rzero

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Dedicated to Katherine

So if you find someone that
gives you all of her love
Take it to your heart,
don't let it stray
For one thing that's certain
You will surely be a-hurtin
If you throw it all away

–Bob Dylan

Preface

"I am a Quantum Engineer, but on Sundays I Have Principles."
– J.S. Bell, March 1983, as quoted by Nicolas Gisin, *[15]*

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. My advisor, Proffessor Doug Hallman, 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: 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.

!

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 some dear friends, Ted, Peter, and Dave. 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 our 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.

Over the past two decades, I have helped people build software solutions in business, started a few small software startups, and met great people. Still doing it, it's fun.

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!)[63]. I was originally hopeful that foundational physics would soon jump ahead, but it just hasn't happened. Physics isn't dead, it's a big field. But the foundations are, as Sabine Hossenfelder points out, in her book, Lost in Math[55].

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 (but I have some - see my Google Scholar profile), and often even to attend conferences with a busy job (and family - three wonderful sons). What I learned from my software career is that marvellously 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 small language[59].

To continue my software analogy, physics has gone the way of C++ - an extremely useful convoluted mess (only physics is worse, In My Opinion).

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 modern 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 read like straitjackets.

So the purpose of the book is simply to reveal another viewpoint on where physics could 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 weird trick'.

Contents

1

TL;DR

> *"You guys need more money. You struck the worlds worst licening deal."*
>
> – Eric Weinstein talking to Brian Keating, *YouTube[39]*

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.

Ok, I lied. I'm starting with a few paragraphs on General Relativity.

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 behave. The magic of Einstein was to realize that space and time *could* 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 modern (non General Relativity) physics - is that spacetime is a perfect, god - given grid, and on that grid, we have forces. That is a major concept in physics even today. Standard physics won't really let General Relativity in the door. Here's Newton[70]:

> 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.

Einstein's special relativity did not change that. It was the theory of General Relativity that really changed the game. (I'll use the term General Relativity capitalized to refer to Einstein's 1916 theory, today's accepted theory of time and space.)

In some ways, though, General Relativity *adds* to Newton's idea of space and time as an actual thing. Newton's fixed Cartesian grid is so perfect it's possible to ignore its existence, i.e., to think of it as an 'obviously trivial' statement. Einstein elevated space and time to a dynamical object itself. In a 1920 lecture:[45]

> Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether.

So ignore anything you have read about Einstein killing the ether in 1905. General Relativity is an ether theory.

1.4 It's all gravity

Really. That's it. That's what this book is about.

Einstein wanted it this way:[44]

> Instead of 'aether', one could equally well speak of 'the physical qualities of space'. Now, it might be claimed that this concept covers all objects of physics, for according to consistent field theory, even ponderable matter, or its constituent elementary particles, are to be understood as fields of some kind or particular 'states of space'. But it must be admitted that such a view would be premature, since, thus far, all efforts directed toward this goal have foundered. So we are effectively forced by the current state of things to distinguish between matter and aether, even though we may hope that future generations will transcend this dualistic conception and replace it with a unified theory, as the field theoreticians of our day have tried in vain to accomplish.

(although he was too modest to assume that General Relativity alone could be all we need). I also like that in 1924, Einstein was already a field theory aficionado. Great work Albert!

My thesis again: 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 phenomena in General Relativity, like beer forming from malt, hops, yeast and water.

1.4.1 Here's the equation

Look 👓:

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

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. I don't even think I am alone in my regard for this: Vishwakarma[88][89]

> A good place to start would be questioning the requirement of the energy-stress tensor in GR – one of the two very foundational building blocks of the theory, the "marble" (geometry) and the "wood" (the energy-stress tensor).

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. If you have seen Einstein's field equations before (you're some expert in the field...), you will realize that (1.1) are the vacuum field equations. We are, after all, starting from scratch here!

The most famous solution of equation (1.1) is of course the Schwarzschild solution, found over 100 years ago by Karl Schwarzschild[2][80]. Here it is:

$$ds^2 = \left(1 - \frac{2GM}{c^2 r}\right) c^2 dt^2 \; - \; \left(1 - \frac{2GM}{c^2 r}\right)^{-1} dr^2 \; - \; r^2 \left(d\theta^2 + \sin^2\theta d\phi^2\right). \tag{1.2}$$

No use explaining it here, there is plenty of that on the internet. I will reiterate that this is a vacuum solution - a solution of equation (1.1) even

[1] But see chapter 6. Damn that fine print!

[2] It's funny :-) how people with same last name as an equation end up finding it first. It's less funny that there are a great number of equations who are named after the person who didn't find it first.

though it has a mass M in it! Strange, to me at least, but there it is. Chapter 6 has some details on why this is strange, and maybe even wrong.

1.4.2 Wheeler's progress

In this compelling 1966 paper[95], a decade after the classic geometrodynamics[67][96] papers came out, Wheeler wrote:

> Is curved empty geometry a kind of magic building material out of which everything in the physical world is made: (1) slow curvature in one region of space describes a gravitational field; (2) a rippled geometry with a different type of curvature somewhere else describes an electromagnetic field; (3) a knotted-up region of high curvature describes a concentration of charge and mass-energy that moves like a particle? Are fields and particles foreign entities immersed in geometry, or are they nothing but geometry?

To this I say yes, John, let's continue!

1.5 Chapters

I could explain what each chapter does here, but I'll leave that to the table of contents and the chapter introductions.

Each chapter looks at an aspect of General Relativity from my point of view. It's not an Introduction to General Relativity.

2

Electromagnetism

> *"The electromagnetic field is entirely determined by the curvature of space-time, so that there is no need of further generalizing the general relativity theory."*
>
> – George Yuri Rainich, 1923[74]

2.1 What is Electromagnetism

If you don't know, stop now. Ok, don't stop. It's light and cell phones.

2.2 It's not an 'electric universe'

Einstein gave a wonderful talk about his ether backtracking in 1920[45], then in 1924 he put out a paper *Concerning the Aether*[44](translated version).

He was annoyed with the success of electricity and magnetism, and how it tilted the field. In my opinion this is still true today, and Einstein's complaints about electromagnetism not being suitable as an '*ether of everything*' (my term I just coined - whaddya think?) are still true. Einstein[44]:

> There was another way too in which the Maxwell-Lorentz theory set back physicists' basic understanding. Since electromagnetic fields were seen as fundamental, irreducible entities, they seemed destined to rob ponderable masses, possessing inertia, of their primary meaning. It was shown by Maxwell's equations that a moving, electrically charged body is surrounded by a magnetic field whose energy is, to first approximation, a quadratic function of speed. It seemed only natural to conceive of all kinetic energy as electromagnetic energy. Thus one could hope to reduce mechanics to electromagnetism, since efforts to reduce electromagnetic phenomena to mechanics had failed. Indeed this looked all the more promising as it became apparent

> that all ponderable matter was composed of electromagnetic elementary particles. But there were two difficulties that could not be overcome. Firstly the Maxwell-Loretz equations could not explain how the electric charge constituting an electrical elementary particle can exist in equilibrium in spite of the forces of electrostatic repulsion. Secondly electromagnetic theory could not give a reasonably natural and satisfactory explanation of gravitation. Nevertheless the results that electromagnetic theory achieved for physics were so significant they came to be regarded as a completely secured possession, indeed as its most firmly established success.

Einstein's facts are still true today:

- Electrostatic repulsion is a problem for (QED) particle models.
- No gravity from electromagnetism.
- Electromagnetism is firmly established as a field.
- Electromagnetism is firmly established as a field.

You may think you have found a problem in the text - Iv'e gone and duplicated that last point! Sorry, nope.

- *Field* as a real, base level physical entity.
- *Field* as in a 'what field do you work in?' QFT.

Both of these fields are problems for even anyone even trying to mention that electromagnetism might be an emergent phenomenon, which is one reason that there are so few papers on it lately.[11]. There are some that stick out though - from 7 or more decades ago.

2.3 Rainich, Misner and Wheeler

Wheeler pointed out that Einstein also worked on unifying his General Relativty with Electromagnetism, and furthermore that he had no idea of Rainich's work, which seems a shame. Einstein was into altering the equations of General Relativity to include electromagnetism. Wheeler[95]:

> Unaware of Rainich's early work, Einstein had tried for many years, up to his death, to invent some new kind of geometry[46] which would have sufficient richness to describe both gravitation and electromagnetism.

Einstein's non symmetric tensor didn't work.

In contrast, Misner and Wheeler's approach[67][96], based on Rainich[74] does exactly what I am aiming at here, with one exception - Misner and Wheeler obtain 'charge without charge' from field lines trapped in wormholes.

I instead try to construct a wormhole free[1] source of electromagnetism. With such a construction, much of the rest of 'already unified' formalism of Rainich, Misner and Wheeler can be used.

2.4 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 (in at least three senses of the word) we can get in this chapter.

2.5 Emergence

The emergence of electromagnetic phenomena from Einstein's 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[60]. I don't use the Kerr - Newman 'charged' solution[69], 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[24] 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 gravtitational phenomena.

Other people have looked at electron as a Compton radius ring of some sort. Usually called zitterbewegung motion from the Dirac equation[38]. See Hestenes[53], Barut[12], and Maddox[62] (yes the editor of Nature back in the day, when Nature meant something).

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 $99\frac{44}{100}\%$ of pure physicists know can't exist in nature. But they won't argue that this naked ring is a solution of Einsteins vacuum equations, (i.e. 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 8) is a possible model of the electron.

As a defence of my so far nascent electron model, I will point out that there is no truly self consistent model of the electron known at this point.

[1] I like wormholes as much as the next person, don't @ me.

As the Richard Feynman one of a few authors of QED, our best 'standard physics' model of the electron pointed out[48] (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."

Our standard model physicist[2] 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 seven decades since QED[47]. QED renormalization is now a walk in the park. To be fair, it does actually work. (Although see Consa[31] 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 paste* - the energy you need to bring together bits this paste to form a small thing that looks like an electron goes to infinity. The problem is that 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 10^{42} longer than the natural 'black hole' size of the electron). Dividing this long singularity into 10^{42} sections, I find that each section has a gravitational wave interaction about equal to the gravitational Newtonian interaction between two electrons (a cross section). And all these small interactions can add up to a huge Coulomb level force between two of them.

2.5.1 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 electromagnetism, since in reality all charges are of unit size. I will use this second one. Note that:

- α is a number, about $1/137$.[3]

[2] A *standard model physicist* is a normal card carrying member of the professional ranks of the academic industrial complex, level 3 or higher.

[3] Feynman - "all good theoretical physicists put this number up on their wall and worry about it."[48] (I doubt they do any longer –Tom)

- $\hbar$ 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)

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

I will now construct a force k' stronger than the usual Newtonian gravitational force using only the Kerr solution of Einsteins equations, with no reference to electromagnetism. If your afraid of magicians, look away, now.

2.6 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)[90], the expression for the 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 8. 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, we get a ratio of these sizes:

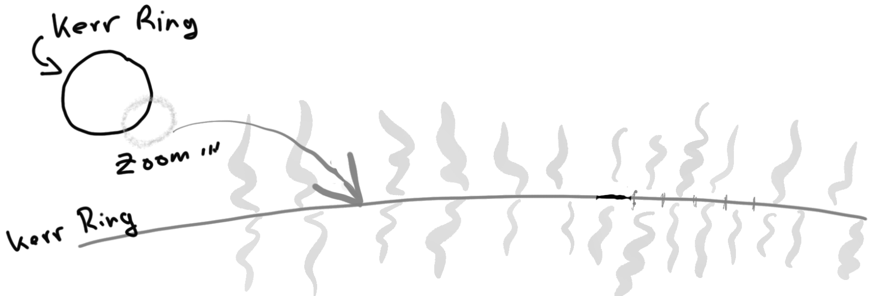

Figure 2.1: Upper left: A Kerr ring singularity. Main: zoom in on a small section of it to reveal gravitational waves of a wavelength equal to the Schwarzschild radius (and up). This results in about 1.4×10^{44} segments, each interacting with an α cross section.

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

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 next 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? In other words - I have some compelling (to me) geometry - but no force yet.

2.7 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 $\alpha G m_e^2/r^2$, 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 might lie in gravitational wave interaction, it better, because that's all I really have, as 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 will interact very well[68] 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, via superradiance, emit or absorb a significant fraction (10%!) of its energy given the right gravitational wave parameters.[21].

Each section would need to be interacting with gravitational waves of a fantastic frequency - the wavelength would have to about 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, $10^{65} Hz$ frequency would be tiny, as the energy carried in a gravitational wave depends on amplitude and square of frequency, much too small to cause directly measurable 'gravitational' effects. These waves are many orders of magnitude smaller in amplitude than those measured by LIGO, for example. We would only see the force of one electron on another as they exchange gravitational wave energy, interpreting it as the Coulomb force, since there are so many interactions happening at once.

Once we have individual segments interacting with 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.

Other researchers have looked at models of electromagnetic interaction - Cetto[29] outlines a physical description of QED, using a physical model of QED arising from a stochastic background field.

We're still at the 'believe me' level here, and it's going to stay that way. I leave it to someone to point out all the problems with this kind of solution. But there are some good points:

- Not a QED like charged goo model.
- Fewer infinities (there is that naked singularity).
- Easy to understand for engineer types.

2.8 Carrier waves

Essentially, electromagnetic 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. The carriers are 'spin 2'.

If you think you know that spin 1 photons can't be built with spin - 2 gravitational waves, I have news for you. Here, for instance is someone[81] 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 experimentally observed spin of a field can be emergent. As an example Cetto de la Peña obtain fermion statistics from a spin one field.[28]. Here Barceló[11] shows how one might emerge electromagnetism itself. Also see Ranada[75].

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.

2.9 Calculating α

The hypothesis that these ultra high gravitational waves

2.10 The End (of this chapter)

The ratio of the size of the Kerr solution to the Schwarchild solution for an electron being the same as the ratio of electric to gravtiational forces is telling.

The

3

Physics Today

"In science there is only physics; all the rest is stamp collecting."
– Lord Kelvin

3.1 Stamp Collecting

Collecting stamps in physics consists of interpreting every experimental result as another stamp of approval. Why is no one worried about:

- Forty free parameters in the Standard Model.
- No cool hairdos anymore.[1]
- Dark Matter completely missing in the Standard Model.
- Dark Energy completely missing in the Standard Model.

[1]appears fixed. see Figure (3.1) Thanks!

Figure 3.1: "for the discovery of a supermassive compact object at the centre of our galaxy" From[19] Creative Commons

- String Theory^{TM}.
- Dippy renormalization in QED.
- Completely unrenormalizable strong force.
- Completely ungovernable strong force.
- Completely unmanageable strong force.
- No coherent model of the vacuum.
- 1000 person years on Quantum Gravity/Strings/Loops and not much progress.
- Astronomy kicking its butt.
- Global schools of thought built using social media.
- Independent free thought.
- 2024 Nobel doesn't even go to a physicist.
- 27 Dimensions.
- 11 Dimensions.
- Heck, 5 dimensions.
- Infinite multiverses (at least 3).
- iPhones are cool, but we don't have flying cars.
- Jillions of bandwagon papers. :-(

3.2 Rant

Obviously physics is filled with mostly nice people. Wouldn't want to ruffle any feathers.

Theoretical physics went well until about 1980. Theoretical physics then stumbled. 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. [99][82][55]. But perhaps the biggest problem are 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.

3.2.1 How do we Restart Physics?

I don't know. But maybe we need to break it, and see what happens.

3.2.2 Books

- Lost in Math.
- Not Even Wrong.
- Not this Book. (how is that working out?)
- Lee Smolin
- For some reason I'm not gonna list actual great useful works that allow actual calculations so we can actually move ahead. But these do exist! Know your stuff.

We should watch:

- Youtube videos by Dialect.
- Pisra.org videos.
- Channels
- Nice Guy daily
- ....OTHERS

3.3 Summary

Do everything I wouldn't do.

4

Monopole Gravitational Waves

"Now consider gravitational radiation. Let the mass-energy density be $\rho(r)$. The monopole moment is $\int \rho(\mathbf{r})d^3r$, which is simply the total mass-energy. This is constant, so there cannot be monopolar gravitational radiation."

– Standard Model Physicist, *Astro 498[66]*

4.1 Monopole Waves

Monopole Waves are waves that emanate spherically from a source. Due to symmetry, they can really only be pressure, also known as longitudinal waves. The typical example is a spherical speaker (who has spherical speakers? Is it 1974 or something?). The sound (sound is a pressure wave) goes in all directions and each wave crest forms a spherical pattern, moving away from the speaker at the speed of sound. That is how acoustic monopole waves work. Let's look at General Relativity now.

4.2 They Can't Exist

One of the most famous theorems of General Relativity is Birkhoff's Theorem[16]. It's clear, the gravitational field outside a spherical mass is always exactly the static Schwarschild field. So with that big word static in there, it seems there cannot be and monopole gravitational waves. Case closed.

One can, however, make (an almost trivial) 'dragged along' monopole gravitational wave by imagining a typical supernova explosion, with an unlucky observation spacecraft orbiting around it. The basics are depicted in figure (4.1) In a supernova a large amount of energy is emitted as neutrinos

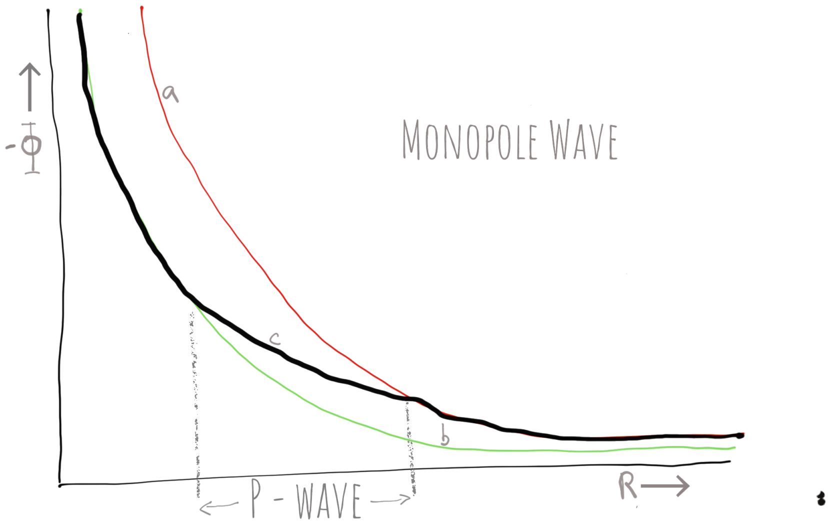

Figure 4.1: Monopole Wave: Birkhoff's theorem holds even for a dynamic situation as, for instance discussed in the text. The left axis is the negative of the gravitational potential, bottom axis is radius. Curve a is for a large mass, b for a small mass, and c for the actual physics. The region shown by the label $P - Wave$ is the location of the moving monopole gravitational wave.

as the first step, about 1/1000 of a solar mass worth of energy. The spaceship has no neutrino detector on board, but can of course observe its own motion accurately. It will notice the central mass drop as the (undetected) neutrinos pass by. This wave (not self supported), is a monopole $p - wave$, it's spherically symmetric, and will resize a ring of beads in manner so as to allow the extraction of energy (Feynman's criteria). It doesn't violate Birkhoff's Theorem, the gravitational field always looks spherical, and describes the mass - energy still left inside the position of the spacecraft.

4.2.1 Vacuum solution

Another example of this phenomenon is obtained by looking at a LIGO[2] event using the vacuum Einstein Equations $R_{\mu\nu} = 0$(equation 1.1 in the intro again). In that spectacular 2015 $GW150914$ LIGO event, about 3 solar masses of energy were emitted. It's interesting to think about the 3 solar mass monopole wave that must have accompanied it as being a part of the pure vacuum field equations, after all the entire $GW150914$ event took place in an Einstein vacuum region.

But the Einstein equations don't automatically include the energy of the gravitational field itself. One has to 'cheat' and move the gravitational waves to the right side of the equation (into T) to get anything to work at all. Which likely isn't good.

So people naturally look for solutions to this problem. [36]

> Thus non-trivial gravitational fields that satisfy the Einstein field equations with T = 0 have no covariantly defined mass-energy or momentum densities associated with them.

It may be that the Einstein theory of General Relativity is missing something![13]. See chapter 6 - where I look at this in depth.

4.3 Energy argument for their existence

In this chapter, instead of looking at how to perhaps modify Einstein's General Relativity, I look at an energy based argument for the existence of monopole gravitational waves. I think the rational for independent (non dragged - along) monopole waves is strong, and I don't want to muddy the waters by looking at one psuedo tensor or other approach.

4.3.1 Brown & York and Lynden-Bell & Katz

The fact that Einstein's equations don't describe energy in the actual field just *feels* wrong. To deal with this feeling, physicists have come up with some ways to think about the energy in a gravitational field. It's called 'quasi-local' energy. In most papers on quasi local energy, the authors don't discuss ways of modifying the Einstein field equations to take this quasi local energy into account, they 'merely' come up with expressions that describe energy in the gravitational field. So my plan is as follows: I look at the expressions for gravitational energy in the field from Brown and York[23], and Lynden-Bell Katz[33]. I then look at a radial perturbation of gravitational field energy.

4.3.2 Gravitational Energy Density near you. (Gasoline!)

To get a feel for these energy densities, consider this. The Lynden-Bell and Katz or Brown and York energy density[1], are, to an excellent approximation, once your radius exceeds the black hole radius by a good amount:

$$E_{density}(\bar{r}) \approx \frac{1}{8\pi}\frac{GM^2}{\bar{r}^4}. \tag{4.1}$$

For the earth's surface we have an energy density of $6 \times 10^{10} J/m^3$, which is according to WolframAlpha, is about the same energy density as gasoline.

[1] while both these have the same magnitude, one is negative, the other positive!

More than I guessed it would be. Don't think about it, you'll be fine. (Or maybe *do* think about it and a way to extract it for space travel!)

The total mass of the quasi local gravitational energy around the earth is less than one part in 10^{-10} or about the mass of all the stuff built by people. So like not much.

4.3.3 Monopole Wave Energy Calculation

The idea is to create a monopole wave that isn't 'dragged along' - instead the energy in the gravitational field will itself be used to create a wave. It turns out that the energy won't balance unless we get the monopole wave moving.

Looking again at figure 4.1, this time instead of a accompanying burst of energy (like the supernova neutrinos or the gravtitational waves of a LIGO event), I will try and look at the excess energy in the 'P - wave' zone in the image, and imagine it moving, either outward or inward.

Consider a spherical area of Minkowski (flat) geometry (Figure 4.2). The gravitational field is Minkowskian (flat), so the energy in this interior area is zero. Outside of this region is a region of vacuum gravitational energy, in the form of a Schwarzschild metric, truncated at the boundary, say at $\bar{r}$. As per Birkhoff's theorem, we really have no choice, this exterior region must look like a black hole of mass M from the outside. See Vishwakarma[89][88] for details on the reality of energy in the gravitational field. The situation as shown in the image is at best unstable, and perhaps implausible[2]. The idea is to figure out a plausible, if dynamic solution for this configuration.

Now let's consider the gravitational field energy in this system. From Lynden-Bell and Katz[33], the field energy outside of $\bar{r}$ (in isotropic coordinates, hence the use of the notation $\bar{r}$) is

$$GM^2/2\bar{r}. \tag{4.2}$$

We note that at the horizon, in isotropic coordinates, the radius is $\bar{r} = GM/2$, so for a complete, 'normal' black hole we see all the mass of the black hole is in the field. That's the basic idea of these energy density formulas.

However, with our 'hollowed out' Schwarzschild solution, there will be a mass/energy shortfall. Given any $\bar{r}$ the - where is this energy? While energy can get tricky in general relativity, nothing is stopping us from starting with the flat region being of a large radius $\bar{r}$ to put general relativity into an almost linear regime, where energy conservation is simple. We now assume that this missing energy is kinetic energy - that the boundary is rapidly moving (pure gravitational fields carry kinetic energy). Thus the total energy in the entire diagram (inner flat + outer) region is:

[2] but I bet one could construct it from some Fourier series of gravitational waves...

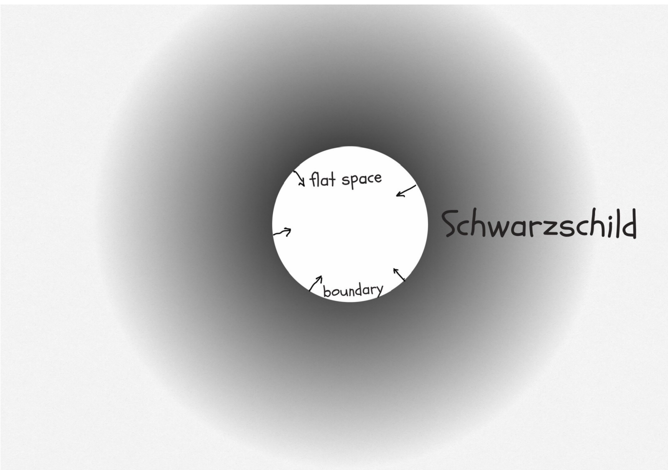

Figure 4.2: Monopole Energy: In the outer region there is a Schwarzschild metric, which is impinging on a spherical region of flat space. We will find that the boundary must be rapidly moving to satisfy energy conservation.

$$M = GM^2/2\bar{r} + K.E. \tag{4.3}$$

Where the LHS M comes from use of Birkhoff's theroem. For K.E. we can use either the Lorentz or Newtonian formulas.

Using Newtonian Kinetic Energy

Using Newtonian mechanics, rearranging (4.3), and assuming that the effective moving mass is a function of radius, $m(r)$,

$$\frac{1}{2}m(r)v^2 = M - GM^2/2\bar{r}, \tag{4.4}$$

What is this dynamic - moving mass $m(r)$? We note that most of the mass is near the boundary area since the quasilocal energy is mostly all near the inner surface, so $m(r) \approx GM^2/2\bar{r}$. Making the substitution in to (4.4), and solving for v we get, still in isotropic coords,

$$v = 2\sqrt{\frac{\bar{r}}{GM} - \frac{1}{2}}, \tag{4.5}$$

or in the more often used Schwarzschild coordinates,

$$v = 2\sqrt{\frac{r}{GM} - 2}. \tag{4.6}$$

Thus, if the boundary is moving at v, we have energy conservation. Birkhoff's theorem works at any radius. It's obvious that the velocity could be positive or negative, so the pulse could be moving in or out. The calculated velocity here is greater than the speed of light (which is 1 here), except for close to the horizon. It's easy to calculate, and is often about 10^4c in places like earth bound labs and interstellar space. It seems to be frame dependent, too - since the speed depends on the (inverse of) the gravitational potential, GM/r, a global fact of the spacetime.

For actual physical spacetimes, such as on the surface of the earth, an approximate value of v can be calculated by looking at the nearest masses and picking the slowest speed. (At earth's surface, remembering the black hole size for the earth's mass is about a centimetre, and the earth's radius is 6000km),

$$v_{earth} = 2\sqrt{\frac{6000km}{1cm} - 2} \approx 25000c. \tag{4.7}$$

From the sun on earth:

$$v_{sun} = 2\sqrt{\frac{150e6km}{1km} - 2} \approx 12000c. \tag{4.8}$$

The reason, in our view, for taking the time to layout the Newtonian superluminal solution for this velocity is that the solution already violates the equivalence principle, perhaps implying a more Lorentzian viewpoint of Einstein's Ether[45]. Namely that there is a special frame, and if there is, there must be Lorentz violation.

Relativisic KE

Using a relativistic approach to the total energy, generically,

$$E = \frac{m}{\sqrt{1 - v^2}}. \tag{4.9}$$

For the case here, we know the total energy is M, while the rest mass of the gravtiational field is $GM^2/2\bar{r}$, so

$$M = \frac{GM^2}{2\bar{r}\sqrt{1 - v^2}}. \tag{4.10}$$

Solving for v,

$$v = \sqrt{1 - \frac{G^2M^2}{4\bar{r}^2}}. \tag{4.11}$$

This relativistic result seems to be the one to use, but it's still dependent on the gravitational potential, which is strange, and brings us back to a global potential dependent velocity. Which is why I'm more inclined to pick the funner solution. I mean who doesn't want a faster than light effect?

4.4 Experimental Consequences

Monopole vs transverse Surface (deep water) vs Shallow water (Tsunami waves) with the entire velocity thing... crashing on shore, etc.

Tsunami has same speed formula as these waves. Shallow == black hole horizon...

4.4.1 Experimental Consequences

Quantum mechanics has non

4.5 Quantum Mechanics from General Relativity

my theory

4.6 Dark matter is quantum mechanics

Model is laid out

5

Quantum Mechanics

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

– Eric Weinstein talking to Brian Keating, *Youtube[39]*

5.1 Madelung 1927

While quantum mechanics was becoming the buzz in physics, Madelung[41] tried to break the field open into the direction it should have gone (and yes that is my opinion). 1927:

> It is shown that the Schrödinger equation for one-electron problems can be transformed into the form of hydrodynamical equations.

His observation was that one can take the Schrödinger equation and pull it apart into two equations involving real phenomena, without the pesky $i \equiv \sqrt{-1}$ that causes undergrads all that trouble.

Turns out i is often concered with drag or honey, etc. So hydrodynamics drops right out of quantum mechanics, if you let it.

We all know the outcome of that, Madelung was footnoted away, and complex algebra in quantum mechanics became so ingrained in the mind of the standard model physicist[72] that now they are saying it's required![10] No, American Physical Society i is not required.[65]. If you want a simpleton explanation (i.e. by me) you can have a look at the American Physical Society paper and see if the hydrodynamic formulation is mentioned. It's not. The American Physical Society paper does have this 'get out of jail free' scentence in it, though:

> As Renou and his co-workers point out, these results would not be applicable to alternative formulations of quantum me-

> chanics, such as Bohmian mechanics, which are based on different postulates. Therefore, these results could stimulate attempts to go beyond the standard formalism of quantum mechanics, which, despite great successes in predicting experimental results, is often considered inadequate from an interpretative point of view

Ok - so maybe I'm being a little harsh on them. After all it's a great segue.

5.2 Emergent Quantum Mechanics

Everything, according to this thesis, is emergent, so then must be quantum mechanics. There is even an honest to goodness entire (ok small) research community publishing papers like [1],[50],[3],[92], [40], [7] etc.

These emergent quantum theories all say (including mine) that there is some underlying process or commonly a field from which quantum effects emerge.

5.2.1 Hydrodynamic Quantum Analogs

One of the most inspiring discoveries in theories of quantum mechanics has been the development of Hydrodynamic Quantum Analogs, which is tech speak for little (millimeter) drops of silicon oil that 'self float' above a vibrating little bathtub (watch the videos if you don't believe me). Couder and Fort [42] are the acknowledged pioneers of this macroscopic quantum emulation in a petri dish business. (Although I remember being at Dinty's coffee in 1986 and vibrating styro coffee cups, watching the little balls of coffee running around on top of the coffee and thinking - 'thats a great model for particle physics'.) Here are a couple of fun movies to watch - [6], [87]

These videos, are 'actually good'[84] as this comment attests:

> Dude, I have a PhD in quantum information theory, and I've never heard of these droplets. This analogy is absolutely beautiful.

This Physics Today™ article by Bush and team is great.[25]. Trust me, you will learn lots - also pretty - see figure 5.1.

Of course no one really thinks that quantum mechanics is powered by $10^{-19}m$ drops running around on some 2D oil bath. Although certain people have nonetheless tried to argue on that basis. Shame on them (not the reporter - the scientists, lol).[100]

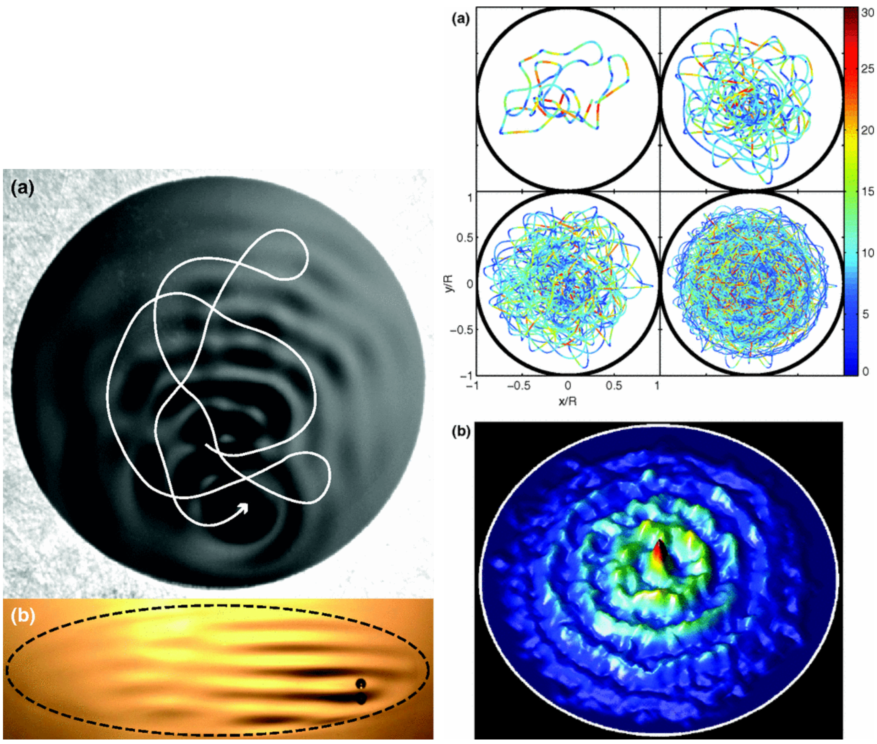

Figure 5.1: Walker: Bush, continuing and expanding on by earlier experiments by Couder, has shown just how a millimetre sized droplet on a vibrating bath can emulate a analagous quantum mechanical system. From[51] Used with permission

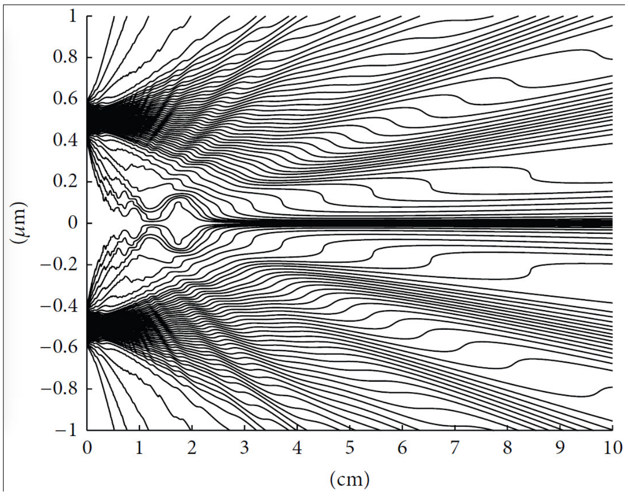

Figure 5.2: In de Broglie - Bohm theory, particles follow definite paths guided by the quantum potential. As J.S Bell states, there is zero indeterminacy or vagueness. From[49] Creative Commons

5.2.2 The de Broglie Bohm Model

Perhaps the most famous theory of quantum mechanics that comes to mind when one thinks about emergence, is the de Broglie - Bohm theory[18], [22], [85], [17]. From my point of view, de Broglie's theory is more in line with emergent QM, while Bohm showed the world that quantum mechanics can be built with particle positions and waves. In other words de Broglie was trying to build quantum mechanics from a simple underlying field, while Bohm went for a perfect replication of quantum mechanics. Both ended up at about the same place.

As J.S. Bell put it [14]:

> Why is the pilot wave picture ignored in text books? Should it not be taught, not as the only way, but as an antidote to the prevailing complacency? To show that vagueness, subjectivity, and indeterminism, are not forced on us by experimental facts, but by deliberate theoretical choice?

About the only thing I have against the pilot wave theory of Bohm is that it's *too good* - it has predictions identical to that of quantum mechanics - it *is* quantum mechanics, after all. The wave function of Bohm is thus also just as multidimensional as all the Hilbert spaces out there, which I think is a little suspect. But still, to me, it's the closest thing we have to what nature is really like in the quantum regime. In figure 5.2 one can see the traces of hundreds of particles in a two slit experiment. It was an image like this which reignited interest in Bohmian mechanics in the 1980s.

5.2.3 Other Emergent Models of Quantum Mechanics

So typically, and with a generous oversimplification by me, one posits some sort of field which is not quantum (remember, we are building quantum mechanics here, so it would be a little circular to start with a quantum scalar field). Adler[4] is a pioneer in the resurrection phase of this field, and Grössing is a person I admired for his attitude, leadership and organizational skills (great EmQM conferences in the 2010s)[50].

de la Peña and Cetto, have worked on a theory of emergent quantum mechanics from electromagnetism - and it's pretty nice, too.[34].

> The main purpose of this book is to show that such alternative exists, and that it is tightly linked to the stochastic zero-point radiation field. This is a fluctuating field, solution of the classical Maxwell equations, yet by having a nonzero mean energy at zero temperature it is foreign to classical physics. The fundamental hypothesis of the theory here developed is that any material system is an open system permanently shaken by this field; the ensuing interaction turns out to be ultimately responsible for quantization. In other words, rather than being an intrinsic property of matter and the (photonic) radiation field, quantization emerges from a deeper stochastic process.

When authors in emergent quantum mechanics say their theory is non classical, they generally mean that the mechanism(s) required are not 'normal' classical mechanics - there are fields with no back reaction, the stochastic electromagnetic field of de la Peña and Cetto, etc.

Me, being bat crap crazy, have worked on a theory of emergent quantum mechanics from General Relativity - and it's pretty weird, too.[7]. But first let's look at some facts about quantum mechanics.

5.3 An Underlying Field

If quantum mechanics is emergent, there are two main tasks, determining the nature of the underlying field (Electromagnetism, Scalar, General Relativity) and on top of that field, the rules and regulations that allow that field to create experimental results that match what the standard quantum theory predicts.

Of course the two steps are interrelated. What I'm getting at here is that if one were to find my theory of the underlying material field as Einstein's Ether[45] (General Relativity), tenable, then hopefully you won't tie that to my interpretation of what makes it all go. IOW, I am likely wrong on all counts here, but in the chance there is something to General Relativity being the base structure of quantum mechanics, don't think it has to go exactly like I sketch out here.

5.4 Experimental Relality

What do we know about quantum mechanics?

1. Quantum mechanics works faster than light.
2. The normal stuff that they teach in uni

One might think I put item (1) in there just to get proper standard model physicists upset. But I really believe it - from an experimental viewpoint, quantum mechanics is 'non local'. The Nobel Committee agrees[5] (well they did in 2022). Here is what Maudlin has to say about it[64]:

> I retrace the history and logical structure of these arguments in order to clarify the proper conclusion, namely that any world that displays violations of Bell's inequality for experiments done far from one another must be non–local. Since the world we happen to live in displays such violations, actual physics is non–local.

Since Tim Maudlin is a philosoher, physicists can and do ignore him, or try and bury him[94], but he does fight back[91].

For me, non-locality is an imprecise description of what is going on. In the sense discussed in this book 'non local' means 'faster than light' - not acausal. Almost all physicists hold that these are equivalent ideas, because any faster than light effect can be looked at in a frame that violates causality, but as Sabine Hossenfelder[78], 'Dialect'(who is that?)[37] and this fine gentleman, Lukas Rafaj (reluctantly?)[73] point out, it's not cut and dry. There is no proof that Einstein's philosophical 'the way it is' approach to special relativity is any better than the Lorentz physical contraction theory viewpoint.

There may be a grand rest frame. Special Relativity does not rule it out. It 'merely' says that we can't use light beams, rocket ships, rulers or the Large Hadron Collider to find it. (Just don't look out a window at night, you might see a rest frame!).

Look at Consoli [32]

> In this way, by comparing with experiments [19, 20, 21, 22, 23] one finds the lower bounds $v_{QI} > 10^4 - 10^6 c$ if the preferred Σ frame is identified with the reference system where the Cosmic Microwave Background (CMB) is seen isotropic, namely that particular system where the observed CMB Kinematic Dipole [18] vanishes exactly.

Any theory of emergent quantum mechanics has to reproduce something like the Schrödinger equation, etc, so that all the atoms and NP gates work as they actually do.

Us very simple minded folk[56] like to think of the effects of quantum mechanics in the real world most often as just de Broglie wavelength effects. So while the theory people live a more Hilbert like lifestyle, us(? am i still one?) experimenters are still dealing with waves and particles, like Issac Newton and Thomas Young.[1]

So I'm going to concentrate on that bit of quantum mechanics, the source of these de Broglie waves. Sort of a 1920 level of description.

5.5 Quantum Mechanics from General Relativity

Finally, I will spill the beans on what I think is happening with quantum mechanics.

5.5.1 Some sort of Emergent Quantum Mechanics holds

I'll start by reiterating that I think that one of the extant models of emergent quantum mechanics as outlined in section 5.2 above is approximately right, and quantum mechanics is riding on top of some sort of field. I'm here to sell you on General Relativity being that field.

5.5.2 General Relativity has an ability to send signals faster than light.

What?

Did you not read chapter 4? I tried to show that General Relativity, if one counts energy in a reasonable manner, might allow for a faster than light pressure wave which has a speed of $\approx \sqrt{r/m}$ (relative to the master 'Cosmic Microwave Background' frame. This wave typically has a speed of $10^4 c$, in the earth, solar system and galaxy. This pressure wave is distinct from all the light speed stuff we know, which includes:

- Light (duh).
- Gravitational waves.
- Matter.
- Other stuff I have likely forgot about.

[1]Of course atomic physicists use the complete rules of quantum mechanics to predict the energy levels of atoms. Kudos to them to dream that they aren't chemists.

Matter is on the list at least experimentally, as it follows the Lorentz transformations. Basically this means that all the stuff we know and love is made of transverse waves. Well except for (according to me), the quantum mechanics stuff that seems to be in charge when it comes to many of the rules of the game.

5.5.3 The de Broglie - Compton effect

Particles vibrate at Compton frequencies. This is an experimental fact. Dirac called it Zitterwebung, (and used a number a factor of two away from the Compton frequency, which I won't worry about). For an electron it's $1.236 \times 10^{20} Hz$.

As de Broglie illustrated, one can get the de Broglie wavelength..

BLAH BLAH

5.5.4 Particles absorb and emit these monopole P - waves

So these faster than light pressure waves can experience boundaries and other phenomena. The waves set up a Faraday wave pattern - as in de Broglie, Couder, Bush, etc. This exchange leads to the 'quantum potential'.

5.5.5 The de Broglie - Compton wave

- —frequency - compton see 8
- —de Broglie effect - well known.

5.6 Dark matter is quantum mechanics

All these P-waves running around - we might be able to see them. Consider a model where each particle of matter (aka nucleus, neutron, proton, etc) ,

5.7 Weak force?

Look at a weak force model of stochastic quantum wave effects - seems doubtful...

6

Energy In General Relativity

"The energy of the universe, including the energy of the matter and that of the gravitational field, is investigated with the help of the Einstein gravitational pseudo-tensor. It is found that the total energy vanishes."

– From Nathan Rosen[76]

6.1 Einstein had a problem

The Einstein theory of General Relativity is missing something. Energy.

Einstein, in a lecture delivered on 9 September 1913 to the 96th annual meeting of the Swiss Society for Natural Sciences in Frauenfeld (translated)[43]:

Imagine this live and in person:

> It has already been emphasized above that the material process alone cannot satisfy the conservation laws; but we must demand that the conservation laws be satisfied for the material process and the gravitational field *together*.

A minute or so later he follows up with:

> ...that along with the stress-energy components $T_{\sigma\nu}$ of the material process, those of the gravitational field (namely, $t_{\sigma\nu}$) appear as an equivalent field-inducing cause, a circumstance that obviously must be demanded; for the gravitational effect of a system may not depend on the *physical nature* of the system's field-producing energy.[1]

[1] See the Princeton papers.

Note the word 'obviously'. Still, Einstein had to drop this *obvious* - that the energy of the gravitational field should feedback into the equations, in order to ship General Relativity in late 1915. The reason for this was that his energy tensor $t_{\sigma\nu}$ turned out not to be a tensor, but a rather a pseudo tensor. It isn't covariant.

Fast forward to today: Field energy in General Relativity is a mess. No proper covariant energy tensor has been found, most likely because it's impossible. The fix presented here is not a normal one, we're going to abandon covariance. But first the mess.

6.2 The Mess

6.2.1 Gravitational Field Energy Does Not Exist

Misner Thorne and Wheeler[97]:

> Anybody who looks for a magic formula for "local gravitational energy-momentum" is looking for the right answer to the wrong question. Unhappily, enormous time and effort were devoted in the past to trying to "answer this question" before investigators realized the futility of the enterprise. Toward the end, above all mathematical arguments, one came to appreciate the quiet but rock-like strength of Einstein's equivalence principle. One can always find in any given locality a frame of reference in which all local "gravitational fields" ... disappear.

The cope that people use to enable this is to simply shrug and say gravitational energy is not conserved. But MTW are saying more - they are saying that it doesn't exist. Read it again - at every point in a manifold, one can come up with a frame of reference where energy does not exist. Making *that* your frame zeros out the energy. Of course MTW on that same page wiggle out of their statement, using what I call $The\ Hack^{TM}$

6.2.2 The Hack

The solution used for this problem is for researchers to just 'know' when to bundle up some region of gravitational field energy and toss it into $T_{\sigma\nu}$. A mess. Sure it has a set of rules and makes sense - but lets get this out in the open, it's not automatic in the equations of General Relativity, as it should obviously be.

6.2.3 Consequences of No Hack

Without the hack described in the previous sub section, Einstein's equations are clear - in a matter free universe, the only solution is a flat (presumably infinite) Minkowski space. There simply are no sources. The Scwarshild solution is not really a vacuum solution, as it has mass, its just all concentrated at one point, which no one likes anyway. We clearly need *The Hack*^{TM} to do modern physics.

6.2.4 Quasi Local Energy

Szabados has a great review article on Quasi-Local energy.[83]. I note that it's pretty obvious that there is a huge problem with energy in General Relativity when a huge review paper can't simply state where this energy is and how to calculate it. In the last five or so decades, the use of quasi-local energy has come in as a useful tool to imagine the energy in a gravitational solution. Consider what the titans of General Relativity say about the location of the gravitational energy in the simplest solution out there, the Schwarzschild: (!!!get references!!!)

1. Penrose: The energy is all inside the horizon.
2. Brown and York: The energy is outside the horzion and negative.
3. Katz: The energy is outside the horizon and positive.
4. MTW: We are smart and you aren't.

6.3 A simple story

If we imagine a universe made with only the accepted Einstein vacuum field equations, we can get to a lot. Consider a model where the dust in the usual Friedmann–Lemaître–Robertson–Walker cosmological model is made of black holes, we can imagine a universe appearing with very similar gravitational profile to ours.

But there is a problem with that. What side of the Einstein Field Equations is this dust on? The entire thing is one (extremely complicated) vacuum solution, so we should be able to solve it with the stress energy tensor set to zero, but we can also move the black hole dust over to the right, creating the usual FRW dust stress energy tensor.

This reveals a paradox: If we assume the vacuum equations are handling this all on their own, then where is the mass? The gravitational field is massless according to General Relativity! When we put the dust in the stress energy tensor, we ascribe mass to each black hole.

Where does this mass come from? The usual explanation for this is that it's just the singular masses M - the constants in each black hole. But there are serious issues with this approach. Why can we use the mass parameter - the mass is not even causally connected to our universe! The mass M is 'just' a parameter in the Field Equations.

As Vishwakarma[88] points out, there are vacuum solutions of Einstein's equations where the free parameters don't . Indeed - that and other papers by him solidified my perspective. We need to ditch the stress energy tensor.

> A remarkable piece of evidence of the presence of fields in the absence of T_{ik} is provided by the Kasner solution, which exemplifies that even in the standard paradigm, all the well-known curved solutions of Equation (3)[2] do not represent space outside a gravitating mass in an empty space. [It is conventionally believed that only those curved solutions of Equation (3) are meaningful which represent space outside some source matter, otherwise the solutions represent an empty spacetime.

In order to achieve that, we have had to move the

6.4 The Psuedo Tensor(s)

A great into is this paper by Nikolic[71]

And from Baryshev[13]:

> Schrodinger (1918) showed that the mathematical object suggested by Einstein in his final general relativity for describing the energy-momentum of the gravity field may be made vanish by a coordinate transformation for the Schwarzschild solution if that solution is transformed to Cartesian coordinates. Bauer (1918) pointed out that Einstein's energy-momentum object, when calculated for a flat space-time but in a curvilinear system of coordinates, leads to a nonzero result. In other words, can be zero when it should not be, and can be nonzero when it should.

6.5 Kutschera

Tom views this paper as a plea for solving the gravitational energy problem - that if one takes a energy M, and converts it to a gas of photons that the energy doubles (density term the same in T, pressure terms now exist!). This bothered Landau, etc...

I will first look at Kutschera (2003)[61], *Monopole gravitational waves from relativistic fireballs driving gamma-ray bursts*

Kutschera studies the impact of this pressure - density formulation in General Relativity. He uses the Einstein Equations as given, and then comes up with '

[2] (His equation (3) refers to the Einstein vacuum equations.

> The gain of a significant amount of active gravitational mass during the formation period is a direct consequence of Whittaker's formula. It is the pressure-generated contribution that grows rapidly and eventually levels off. The other contribution to the gravitational mass is provided by the total energy of the fireball, which, as a conserved quantity, remains unchanged. Before the formation of the fireball this energy is included in the progenitor mass. **Hence the gravitational mass of the fireball, composed equally of energy density and pressure contributions, is not a conserved quantity.** This has profound consequences as it implies emission of monopole gravitational waves.

(I added the bolding of one scentence).

So he finds massive amounts of mass created when matter turns into a non equilbrium gas...a strange consequence of the Einstein equations. I'm not sure Kutschera has the correct viewpoint, in taking Einstein's equations at face value here. See this discussion on the Equivalence Principle in Vishwakarma[88].

This brings us to Tolman's paradox:

> Tolman's Paradox: A static spherical box has been filled with a gravitating substance of a given mass. If this substance undergoes an internal transformation (e.g. matter and anti-matter turning into radiation) raising the pressure, the active mass in the box would change because of the 3p-term since the energy is conserved. However, such an internal transformation should not affect the mass measured outside the box, say by an orbiting particle obeying Kepler's third law. In a spherically symmetric field the particle should be oblivious to all spherically symmetric changes inside its orbit, a consequence of the vacuum equations known as Birkhoff's Theorem [6].

On a more general level, people have studied this problem. There is no easy solution. One would like a covariant gravitational energy tensor to be able to bolt onto the Einstein equations, and fix all this, but Einstein, Landau, Wheeler, etc have looked. It seems it cannot be done. [13].

6.6 A Schwarzschild like solution

Here is the plan: Take the quasi local energy definition from Brown and York[23] or Katz[58], and try and apply it to a vacuum Schwarzschild - like solution, where the energy of the gravitational field is now included in the mass term, so that the mass enclosed within a given radius r is less than M, the mass at a distance. Which is how the gravitational field of any physical

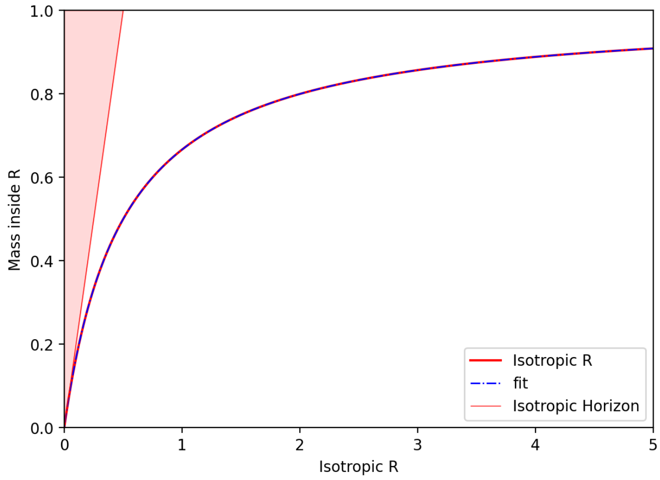

Figure 6.1: Assuming that building the gravitational energy around a 'black hole' requires energy, I find that there is no horizon. In addition, an exact analytical function describing the mass function was found.

object behaves. But instead of matter, we are allowing the energy of the gravitational field to itself have mass.

It's pretty easy to see that the resulting metric will not satisfy the usual Einstein vacuum equations, the equations will point to a stress energy tensor on the right side. This then is taken to be an instance of some sort of 'psuedo tensor'.

What is the function M(r) - what is the mass inside a radius r? The Lynden-Bell and Katz[33] use for the gravitational energy between $\bar{r}$ and $\bar{r} + d\bar{r}$ in isotropic coordinates:

$$GM(r)^2/2\bar{r}^2 \; d\bar{r}. \tag{6.1}$$

So we can think about getting the total mass inside an isotropic radius $\bar{r}$ distant constant mass M minus the integral of equation (6.1) $\bar{r}$ out to infinity. Another way of looking at it, is we start at a distant point out, then walk in, dropping energy from the (say collapsing) mass into the gravitational field at every step.

I have written a Jupyter python script to calculate this mass function. It assumes Birkhoff's theorem at every step, so the gravitational field outside of r should be identical to the Schwarzschild at that point. See the publicly available Jupyter file[77] for the gory details.

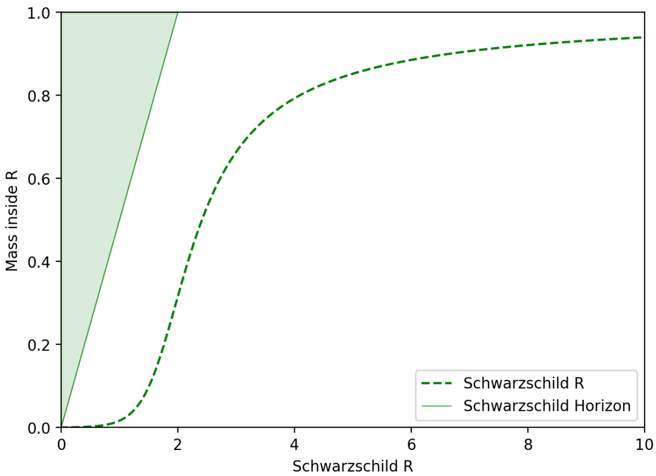

Figure 6.2: The same data as in figure 6.1, but with Schwarzschild coordinates. The mass at every radius is below the horizon radius for that mass, so there is no event horixon.

7

Quantum Gravity

*"We sing in the darkness
We open our eyes"*

– *David Byrne*

7.1 It's Simple

Well - honestly it is! Since in chapter 5 and the thesis of the work, we posit that everything is built of gravity, we gravity can't be in a superposition. Particles can't either, and we have a Bohmian trajectory like solution....

Take a double slit experiment. You *can*, in theory use gravity to tell which slit the particle went through, and also see a perfect interference pattern.

This results in specific experimental predictions:

Put poster in here...

8

The Electron Model

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

– Eric Weinstein talking to Brian Keating, *Youtube[39]*

8.1 This chapter

Basically, the electron model was leaked in chapter 2. What I add here is a model for the generation of de Broglie waves, thoughts on the 'lack of back reaction' in the de Broglie - Bohm quantum mechanics, etc.

8.2 Model - the Gravitational Zitter Electron

The electron is modelled as a dynamically perturbed uncharged Kerr solution to the Einstein equations. The naked ring singularity of the Kerr solution is found to have tension. The Gravitational Zitter Electron (GZE) is then simply this Kerr singularity - an electron model composed of nothing more than general relativity. These long singularities are found to be extremely efficient gravitational wave generators. In contrast to macroscopic matter, they are ideal 'stir sticks'/'stirees'[1] of the Riemann manifold. This efficient transfer of energy from/to the Kerr singularity of the GZE to gravitational waves at Compton frequencies results in the emergence of quantum effects through a de Broglie/Bohm pilot wave mechanism. At much higher frequencies of gravitational wave interaction electromagnetic strength forces emerge between these uncharged Kerr solutions, to be identified with the Coulomb force. Thus the electron can thus be modelled with only general relativity.

[1] Is stiree a word?

8.3 Electromagnetism

I could just copy section 2.6 here, but you will go back and read it again, right? As a recap, the electron is modelled as an 'uncharged' Kerr ring, with a long, thread-like singluarity, the length of which allows a carrier wave model of electromagnetic interaction.

8.3.1 The good bits

One of the main problems with electromagnetism is pointed out by Einstein, (I already quoted this at length in section 2.2 but I can't resist this part again): Einstein[45]

> Firstly the Maxwell-Loretz equations could not explain how the electric charge constituting an electrical elementary particle can exist in equilibrium in spite of the forces of electrostatic repulsion.

and Feynman[48] (again!) in more modern language:

> ...it is what I would call a dippy process!

What this zitter model of the electron I am proposing achieves is a way out of this 'charge is self repelling goo' problem. An actual mechanism for electromagnetism is promoted, one which does not use electromagnetism to explain itself.

I think that's a good thing.

8.3.2 Not so good bits

- Why is there quantization of charge? I'm not really sure yet, but I'm sure it will come to me any day now.

- The goofy thing about charge quantization is that its so accurate. A proton is composed of like eight to a jillion parts, each one having a charge of +1/3, -2/3, and numbers like that, all coming into and out of existence at some horrific rate. I guess an advantage of good old QM is that this charge quantization is just stated as an unquestionable truth, sort of like taxes.

- There really isn't a fully accurate description of electromagnetism here, it's just some ideas on how one can generate electromagnetism with general relativity.

8.4 de Broglie waves

8.5 From Zitterbewegung to Electric Zitter Electrons

In 1930 Erwin Schrödinger[79] found that solutions of the Dirac equation for relativistic electrons in free space predict a fluctuation at the speed of light of the position of an electron around its median path with an angular frequency of

$$\frac{2m_e c^2}{h} = 1.6 \times 10^{21} \quad radians/sec \tag{8.1}$$

at a radius of

$$radius_{zitter} = J/mc = \hbar/2m_e c = 1.93 \times 10^{-13} m \tag{8.2}$$

This zitterbewegung motion can be pictured as a helical path of Compton radius centred on the mean position of the particle. Several researchers have built electron models based on the helical motion of a charged particle. See Hestenes[53][52], Maddox[62], and Barut[12]. Hestenes summarizes after analyzing the Dirac equation[52]:

> *This leads to a self-consistent interpretation of the Dirac theory with the following features:*
>
> 1. *The electron is modeled as a structureless point particle travelling at the speed of light along a helical lightlike trajectory in spacetime.*
> 2. *The helical trajectory has a diameter on the order of a Compton wavelength, and a circular frequency on the order of twice the de Broglie frequency $mc^2/\hbar \approx 10^{-21}s$.*
> 3. *The helical motion generates electron spin and may be attributed to magnetic self-interaction.*
> 4. *Each solution of the Dirac equation determines an infinite family of such helices and a probability distribution for the electron to be found on any given helix.*
> 5. *The center of curvature for each helix lies on a streamline of the Dirac current.*

The radius and light speed is identical in value to that of the Kerr model as this is the most economical way to generate the spin angular momentum of $\hbar/2$. Still it is remarkable that the Dirac equation and the Kerr equation both point to a similar physical model, one using relativistic quantum mechanics, the other using the full theory of general relativity. Is zitterbewegung a connection between general relativity and quantum mechanics?

The main differences between the helical zitterbewegung charged electron of Hestenes (Hestenes) and the extreme Kerr solution with electron mass and spin (Present work):

- The Hestenes electron has charge, while the present work generates electromagnetism from general relativistic gravitational wave interaction.
- The Hestenes model uses a point like electron, where the present work uses a ring. (Though the ring may often be point like as seen below).

8.6 Tension in the Singularity

The electron model presented here is the GZE - the gravitational zitter electron, composed only of a Kerr solution embedded into a dynamic, stochastic background of only general relativity geometry .

The GZE is a ring singularity. This 'singularity thread' is rotating at c, at a determined size and total mass. The equation for tension in a rotating loop L of rope of mass M, which can be found in elementary physics textbooks is:

$$Tension = ML\omega^2/(2\pi)^2 \tag{8.3}$$

For a ring singularity the rotational velocity is the speed of light, so we have then a direct relationship between ω and L:

$$\omega = 2\pi c/L \tag{8.4}$$

Thus the tension in a Kerr singularity with electron mass and spin is:

$$T = \frac{2(mc^2)^2}{hc}, \quad T_{GZE} = 0.067\ N \tag{8.5}$$

So the tension in a Kerr singularity is finite, equals the mass per unit length (in geometric units), and quadratic in mass (for different particles). Keep in mind that larger masses also correspond to smaller rings. The calculation is accurate without using a relativistic expression, as it uses net values for mass per unit length and energy, etc. Note that this tension has the same characteristics as a cosmic strings, where as for example Brandenberger states[20]:

> Since cosmic strings are relativistic objects, a straight string is described by one number, namely its mass per unit length μ which also equals its tension, or equivalently by the dimensionless number $G\mu$, where G is Newton's gravitational constant (we are using units in which the speed of light is c = 1).

This dimensionless number $G\mu$ for an electron is

$$G\frac{m_e}{ring\ circumference} = G\frac{m_e^2 c}{\pi\hbar} = 5.756 \times 10^{-46} \tag{8.6}$$

The fundamental frequency of a tensioned string is given by

$$f = \frac{\sqrt{\frac{T}{m/L}}}{2L} \tag{8.7}$$

or since $\sqrt{\frac{T}{m/L}} = c$ in our case,

$$f = \frac{c}{2L} = \frac{m_e c^2}{h} = 1.24 \times 10^{20} Hz \tag{8.8}$$

The fundamental frequency is the Compton frequency. Regarding the rotating ring singularity as a tensioned spinning entity allows one to see that the singularity will not be fixed in a circular shape, but rather it will be deformed by any gravitational waves impinging on it.

The Compton frequency is the de Broglie fundamental frequency and is 1/2 the zitter frequency. See for example Wignall[98] on the relationship between de Broglie frequency and matter waves.

These distortions - which will increase the local curvature of the ring, will result in thicker parts of the distorted ring (remember that higher curvature means higher tension and higher mass per unit length). During bombardment by gravitational waves the circle of the ring singularity will be pushed into a non circular shape. A non circular ring will have quadrupole moments. It is well known that the emission of gravitational wave radiation tends to circularize elliptical orbits.

The GZE will react to incoming gravitational waves by scattering them in many ways, from super radiance to super absorption. The effect is large and direct, as singularities have a strong grip on spacetime. Singularities on a circular track will emanate gravitational energy efficiently. Superradiance on the global structure will take place at the primary de Broglie frequency, as superradiance peaks at that frequency.

Nakamura, Shibata and Nakao:[68] talk about the efficient radiation of gravitational waves from a naked singularity, in this case a spindle shaped collapse.

> Intuitively at the formation of the singularity, very short wavelength disturbances of space-time will be created. If there is no event horizon, these disturbances may propagate as gravitational waves so that naked singularity may be a strong source of the very short wavelength (i.e., $\lambda \ll M$, where M is the mass of naked singularity) gravitational waves, which suggests that the singularity itself should suffer strong back reaction.

8.6.1 Quantum forces, the de Broglie double solution and Fermi

From *de Broglie's double solution program: 90 years later* by Colin, Durt and Willox[30]

> This was highly dissatisfying for de Broglie and in his effort to reinstate the role of the corpuscle in the theory, he started to develop his double solution program (1925-1927), the (first) core idea of which is that there should be two synchronous, coupled, solutions of the wave equation:
>
> - a ψ-wave, the phase of which has physical significance but the amplitude of which does not,
> - and a u-wave, which is a solution describing a moving singularity, the singularity corresponding to the particle. A trivial example would be $u(t, \mathbf{x}) = \frac{1}{|\mathbf{x}-\mathbf{x}(t)|} e^{iS(t,\mathbf{x})/\hbar}$.
>   The phase of the u-wave is required to be equal to that of the ψ-wave and the u-wave itself is supposed to provide a description of the physical reality.

In the model presented here, the wholescale 'lowest order' vibration rate of the ring at the Compton frequency produces the ψ-wave, which is a high-memory wave that feels out the surroundings, and the ring itself is the u-wave - riding the ψ-wave in a Couder-Bush[26][86] like way, keeping the ring tied to the phase of the Compton ψ-wave. This 'walker force' is enormous, and thus looks like a Bohmian 'quantum potential' - something that sets the velocity of the particle. This velocity setting or 'mysterious quantum potential' is thus explained using Couder-Bush like mechanics, with the substrate being Einstein's ether - a substrate so many orders of magnitude more exact and powerful than the silicon oil of the table top analogs.

8.6.2 The Ring Singularity's apparent size:zero

The 2007 paper by Arcos1 Pereira (KN refers to the Kerr-Neumann solution): [9]

> This result is consistent with previous analysis made by some authors [refs], who pointed out that an external observer is unable to "see" the KN solution as an extended object, but only as a point-like object.We can then say that the "particle" concept is validated in the sense that the non-trivial KN structure is seen, by all observers, as a point-like object.

In other words the 'r' coordinate in the Kerr solutions (any coord system where the distant coordinate system used approaches the Minkowski system), tells observers far away from the object that the radius appears to be zero. This is the solution to the quantum spin puzzle. The main thing that makes quantum spin so 'quantum' is that its classically impossible to fit $\hbar$ into something the size of an electron. The electron is large, but from the point of view of an experimenter who is far away the size is zero. It's a geometric effect for distant observers. We are always distant in some way so measure the size of the electron to be about 0, with a 'quantum spin' that is too large to fit into the measured size of the electron.

Carter and Israel point out that the set of paths that end in the singularity is of zero measure.

Carter:[27]

> It will be shown that the ringlike curvature singularities in the inner parts of the Kerr fields are comparatively innocuous (they are in fact invisible except in the equatorial direction) in contrast with the all-embracing curvature singularity in the Schwarzschild solution.

It is well known that the gyromagnetic anomaly - the factor of two - of the electron is recreated with a Kerr - Newman. See Israel [57] for some comments on this.

8.6.3 Cross section of the Ring Singularity

The cross section is the Planck area, for a Kerr singularity of 'any' mass and angular momentum $hbar/2$. Cross section calculation is that the cross section of a section of the singularity of length of Shwarscild radius r_s also has a width r_s, so the total cross section of the ring is the length of the ring $L = \pi\hbar/m_e c$ times the width:

$$\sigma = length * width = \frac{\pi\hbar}{m_e c}\frac{2Gm_e}{c^2} = \frac{2\pi G\hbar}{c^3} = 2\pi Planck\ Area \tag{8.9}$$

So the cross section area of all charged particles is the same, as long as the cross section width increases linearly with mass, which seems reasonable. The GZE (or muon, tau) has a cross section for gravitational waves of the Planck Area.

8.6.4 Apparent size of the Ring Singularity

The cross section is measured by waves small enough to probe the microscopic scale of the ring. For measurements on scales larger than this (say larger than 10-21 metres) we need to use the overall geometry of the Kerr solution. Physicists probe the size of a particle using other particles. Imagine probing the size of the Kerr singularity with uncharged test mass point particles of high energy - what size would they measure? [27] points out that the cross section of the singularity measured this way is a 'set of zero measure'. Arcos and Pereira argue that high energy interactions will show electrons[8] [9].The Boyer-Lindquist coordinates also show a radius of zero as

8.6.5 Strength of the GZE interaction

The force on the GZE from another nearby GZE can be modelled by looking at the exchange of gravitational wave energy between two such particles a distance r apart.

Nakamura, Shibata and Nakao:[68] estimate that the energy released by gravitational waves in a spindle is such that almost all the initial rest mass energy will be radiated as gravitational waves in some small multiple of the light travel time across the spindle. (see section 3). A GZE when perturbed will be in this spindle like shape, and hence the result hold. shaped approximate spindle shape of some multiple of the distance our case this corresponds to the GZE losing energy and gaining it back from a stochastic background of all other GZEs. The GZE exchanges an amount of energy about equal to some fraction of its mass over each Compton time interval. Call this fraction α

8.6.6 The Highly Efficient Singularity

The GZE model consists of a string singularity that is a Compton radius in size, spinning at the speed of light. For gravitational waves at a frequency greater then the Compton frequency the singularity can be thought of as a straight section of tensioned string, moving at c. The action of a passing gravitational wave in an ideal geometry (lined up with to the rotation axis of the GZE) of amplitude h and frequency f is to alternatively stretch and compress a wavelength long section of the singularity. Since the singularity is under a tension (0.067 Newtons for the GZE), this requires energy. The amount of energy exchanged per second on the entire ring for a monochromatic wave is by dimensional analysis: If we look at one singularity segment of length $\lambda = 1/f$, a wave passing of amplitude h will cause an energy change in the singularity string of $T\lambda h$. This happens at a frequency f repeated about r_{GZE}/λ times per half cycle on the singularity. (Not $2\pi r_{GZE}$ from geometry since only the parts of the singularity parallel to the wave will compress/expand).

Thus for the entire ring:

$$E(flow) = 2Thfr_{GZE}. \tag{8.10}$$

Since the singularity is travelling at the speed of light perpendicular to the wave vector, there will be also be energy transferred into the ring singularity (or removed) based on delicate frequency and angle effects. In other words the GZE exchanges energy with the surrounding gravitational field in an efficient manner.

For example for a frequency 1000 times that of the Compton frequency, and a gravitational wave amplitude of $h1x10-23$), the energy flux works out to $E(flow)3x106eV/s$) This large force integrated over multiple frequencies might be identified with an emergent electromagnetic field - em from gravitation.

8.6.7 The emergent electric potential

The electric potential is the fundamental level of electric behaviour in this theory. One arrives at an potential phi as above, and one can see by wiggling a single one of these constructions up and down that a field will be created identical to the vector potential of radiation. The electron on the other end feels this vector potential identically to the way a standard model electron feels the potential, and thus we create EM vector potential and all of Maxwell's equations. See [93] - or at least show how a scalar + vector potential is easier to model/think about. Note that [93] talks about the reality of the ether. Einstein also believed in the reality of the GR ether.[45]

8.7 Quantum behaviour from memory effects

Note that a tuning fork rings at the same frequency no matter how you hit it.

Memory effect of the Kerr response to GW wave bombardment. At resonance, we have the deBroglie fundamental frequency, (i.e. Compton) and after being hit with a GW, the Kerr will re-radiate with memory. Couder - Bush - de Broglie memory.

Pauli exclusion principle is related to the two available polarizations of a gravitational wave?

So this memory effect combined with energy absorption and re-radiation IS QM.

Kerr ring has two frequency bands. EM band is high frequency exchange in the linear region of the singularity line, while Compton - de Broglie frequency is QM.

The memory effect can be quantified by estimating the Q value of the ring in various scenarios. (Does Q increase with increasing stochastic GW energy).

SEE FEYNMAN $http://www.feynmanlectures.caltech.edu/I_41.html$ equations 41.5, 41.6 Q is discussed. Q might be very high !!

$$Q = 2pi \frac{EnergyStored}{EnergyDissipatedpercycle} \tag{8.11}$$

Energy storage of a ring: We have tension, etc say a fraction f of energy is added to the ring, it vibrates. Is the only energy loss in GW? I think so, there is no friction or heating loss. So GW emission is....

$$Energy\ stored = \frac{1}{2}\mu\omega^2 A^2\lambda \tag{8.12}$$

Since $m_e = \mu\lambda$

$$Energy\ stored = \frac{1}{2}m_e\omega^2 A^2 \tag{8.13}$$

$$E_{flux} = \frac{\omega^2 c^3}{32\pi G}(h_+^2 + h_\times^2) \tag{8.14}$$

The quantum energy out/in for an electron is

$$E_{flux}\ *\ ring\ width\ *\ ring\ length \tag{8.15}$$

The string singularity has a radius of influence of r_s - so r_s is the ring width and R_e is the ring radius.

The dimensionless h is A/R , so we have

$$E_{output\ de\ Broglie} = \frac{\omega^2 c^3}{32\pi G}(\frac{A}{R_e})^2 r_s 2\pi R_e \tag{8.16}$$

Energy output in ONE cycle is simply

$$E_{singlecycle} = \frac{\omega c^3}{32\pi G}(\frac{A}{R_e})^2 r_s 2\pi R_e \tag{8.17}$$

The ratio is the Quality Factor for an electron Kerr ring is the ratio of the two equations above

$$Q_{quality} = \frac{8\pi}{4}\frac{\hbar\omega}{c^2 m_e} = 1 \tag{8.18}$$

That's a long journey to end at 1! A quality factor of one in a sprung device implies optimal damping.

8.8 Conclusion

Many, if not all physical theories have absurdities built into them. Newtonian gravity has its problems as Newton himself pointed out with instantaneous effect transmission, general relativity has its singularities, and quantum field theory has its renormalization problem, which Feynman called in the case of QED a 'dippy process'[48].

The singularities and self inconsistencies in quantum field theory are of a different nature from those in general relativity.

Trying to calculate the Standard Model (even with out gravity) using QFT gives rise to many self inconsistencies. For instance even the stability of the vacuum is not guaranteed[35]. The infamous ZPF energy calculation error of 124 orders of magnitude is another example of the frailty of present state of quantum field theory. Another way, perhaps a little harsh, of stating the current situation is that the formalism of the Standard Model breaks down of its own accord. *The Standard Model blows up all on its own.*

In general relativity the singularities only cause problems when they are exposed to other fields, such as electromagnetism, or indeed any Standard Model force. If one takes a universe with only general relativity in it, then singularities are well behaved in the sense that they do not destroy the vacuum, or explode/implode all on their own. *General Relativity does not self destruct all on its own.*

Can we construct elementary particles and quantum mechanics out of nothing more than general relativity? We suppose the answer is yes, but there is much more work to be done.

[54], [24]

9

Thanks

> *"You guys need more money. You struck the worlds worst licening deal."*
>
> – Eric Weinstein talking to Brian Keating, *Youtube[39]*

9.1 This chapter

I'm not sure what to say here.

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