This entry was posted in Dark Matter, LHC Background Info, LHC News, Particle Physics and tagged atlas, cms, DarkMatter, LHC. Bookmark the permalink.

79 RESPONSES TO "DARK MATTER: HOW COULD THE LARGE HADRON COLLIDER DISCOVER IT?"

M. Many | April 13, 2015 at 9:09 AM |

The question of today is : we observe gravitation effects , we infer that some gravitating something exists , but , is it possible that some unknown configurations of space itself is the cause of what we observe in the large scale with no such DM ???
N. B. : according to GR gravity assumed to be space configuration .

Matt Strassler | April 13, 2015 at 10:57 AM |

No one has proposed a theory — i.e., a set of consistent equations that makes detailed predictions and violates no known observations — where such an idea would make sense. If someone does, that would be very interesting.

Richard Bauman | April 13, 2015 at 3:13 PM |

Sorry ,but this is too easy. Such a theory is almost too simple. Where ever you need the force of gravity to be stronger , you increase the number tfo gravitons being exchanged over a give unit of time. To double the strength you double the number fo gravitons being exchanged. Should this be true it must apply to all massless bosons, and thats can be seen too. Now that doesn't happen in the solar system much. So the other conditions is that the faster gravitons ,and all massless bosons only go faster if they go through the same space. That's a long story why, but back to trying it out for gravity. So the slower one body moves off the line of sight in space the stronger the force. Results; between the centers of two galaxies a factor of 10, between a star and ihe center of a galaxy a factor of 2+ , in the bar of a galaxy up to 3 at the end of the bar, etc. Very close to what MOND and MOG state, only with a reason this time. Ever neutrinos do this, with mass, but only go faster than C in one direction, not both as is the case for massless particles. Two minor examples are Opera1 and Pioneer which now do not need some other made up story..

I would like to wait for the establishment of the ILC (International Linear Collider) which will be constructed in Japan. I visited the proposed site. It is a good place. The ILC would collide electrons with positrons. So a great energy will be produced and many particles will appear clearly without remnants. Scientists are talking about the first work for the ICL which will be the precise study of the Higg's particle.

Richard H | April 14, 2015 at 11:24 PM |

Matt, what could dark matter be if not particles?

> **Matt Strassler** | April 15, 2015 at 10:26 AM |
>
> Didn't I answer this question? Check around… if not I'll answer again. Maybe the answer disappeared.

plarryhotter | April 15, 2015 at 12:33 PM |

Mr. Strassler, thanks for the summary. I dont perceive it as cryptic at all, but as a concise abstract,

richardbenish | April 15, 2015 at 2:43 PM |

Insofar as the prevailing ideas about dark matter assume that General Relativity (GR) is right, and that our proper concern is "equations whose predictions agree with data," it is pertinent to point out a rather large gap in GR's confrontation with data.

In the local Universe, virtually all we know about gravity-induced motion comes from observations of phenomena *over* the surfaces of large bodies such as the Earth or Sun. In other words, the Schwarzschild *exterior* solution has seemingly been well-tested.

But throughout the range of these tests—from mm to AU—Schwarzschild's *interior* solution has never been tested. The most noteworthy feature of the interior field of a massive body is that—according to GR—the rate of a clock at its center is supposed to be a minimum. In terms of Newtonian gravity, this corresponds to the prediction that a test mass dropped into a hole through a larger body will oscillate between the hole's extremities. Neither of these predictions has ever been tested.

Almost 400 years ago Galileo proposed such a test. The apparatus needed to carry it out may be called a Small Low-Energy Non-Collider. Such an apparatus could be operated in an Earth-based laboratory (modified Cavendish balance) or in an orbiting satellite.

Because the unexplored domain is so large (the most ponderous half of the gravitational Universe) and because the idea to explore it has been on the books for so very long, it is clearly in the interest of science to conduct Galileo's experiment.

Furthermore, as suggested in: * **Deleted link re-inserted at top of next page**

* *[Link Deleted by Host. Why? (a) This is not an advertising site for individuals to promote their individual ideas. Submit papers to journals. (b) The host looked at the paper. It has not a single equation, calculation or simulation. It does not consider the possibility that properties of the Earth's geology, obtained via seismology, or properties of the Sun, or of neutron stars, constrain the properties of gravity already, and it does not show that the proposed experiment (which is practically impossible anyway) could potentially give stronger constraints. In short, it is not a scientific paper and is not suitable for this site.]*

at least one reason exists to suspect that the standard prediction may not be correct. If this turned out to be true, various cosmological assumptions would also have to be re-thought. But even independent of any such radical result, the fact that GR's (Schwarzschild's) interior solution has not been tested is surely reason enough to finally fill this gap in our empirical knowledge of gravity.

http://vixra.org/pdf/1503.0139v1.pdf
[*Galileo's Belated Gravity Experiment*]

Re-inserted link from previous comment.

richardbenish | April 16, 2015 at 12:29 AM |

Concerning the reasons given for deletion of a link in my previous comment, I should respond as follows:

a) My "individual idea" coincides, essentially, with Galileo's. Having been accused of advertising that idea, I stand guilty as charged.

* *[The host deleted the* {bulk of the} *previous post because it was far too long and directed purely at self-defense, and of no interest to anyone except the writer. Since the writer persists, the host will give him another chance to consider proper etiquette, but will not allow a long discussion by someone who has proven himself a crackpot of the highest order.]*

* See p 7/12a for full re-inserted comment.

The host may imagine the result of Galileo's experiment as "self-evident," even without direct empirical support. I'd guess that Galileo would have preferred to let *Nature* testify on the matter.

Matt Strassler | April 16, 2015 at 8:02 AM |

Your position is indefensible and there's no hope of saving it. (a) You've shown you have no sense, or physics understanding; it is impossible to build a tunnel through the earth, due to the immense geological forces and heat inside the earth, and even if you could it would cost more than you can fathom — it is as silly an idea as building a bridge to the moon. (b) Crackpots never know the difference between a wordy commentary and a true scientific paper. They learn from a few famous papers that were wordier than some — guess what! those are the ones they read! since the technical ones are too hard — so they imitate them without understanding that it is the small technical details in the famous papers are what made them famous. For example, read this Nobel-Prize-winning paper by Penzias and Wilson, http://adsabs.harvard.edu/full/1965ApJ...142..419P(c) pages 419-421; it's all words, no equations! Well, wait, and look closely. There are crisp statements, one after another, each one packed with information about the experiment. There's a reference to a longer paper that describes the experiment, too. And there are numbers, with uncertainties. This is a scientific paper par excellence. It's not just a set of **ideas**; it is a set of **results**. (c) Crackpots usually reach back to and appeal to someone very famous without regard for the fact that there's been a lot of work done by other people in the interim. They don't bother to read the work of those other people; they just don't have the time. Well, a lot has been learned in the last few centuries, and Galileo's idea is now known to be completely impractical, even though he did not know that. And more is known about gravity — empirically — than you realize. (d) Specifically, crackpots never consider carefully the full range of data that scientists have available, and never check what can be done with existing or easy-to-obtain data. I am an empiricist and do not take answers to physical questions as self-evident, so I always think about the data. There are in fact tests of gravity inside a body. For instance, our understanding of the sun is remarkably good, as evidenced by helioseismology and solar neutrino emission, which probe the interior of the sun; our understanding assumes standard gravity, and therefore tests it. I believe that you would also learn something from the seismology of the earth, though probably less than from the sun. Also, we exist OUTSIDE the sun, but INSIDE the earth-moon-sun system, and INSIDE the galaxy, so we do know something about gravity inside objects from that score. Now if you want to propose a hugely expensive and impractical experiment, it's *your* job to prove that other, cheaper methods haven't done, or can't do, a pretty good job. For instance, did you consider what you could learn from a neutrino beam sent through the earth? Maybe you would not learn much, but at least that's an experiment people *could* do someday, with a neutrino factory, for finite cost — so you should check. But oh, I know, that's too hard. Let's just listen to Galileo, because we're not smart enough to think for ourselves.

If Galileo's "idea" is narrowly regarded as a cannonball through Earth, yes. If regarded generally (more reasonably) as a small body through a larger body, then *absolutely not.*

Response to this flame-fest is at top of p 8/13.

richardbenish | April 15, 2015 at 8:29 PM | Reply

Concerning the reasons given for deletion of a link in my previous comment, I should respond as follows:

a) My "individual idea" coincides, essentially, with Galileo's. Having been accused of advertising that idea, I stand guilty as charged.

b) The host's interpretation of what constitutes a "scientific paper" is not particularly broad. An example of a scientific paper that was published without "equations, calculations or simulations" is that of Arno Penzias (in Societa Italiano de Fisica Conference Proceedings, vol 1, 1985, on the *Cosmic Background Radiation and Fundamental Physics*, p. 277).

Penzias' paper is nevertheless full of scientific *ideas*. I picked this example because Penzias was a harsh critic of the Inflation Model; his paper contains the following poignant quote, which I think still applies today:

"I feel that we are now, at this moment, going through a new period of epicycles in cosmology… We seem to be able to barely fit the data only with the aid of some rather convoluted mathematics… We have contrived to glue the various parts of our world together to fit the data."

The paper that I linked to was not so harshly judgmental. It merely presents a variety of scientific *ideas*, the gist of which is that Galileo's Small Low-Energy Non-Collider experiment is overdue to be done. The experiment would test GR in a way that might conceivably bear on the Dark Matter problem.

Contrary to the host's assertion, the experiment is not "practically impossible anyway." In fact, it was proposed several times as a way of measuring Newton's constant, *G*. See the review paper by Smalley:

http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19750014902.pdf

The proposals reviewed by Smalley were not carried out because they would not have substantially improved on measurements made in Earthbased laboratories.

Also, an Earthbased version (using a modified Cavendish balance) is possible. My correspondence with experimentalists in this regard is recounted in one of my essays (whose link I hesitate to include).

Finally, it has sometimes been argued (as implied by the host's reference to various "constraints") that evidence in support of Newton's and Einstein's exterior solution make doing Galileo's interior solution experiment unnecessary. Countering this conclusion is the advice of Herman Bondi, who warned against needlessly assuming the validity of untested mathematical *extrapolations*, as from an explored domain to an empirically unexplored domain:

> "It is a dangerous habit of the human mind to generalize and to extrapolate without noticing that it is dong so. The physicist should therefore attempt to counter this habit by unceasing vigilance in order to detect any such extrapolation. Most of the great advances in physics have been concerned with showing up the fallacy of such extrapolations, which were supposed to be so self-evident that they were not considered hypotheses. These extrapolations constitute a far greater danger to the progress of physics than so-called spectulation."

The host may imagine the result of Galileo's experiment as "self-evident," even without direct empirical support. I'd guess that Galileo would have preferred to let *Nature* testify on the matter.

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richardbenish | April 16, 2015 at 9:33 AM |

Response to flame-fest on p. 6/12.

As your opening premises imply, the validity of modern cosmology—which has come to include large quantities of exotic dark matter—depends on the validity of GR.

The large physical domain of GR encompassed by the interior solution has not been tested *with regard to gravity-induced motion*. Static and seismological measurements have been made, yes. But nobody has ever seen one body fall through the center of another body due to the gravity of only those two bodies.

The latter observation could be made by doing the experiment that Galileo proposed, with laboratory-sized bodies, of course. This is the experiment whose apparatus I have called a Small Low-Energy Non-Collider and that Larry Smalley has reviewed in the NASA Technical Memorandum linked here:

http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19750014902.pdf

I have never proposed drilling a hole through the Earth. That the host would suggest that I have indicates just one of the many ways that he has misunderstood and underestimated my work.

Matt Strassler | April 16, 2015 at 10:57 AM |

What "**work**"? Show me the work, and we can discuss. The paper you linked to here is a scientific paper by somebody else, proposed to measure something else. And if you don't want people to think you a crackpot, then stop acting like one, and also, stop calling this experiment a "Small Low-Energy Non-Collider". Almost every experiment in my physics department is a small, low-energy, non-collider experiment.

But the apparatus proposed in the paper to make the measurement is exactly the same thing as a Small Low-Energy Non-Collider. Nobody has ever ascertained whether such an instrument works as expected. Surely, it is in the interest of science to see if the operating mechanism of its apparatus works, or not.

Matt Strassler | April 16, 2015 at 11:05 AM |

p.s. and I recommend you not send cutesy little advertisements of your "work" to physics departments. [Can you imagine Einstein doing that?!] Your reputation was destroyed by that action. (I should be clear — your sense of humor was appreciated. But your scientific reputation? Trashed.)

See p 9/13a for "cutesey" Mr Natural postcard.

OakTree (@Class_of_78) | April 16, 2015 at 12:41 PM |

Anything ass... me up.

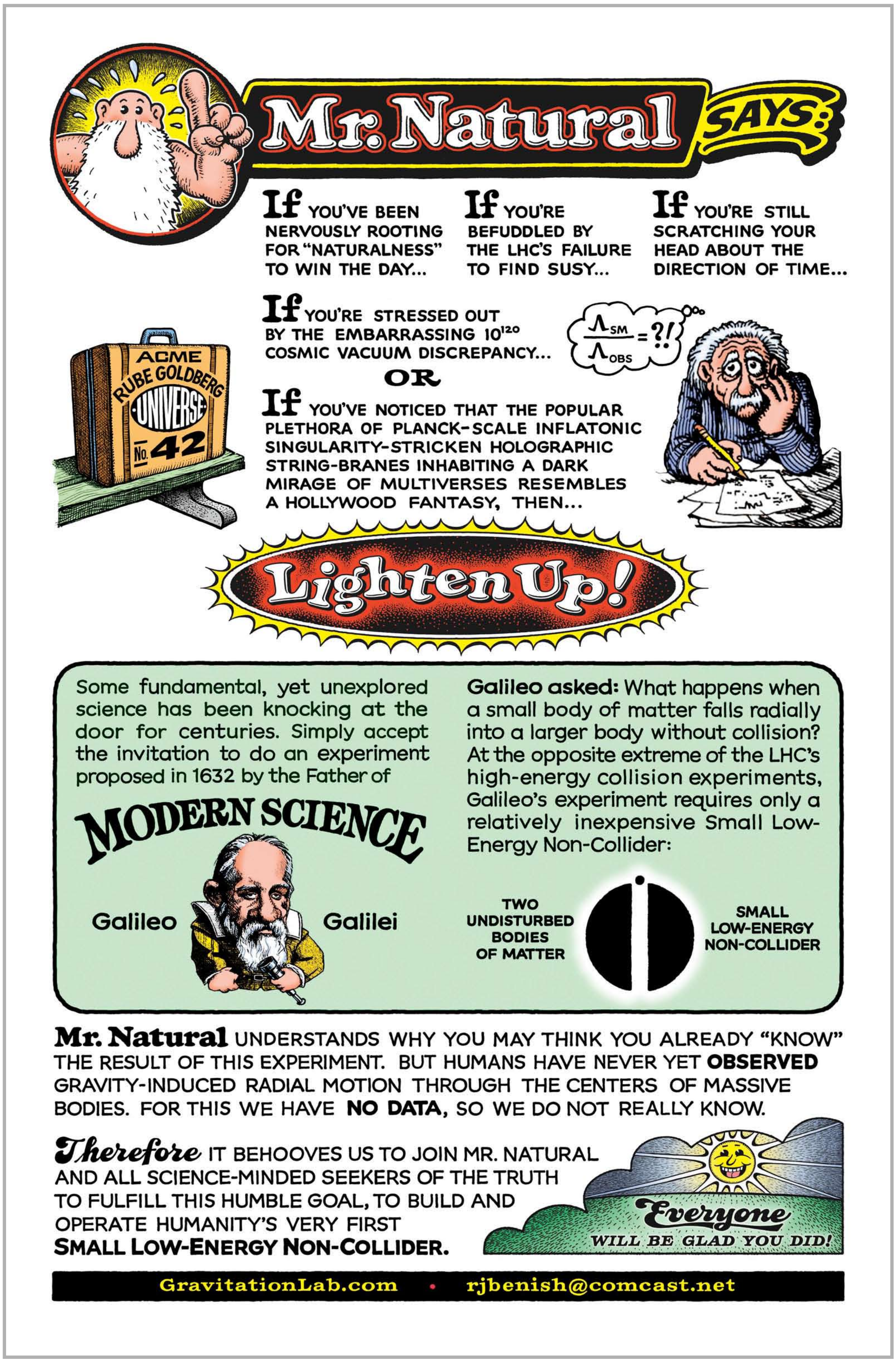
Notice how Trumpian Strassler's response is:

1. **Never apologize. Persist with all misconstruals.**
2. **Evade. Fib. Exaggerate.**
3. **Launch a vigorous *ad hominem* counter-attack.**

Kudzu

I don't kn... Say what you like but NASA's done some solid science and engineering.

In order to form a disk under the influence of gravity particles must be able to 'bump into' each other and emit energy. When normal matter 'cools' it initially is a cloud shape, a sphere. Bits of it are moving in all directions around the center. As they bump together they start cancelling out their movements; bits moving up cancel bits moving down, left bits cancel right bits and so on. The cancelling is done by the emission of EM radiation (Light, IR, radio waves...) This tends to move all the matter to the center.


Mr. Natural SAYS:
If YOU'VE BEEN NERVOUSLY ROOTING FOR "NATURALNESS" TO WIN THE DAY...
If YOU'RE BEFUDDLED BY THE LHC'S FAILURE TO FIND SUSY...
If YOU'RE STILL SCRATCHING YOUR HEAD ABOUT THE DIRECTION OF TIME...
If YOU'RE STRESSED OUT BY THE EMBARRASSING 10^{120} COSMIC VACUUM DISCREPANCY...
ACME RUBE GOLDBERG UNIVERSE No. 42
$\frac{\Lambda_{SM}}{\Lambda_{OBS}} = ?!$
OR
If YOU'VE NOTICED THAT THE POPULAR PLETHORA OF PLANCK-SCALE INFLATONIC SINGULARITY-STRICKEN HOLOGRAPHIC STRING-BRANES INHABITING A DARK MIRAGE OF MULTIVERSES RESEMBLES A HOLLYWOOD FANTASY, THEN...
Lighten Up!
Some fundamental, yet unexplored science has been knocking at the door for centuries. Simply accept the invitation to do an experiment proposed in 1632 by the Father of
MODERN SCIENCE
Galileo Galilei
Galileo asked: What happens when a small body of matter falls radially into a larger body without collision? At the opposite extreme of the LHC's high-energy collision experiments, Galileo's experiment requires only a relatively inexpensive Small Low-Energy Non-Collider:
TWO UNDISTURBED BODIES OF MATTER
SMALL LOW-ENERGY NON-COLLIDER
Mr. Natural UNDERSTANDS WHY YOU MAY THINK YOU ALREADY "KNOW" THE RESULT OF THIS EXPERIMENT. BUT HUMANS HAVE NEVER YET OBSERVED GRAVITY-INDUCED RADIAL MOTION THROUGH THE CENTERS OF MASSIVE BODIES. FOR THIS WE HAVE NO DATA, SO WE DO NOT REALLY KNOW.
Therefore IT BEHOOVES US TO JOIN MR. NATURAL AND ALL SCIENCE-MINDED SEEKERS OF THE TRUTH TO FULFILL THIS HUMBLE GOAL, TO BUILD AND OPERATE HUMANITY'S VERY FIRST SMALL LOW-ENERGY NON-COLLIDER.
Everyone WILL BE GLAD YOU DID!
GravitationLab.com • rjbenish@comcast.net

Page 13a

With dark matter particles can't cool. Gravity keeps trying to pull it towards the center but the motion can't get cancelled out. DM stays all puffy like a cloud of steam.

richardbenish | April 16, 2015 at 2:19 PM |

Thank you for inquiring about my work. The best example is probably a paper submitted to the *International Journal of Theoretical Physics*.

http://vixra.org/pdf/1209.0004v1.pdf

It was motivated by the discovery that the gravity model I'd been working on—whose premises differ greatly from Einstein's, nevertheless—predicts a *maximum force* of the same value as that derived from GR.

* [Abridged by host to remove inappropriate material.] * **Removed material re-inserted here.**

from GR. Being amply backed up by equations and graphs, the paper received favorable comments from the first reviewer:

"The manuscript is well written and well illustrated…The general topic of the manuscript and the results will be interesting enough for IJTP…I would recommend publication."

Unfortunately, this reviewer never pointed out exactly what the purported error was. I resubmitted the same manuscript a second time and was then rejected. (Still no error pointed out.) But I got another favorable response from the physicist Christoph Schiller, whose paper on maximum force published in the same journal was cited and discussed in mine. Schiller wrote:

"I like the clarity with which you expose all issues involved. I like this kind of clear thinking a lot."

There is a recurring irony in all this: As with the IJTP reviewers, you too have not yet pointed out any error in my ideas. It seems you are content to lump me in with all other crackpot-amateurs and dismiss me without carefully looking at what I've written.

Most importantly, the model of gravity alluded to above stands or falls depending on the result of Galileo's experiment. I am eager to defer to empirical evidence.

I still think the apparatus needed to conduct the experiment is nicely described as a particular (gravity-induced radial motion) kind of Small Low-Energy Non-Collider. Concerning the *result of this experiment proposed by Galileo, it seems that you would remain content to guess (i.e., to accept the authority of established ideas). Whereas I would prefer to see the result as revealed by the ultimate authority: Nature.*

Matt Strassler | April 16, 2015 at 3:09 PM |

It seems to me that your reasoning for the experiment you propose is premature. Do you have evidence that measurements of precisely timed satellites (such as gravity probe B), moving in the gravitational field of the Earth and the Moon INSIDE the Earth-Moon system, would not have an altered result? In other words, you should be able to say what the fields are when you are in the interior of a *system*, not just the interior of a solid body, and check that existing satellite orbits are consistent with these formulas.

If you are unable to do this because you only have equations for spherically symmetrical bodies, then

> I think you have a very weak argument. It's not clear you have sensible equations that, for instance, conserve energy and momentum.
>
> Independently of this, I have no objection to someone doing a motion-in-interior experiment, and would support a proposal to perform it as long as (a) it is very inexpensive, and/or (b) there is at least one other thing for which it is useful and for which there is a stronger argument than the one you give. If you want someone to do an *expensive* experiment, such as one that involves a satellite, you need to prove, beyond doubt, that you have a consistent set of equations, and that no existing experiment already rules it out.

My, my, how Strassler's tone has evolved: From *aggressively* condescending, arrogant and presumptuous, to just *vaguely* condescending, arrogant and presumptuous! What happened?

Richard H | April 16, 2015 at 10:52 PM |

Matt, let me rephrase my question–what physical substance might dark matter be composed of if not particles? What else is available for making matter?

richardbenish | April 17, 2015 at 3:46 AM |

Your comment is awaiting moderation. **= Never cleared the censor.**

Since my model has not yet been developed to the point of distinguishing the (arguably very small) effects that might exist for the circumstance you've described, I agree that the satellite version of the experiment should have lower priority than the laboratory version.

Upon sharing an essay that described the apparatus I had in mind (modified Cavendish balance) with a very reputable apparatus builder in New York, he replied: "I have thought of doing exactly what is in your paper." In subsequent correspondence the impression was given that the cost would be well within $1 million. Physics experiments costing twice this much have been called "cheap." (Scientific American, Feb. 2012, p. 32.)

Regardless of the cost, it remains a fact that no human has yet seen what happens when one body is allowed to fall, purely by gravity, through to the center of a larger body. To me, this unexplored territory beckons to be explored, all the more so because it tests Newton's and Einstein's theories where they have not yet been tested. But also for the pure and joyous wonder of seeing the curtain lifted, to expose a large and fundamental process of the Universe for the first time.

To say that my reasoning to want to do Galileo's experiment is "premature" (especially when it is a comparatively cheap and simple test) is to disrespect Galileo and the ideals of science. Astronomer Bradley Schaefer succinctly expressed these ideals: "Science advances by exploring unexplored regions and by performing critical tests of standard wisdom."

The "consistent set of equations" that I yearn to test are those of Newton and Einstein. Why doesn't Strassler also yearn to test these equations, inside matter, where they have not yet been tested?

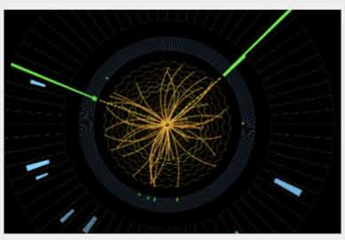
Strassler is evidently not interested in exploring the unexplored or testing standard wisdom—at least not when the advocate for doing so can be easily flamed as a "crackpot of highest order." Strassler appears content to punch down, to appeal to irrelevancies, and be a stick in the mud. Whereas Strassler has not the curiosity to remove the muzzle, I am eager to let Nature speak. Who is behaving like a scientist? Who is behaving like—if not a crackpot, then—an intransigent bully dogmatist?

Of Particular Significance

Conversations About Science with Theoretical Physicist Matt Strassler

FIRST TIME VISITOR?

This site addresses various aspects of science, with a current focus on particle physics. I aim to serve the public, including those with no background knowledge of physics. If you're not yourself an expert, you might want to click on "New? Start Here" or "About" to get started. If you'd like to watch my hour-long public lecture about the Higgs particle, try ``Movie Clips".



A Higgs particle is produced in a proton-proton collision at center, and decays to two photons (particles of light, indicated by green towers) in an LHC detector. Tracks emerging from center are from remnants of the two protons.

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About Me

Hi and welcome! I'm Matt Strassler, theoretical physicist. My research since 2002 or so has been related mainly to the Large Hadron Collider, though I've written many papers on a wide variety of topics in string theory, quantum field theory and particle physics.

I believe deeply that science is one of the world's great spectator sports, and should be a source of joy and excitement for the public, especially for kids and for kids at heart. This is particularly true of particle physics, which is at a watershed, with the Large Hadron Collider (or LHC) exploring all sorts of new territory and having recently discovered the long-sought Higgs particle! But particle physics can be especially hard for non-experts to follow… so I'm working to make it more accessible, even to those with no science background at all. My goal is to make the major challenges and discoveries and disappointments in the field understandable to everyone, and to reflect on the process of science and its roles in history and in modern society.

My website has many articles with background information about the particles and forces of nature, about the universe, and about experiments being done to understand them more deeply. Some of these articles are more technical than others; if you're lost, start with some of the articles listed here. There's also a blog where I post links to new articles as I complete them, discuss breaking news in particle physics and beyond, and announce public talks or other events at which I'll be speaking. (I have some of my talks linked at my video clips page.) If you like, you can follow me on Twitter or Facebook.

More details: I went to college at Simon's Rock (the first "early college.") I got my undergraduate degree from Princeton and got my Ph. D. at Stanford. I worked as a postdoc at Rutgers University and a long-term member at the Institute for Advanced Study, and was a faculty member at the University of Pennsylvania and the University of Washington, before becoming a full professor at Rutgers University. In 2007 I was elected as a member of the American Physical Society. In 2011 I went on leave from Rutgers to pursue other interests, including this website, and I decided to resign my position in 2013. After that I was a visiting scholar and visiting professor at Harvard, a position which concluded in August 2015. In fall 2015 I also spent six weeks as a Simons Foundation fellow at the Galileo Galilei Institute in Florence, Italy.