rzero

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Dedicated to Katherine

Preface

"I am a Quantum Engineer, but on Sundays I Have Principles."
– J.S. Bell, March 1983, as quoted by Nicolas Gisin, *[2]*

About Tom

I didn't have a choice. I think that's the case for many people in science.

Education

I attended high school in the small lakeside community on the Great Lakes, Canada. I attended University of Toronto for my undergraduate studies, starting with a cohort of over 100 students in the Physics Specialist program, which the University of Toronto Department of Physics had just finished remodelling after other top departments around the world. It was a disaster - there were maybe 10 people left by the time third year started - and I wasn't one of them. Thinking that maybe I had made a mistake, I tried a half a year of other topics, before deciding that physics could not be removed from me. So I switched to a double major in math and physics. And by fourth year (ok sixth depending on how you count), I was doing well in any course I cared about, which turned out to be some more abstract math courses, my undergrad thesis course (on Bell's Theorem), and General Relativity. Our fourth year courses were mixed with graduate students entering U of T's physics department.

Trying to attend graduate school was, I was informed, impossible, as my marks were too low. So I again tried to convince myself that physics wasn't for me, and I painted houses for a year and used the savings to travel around the world. I then met the love of my life, Katherine.

I applied at a few schools for a masters program in physics, and got in at Laurentian University of Sudbury, Ontario. I lucked out on my choice of advisor, Prof Doug Hallman, as he was collaborator in the then proposed Sudbury Neutrino Observatory. At a Sudbury collaboration meeting in 1992, my future PhD supervisor John Simpson stood up and said "We have an emergency - we've been funded!". After my masters, I went on to John's low level lab at the University of Guelph, where I did my PhD on a few things, mainly the water team, where we built a novel Radon detector and the software side, where I poked around in the 'SNOMAN' software, writing some muon tracking software. John was an amazingly smart, generous and kind advisor. When we went to off site meetings he would always buy wine way above my palette, I think trying, and succeeding at, educating us on the finer points of living. He was an honest gentleman.

Aside

The Sudbury Neutrino Observatory was a great success, we built a remarkable ten story high detector 2km under ground at the Sudbury nickel mine. The project leader, Art McDonald won the Nobel prize, and the entire collaboration won the Breakthrough Prize in Physics. I even got a nice certificate and a small cheque.

Career

After my PhD, we were starting to have children, and a post doc just didn't seem the way to go. For me this was the right decision. I instead started a software company with a dear friend, Ted. We built the world's biggest (so like 8 person) astronomy software package, called Starry Night, which made it easy for everyone from ordinary people to scientists to see where everything was in the night sky, to visit planets, etc. I can't resist blowing my own horn at this point:

> "In the first five years or so of both the Spirit and Opportunity Mars rover missions, Dr. Jim Bell (lead scientist in charge of the on-board Panoramic camera, Pancam) and colleagues on the rover science team occasionally used Starry Night Pro to verify the positions of the moons Phobos and Deimos in the Martian sky, given the positions of the rovers on the surface and the dates and times of the intended observations. These predictions allowed both rovers to acquire time-lapse images of these moons, including daytime "solar eclipse" transits of both Phobos and Deimos across the Sun as well as nighttime "lunar eclipse" passes of Phobos entering and emerging from the shadow of Mars."
>
> It really was cool that Starry Night was right on! It was like having a planetarium program made for Martians! (and you can quote me on that!)
>
> Thanks again, Jim[1].

[1] Private communication, 2019

For a reason having everything to do with the tech stock market bubble of 2000, we ended up selling the entire operation to Space.com. I was not rich, but hey it helped.

Why this book

While working on several software projects, over years I have kept up with the fields of quantum foundations, general relativity, and experimental quantum gravity (which is now a thing!)[15]. I was originally hopeful that physics would soon jump ahead, but it just hasn't happened. Physics isn't dead, it's a big field. But the supposed cutting edge is, as Sabine Hossenfelder points out, Lost in Math[11].

I have always had a different vision on the foundations of quantum mechanics than the mainstream physics community, a vision that is frankly easier to keep by being somewhat on the outside of academia.

Throughout my software career, I published several papers and attended conferences on quantum foundations and General Relativity. It's hard to publish papers, and often even to attend conferences with a busy job (and three wonderful sons). What I learned from my software career is that marvelously complex things can be built with simple underpinnings. My favourite example of that in software is that the 'c' programming language - a human creation just decades old - runs the entire world. And it's a short book[12].

Physics is in crisis [11]. I'm not the only one, of course that thinks this, but it is by no means an accepted fact in the academic world. To continue my software analogy, physics has gone the way of C++ - an extremely useful convoluted mess (only worse). My hope of standing back and watching the community leaders guide physics into the next revolution has more than faded over the past 20 years. I have about zero hope.

So I have decided to put my ideas - such as they are - into a book form, as I feel books can teach much better than papers. Papers are too short and formal. Books by such greats in Physics as Lee Smolin, Carlo Rovelli, etc (to me anyways) give a much clearer idea of where these people think physics is or should be going. Journal papers feel like straightjackets on free expression.

So the purpose of the book is simply to reveal another viewpoint on where physics should go, and it's a very different direction than where it's headed today. The first chapter runs over the plan and outline of the book, but I will tell you right now that this new viewpoint I have runs on one theory - Einstein's General Relativity. The thesis is that the other fields and phenomena of the world we live in can be built with this 'one simple trick'.

Contents

1

TL;DR

"You guys need more money. You struck the worlds worst licening deal."

– Eric Weinstein talking to Brian Keating, *Youtube[8]*

1.1 Everything all at once

It seems obvious that I should start the book with a chapter on the present state, and what's wrong, etc. But I don't. Instead I'll outline the entire program, like an executive summary. That way, if you're bored you can cut out early and use the saved time to work on a few more eigenvalues or that pickle ball swing.

1.1.1 It's all gravity

Really. That's it.

Everything that we know and care about is just gravity (really Einstein's General Relativity) formed, like clay, into atoms and light. The forces of nature emerge from dynamical phenonemna in General Relativity, like beer forming from malt, hops, yeast and water.

Here's the equation:

$$R_{\mu\nu} = 0.^{1}. \tag{1.1}$$

Looks simple enough, but there is a lot going on behind there, it's really a set of non linear partial differential equations, (math speak for complicated). The freedom in these non linear equations is crucial for building out a (what you are surely thinking at this point is silly) model of our universe from one concept.

[1] But see chapter 4. Damn that fine print!

It does have curb appeal though. So IF one could build something like the phenomena of our universe around us with such a simple equation it would be great. I have been waiting decades for someone to start doing just that. No luck, likely because it's a bad idea, but here we go.

1.2 General Relativity

If the other fields of physics were this smooth, I maybe wouldn't have had to write this book. That's how smooth it is. General Relativity describes how space and time, known as spacetime, for some reason, behaves (or is it behave?).

1.3 Newton

Newton figured out how the planets orbit, and his theory of gravity is amazingly accurate, but perhaps his biggest message - one that still runs underneath all of (non General Relativity) physics - is that spacetime is a perfect, god - given grid, and on that grid, we have forces. That is the major concept of physics even today.

> He endures always and is present everywhere, and by existing always and everywhere he constitutes duration and space. Since each and every particle of space is always, and each and every indivisible moment of duration is everywhere, certainly the maker and lord of all things will not be never or nowhere . . . God is one and the same God always and everywhere. He is omnipresent not only virtually but also substantially; for active power cannot subsist without substance. (Newton 1999: 941).

Einstein's special relativity did not change that.

Theoretical physics went well until about 1980. Theoretical physics then got worse over time. The culprits were the astronomers, who found that 95% of the world wasn't in the Standard Model, the experimental physicists, who showed that the world really has faster than light effects, high temperature superconductivity. But perhaps the biggest enemy of all was the top end schools of thought themselves. Only a few lines of thought have been permitted at all, and if 10,000 person years of effort are any indication, these directions are not useful.

Science is supposed to proceed by opening

What has worked, as

After that, two things happened. Firstly, the model of nature that was settled on around that time, the Standard Model, has gone from explaining virtually everything in the world to about 3-5% of it. Extensions to that theory, primarily, Super Symmetry, String Theory, and Loop Quantum Gravity have proved unfruitful to say the least. [**woit**][**SmolinTrouble**][**SabineLost**].

Explain the layout:

1. Generally Covariant[2].
2. Has the .

- What's right and wrong in present day physics.
- General Relativity
- Quantum Mechanics
- Energy in General Relativity (foundational field)
- Emergent Quantum Mechanics
- Quantum Gravity
- Electromagnetism
- Goopy thoughts
- Goodbye for now

[2] Chapter xxx will try to argue not only that Einsteins ether exists, but is at rest in our universe.

2

Electromagnetism

> *"You guys need more money. You struck the worlds worst licening deal."*
>
> – Eric Weinstein talking to Brian Keating, *Youtube[8]*

2.1 What is Electromagnetism

Essentially, it's light and electricity. Beams of light move at the speed of light, and electrons and other particles carry charge.

2.2 Electromagnetism from General Relativity

Here is the part where I get to do the physics equivalent of pulling a rabbit out of a hat. Everyone *knows* that since electromagnetism is so much stronger than gravity, my task here is not merely hopeless. So let's see just how funny we can get here.

2.3 Starting

The emergence of electromagnetic phenomena from General Relativity comes from starting at an electron model. Since an electron is a spinning thing, with known mass and angular momentum, I start with the known General Relativity solution for a spinning thing with mass, the solution found in 1963 by Roy Kerr[13]. I don't use the Kerr - Newman 'charged' solution[17], after all I am attempting to get electromagnetism to emerge from General Relativity, so I can't just toss electrical stuff in there at the outset, right? Burinskii[5] and others have employed Kerr Newman solutions as possible models for the electron, but, as I stated, I'm not using built in charge. I am attempting to construct charge from phenomena.

The Kerr solution for a particle of the same mass and spin as an electron is known in the biz as a 'naked singularity', which is a thing that $99\frac{99}{100}\%$ of physicists think can't exist, but they won't argue that it is a solution of Einsteins vacuum equations from equation (1.1). So yes, we are going to have to throw caution to the wind here and just assume that the Kerr solution (or something like it as we will see in chapter 7) is a reasonable model of the electron.

As a defence of my so far nascnet electron model, I will point out that there is no truly self consistent model of the electron known at this point. As the Richard Feynman one of a few authors of QED, our best 'standard physics' model of the electron pointed out[9] (page 127):

> "The shell game that we play to find n and j is technically called "renormalization." But no matter how clever the word, it is what I would call a dippy process! Having to resort to such hocus-pocus has prevented us from proving that the theory of quantum electrodynamics is mathematically self-consistent. It's surprising that the theory still hasn't been proved self-consistent one way or the other by now; I suspect that renormalization is not mathematically legitimate."

A typical physics professor will tell you that renormalization isn't a problem - and they are right - but only because so many worse problems have arisen in theoretical physics over the past 7 decades since QED, that QED renormalization now seems like a walk in the park. To be fair, it does actually work. (Although see Consa[7] for a negative outlook on the QED industry.)

Basically, the problem in all electron models, including QED, is quite simple to elucidate: the electron explodes when you try to assemble a model from charge - the energy you need to bring together 'bits of a charge' to form a small thing that looks like an electron goes to infinity. The problem is that charge is modelled as a 'charged goo' and each bit repels all the other bits as you try and squeeze it all into one place. I'll go into this more in chapter 3.

This Kerr naked singularity turns out to be very long (some $num1e42$ longer than the natural size of the electron). Conceptually dividing this long singularity into $num1e42$ sections, I find that each section has a gravitational interaction about equal to the gravitational interaction between two electrons. And all these small interactions add up to a huge Coulomb level force between two of them.

2.3.1 How to add it up

The expression for the electromagnetic Coulomb force F_e between two electrons is

$$F_e = k_e \frac{q^2}{r^2} = \pm \frac{\alpha \hbar c}{r^2}. \tag{2.1}$$

The second version is for single point charges only. It is a more fundamental way of looking at electrostatics, since in reality all charges are of unit size. I will use the second one. Note that:

- α is a number, about 1/137.[1]
- $\hbar$ is the famous quantum constant.
- c is the speed of light.
- r is the distance between the two electrons.

For for the force of gravity F_g we have

$$F_g = G \frac{m_e^2}{r^2}. \tag{2.2}$$

Where

- G is Newton's gravitational constant.
- m_e is the mass of the electron.
- r is the distance between the two electrons.

The large, famous value of the ratio between these two forces, which I will call k' is by inspection of eqn (2.1) and (2.2)

$$k' = ratio_{electric} = \frac{k_e q_e^2}{G m_e^2} = \frac{\alpha \hbar c}{G m_e^2} = 4.166 \times 10^{42} \tag{2.3}$$

I will now construct a force k' stronger than the usual gravitational force using only the Kerr solution of Einsteins equations, with no reference to electromagnetism.

2.4 The Kerr Singularity with Electron Parameters

The well known Kerr solution of Einsteins equations has a naked ring singularity for $J/mc > Gm/c^2$, somewhat better known as $a > m$ in geometric units. I use SI units in this section. In Kerr-Schild coordinates (a coordinate system that is Minkowskian almost everywhere)[19], the expression for the

[1] Feynman - "all good theoretical physicists put this number up on their wall and worry about it." (I doubt they do any longer –tom)

location of the ring singularity is $x^2 + y^2 = (J/mc)^2$, (avoiding the use of r, as r has a meaning on its own in the Kerr solution in Kerr-Schild coordinates). Using the measured experimental values for the mass m_e and spin angular momentum $\hbar/2$ of an electron, the radius of the ring singularity is:

$$R_{ring} = J/mc = \hbar/2m_e c = 1.93 \times 10^{-13} m \tag{2.4}$$

Thus the ring singularity is 0.5 of the Compton wavelength in circumference. This is a *huge* radius, and I will go into how this sort of thing might be possible in chapter 7. This radius can also be calculated as a ratio. The obvious other gravitational length to compare it to is the Schwarzschild radius $r_s = 2Gm_e/c^2$ for the electron mass:

$$size\ ratio = \frac{\hbar/(2m_e c)}{(2Gm_e/c^2)} = \frac{\hbar c}{4Gm_e^2} = 1.4 \times 10^{44} \tag{2.5}$$

It is noteworthy that this ratio is already very close to the ratio k' of the strength of the electric Coulomb force to the gravitational attraction between two electrons. Indeed, multiplying this ratio by the four times the fine structure constant (i.e. ≈ 0.029) gives one *exactly* k' - the ratio of the electric and gravitational force on two electrons.

$$ratio = 4\alpha\frac{\hbar/(2m_e c)}{(2Gm_e/c^2)} = \frac{\alpha\hbar c}{Gm_e^2} = 4.166 \times 10^{42} = k' \tag{2.6}$$

These are of course the same arrangement of constants as in (2.3). The difference here is that this ratio is now calculated without any references to the electric Coulomb force. It is simply a ratio of the radius of a Kerr singularity of the electron's mass and spin angular momentum to that of Schwarzschild radius for the electron mass r_s, along with a factor of 4α added in by hand (see the nest section).

Things are getting interesting, but we're not there yet. What we have is a ring that measures 1.4×10^{44} times the size of an un-spinning black hole the mass of an electron. The next question is how do two of these rings a distance r apart interact strongly?

2.5 Gravitational Waves as carriers

If one imagines the ring singularity is cut into 1.4×10^{44} pieces each of size r_s and each piece interacts with the nearby electron with a 'gravitationally sized' force on each section of $\alpha Gm_e^2/r^2$, perhaps one can create electromagnetic strength forces from entirely gravitational means. 4α then is perhaps some scale factor/antenna cross section of 'order 1' (well 0.029).

How can a single section of the ring with a tiny mass of $10^{-44}m_e$ and length r_s interact so strongly? The answer must lie in gravitational wave interaction. That's all I really have since the point of this book is to build physics with nothing but General Relativity. It seems that the properties of a singularity are such that it should interact very well[16] with gravitational waves. A gravitational wave effect could thus be strong enough to provide a net force of $\alpha G m_e^2/r^2$ per segment, with super radiance and absorption taken into account. For comparison, an astrophysical black hole of radius r_s can emit or absorb a significant (10%!) of its energy given the right gravitational wave parameters.[3].

Each section would need to be interacting with gravitational waves of a fantastic frequency - the wavelength would have to match the Schwarzschild radius (r_s) of the electron. This is of course a frequency well beyond that usually conceived in accepted quantum physics - but remember - I am trying to also emerge quantum mechanics from General Relativity, so I'm asking you to sit on this 'annoyance' for a while (until chapter 5. In for a penny and all that.

The amplitude of the gravitational waves at this incredible, $2 \times 10^{65} Hz$ frequency is tiny, much too small to cause measurable 'gravitational' effects - we would only see the force of one electron on another as they exchange gravitational wave energy. These waves are of many orders of magnitude smaller in amplitude than those measured by LIGO, for example.

Once we have individual segments interacting with a the right force we have recreated the Coulomb force, or at least a rough mechanism as to how it would work. Another way of thinking of it is to look at the overall energy balance - the waves configuration of two electrons will drop in energy as the two electrons move further apart from each other. Cetto[6] outlines a physical description of QED, one that uses a more physical model of QED.

An electron model based on a Kerr ring has some references in the literature - see for example Burinski[4]. The more general model of an electron as a ring of some sort (or a particle on a ring) of Compton radius is discussed mostly in respect to the zitterbewegung motion from the Dirac equation. See Hestenes[10], Maddox[14], and Barut[1].

2.6 Electromagnetism - non Coulomb interactions

Essentially, electromagneitic waves - photons are constructed as modulations of these fundamental gravitational waves - the gravitational waves are carrier waves. In this model, spin 1 is simply a result of moving a charge up and down.

If you think you know that spin 1 photons can't be built with spin - 2 gravtiational waves, I have news for you. Here, for instance is someone[18] building spin 1 from a scalar (pressure wave) acoustic field. Basically, you get spin 1 by taking a source exchanging energy and wiggling it up and down. Another source/receptor will see the other source and vibrate up and down in the same direction.

The idea is to use this fundamental energy exchange via gravitational waves as a carrier wave for electromagnetic waves. An EM wave is thus composed of trillions of trillions of gravitational carriers - underneath it, so to speak.

I am going to need to expand this, get some drawings going, etc.

Lorentz + Coloumb == EM.

2.7 Calculating α

The hypothesis that these ultra high gravitational waves

2.8 Discussion

While there are of course other more pedestrian explanations, this ratio result is exact - it is not approximate numerology.

The interpretation section above postulated gravitational wave interactions between Kerr solutions with electron mass and angular momentum parameters as a mechanism to start to build electromagnetism from general relativity. Irrespective of any validity to those guesses it's *still* a mystery as to why the scale of the Coulomb force to the gravitational force is identical with the radius of the Kerr ring singularity to the much smaller Schwarzschild radius of an electron mass.

Indeed, this Kerr - Coulomb ratio is interesting in its own right, even if a direct physical interpretation is not imagined. Wheeler's Geometrodynamics [20] seeks an already unified picture, but Wheeler in no way hypothesizes that EM can emerge from gravitation.

3

Physics Today

> *"You guys need more money. You struck the worlds worst licening deal."*
>
> – Eric Weinstein talking to Brian Keating, *Youtube[8]*

3.1 This chapter

Hello

4

Energy In General Relativity

"You guys need more money. You struck the worlds worst licening deal."

– Eric Weinstein talking to Brian Keating, *Youtube[8]*

4.1 This chapter

Hello

5

Quantum Mechanics

> *"You guys need more money. You struck the worlds worst licening deal."*
>
> – Eric Weinstein talking to Brian Keating, *Youtube[8]*

5.1 This chapter

Hello

6

Quantum Gravity

"You guys need more money. You struck the worlds worst licening deal."

– Eric Weinstein talking to Brian Keating, *Youtube[8]*

6.1 This chapter

Hello

7

The Electron Model

"You guys need more money. You struck the worlds worst licening deal."

– Eric Weinstein talking to Brian Keating, *Youtube[8]*

7.1 This chapter

Hello

8

Thanks

> *"You guys need more money. You struck the worlds worst licening deal."*
>
> – Eric Weinstein talking to Brian Keating, *Youtube[8]*

8.1 This chapter

Hello

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