Physical Truth

A New Philosophy

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For Tara

Preface – A Personal Introduction

What is Truth? Does it exist? How can we know it and recognize it? Should we follow it and adhere to it? Does it matter?

The Truth exists. The Truth is real. The Truth is so real that the entire Universe is made up of the stuff.

Our culture, the culture of the western world, the culture of northern Europe, is very, very recent. Our culture goes back only about two to three thousand years – it is just at its bare beginnings and our recent way of life is but a few centuries old. And yet, even we, of a materialistic and self indulgent society, have our cultural roots in the search for Truth.

The Greeks thought Truth to be a supreme virtue. Vikings and Celts thought Fate could be changed through acts of great courage and virtue. The middle ages saw the birth of our legal system based on the belief that Truth was so powerful that a honest man could not possibly lose in a trial by combat or be abandoned by the Source of Goodness in an ordeal.

My journey has come to an end. I was walking along the banks of a dried up river in Southern Alberta. I was thinking of Truth and the many truths that follow from it. "How am I going to explain this?" I thought. I looked down and saw stones in the river bed, many of them. I saw one in particular and reached down and picked it up. "Ah," I thought, "this will do nicely. A perfect example of Truth." I held the stone with a degree of gratitude. It is so remarkably simple.

I thought back. My search for Truth began a very long time ago. I was rather young, I guess 10 or so in the late 1950s, and I read the life of Socrates from a wonderful book for boys titled, "Socrates". I really admired the ancient philosopher for laying down his life for what he believed in, esoteric though it was, and grasping the crown of martyrdom when it was offered to him. He said he was an old man anyway and, what the heck, may as well go out defending what he believed in. Cool.

Obviously, I didn't get out much. Actually it was because of my father who is very old now and is about to step into the next world. I am also getting on but still have a few decades to wait. Dad was a high school teacher and to say he was pragmatic would be a gross understatement. I was ordered to my room and forced to stay there for at least four hours every night to "study" from the time I was in grade four. There is not much homework or study to do in grade four, but that was the way it was. There were no electronic games; they hadn't been invented yet. As a matter of fact, TV had just been invented only a few years earlier. All I had to keep me occupied was a copy of the Elements by Barnard and Child, a compass, with which to draw circles, a straight edge and an eraser to poke holes in with the sharp end of the compass. I could do every construction in the Elements by *heart and had set out to trisect an angle just to keep my mind alive. I got to be very good at Euclidean Geometry. Sometimes I snuck down into my Dad's study and read old books. Socrates was one of them.*

This journey came to a major turning point in grade nine. I was taking physics and hadn't a clue what it was about. It made no sense to me at all. Breaking down, I asked my Dad for help with some of the problems while we were at the supper table.

"What do you need help in?" he asked, "Is it your math?"

"No Dad, it's physics," I replied.

With the mention of the word "physics" my father froze and I could see the fear of God Almighty cross his face. He was terrified.

"No," he said, "I can't help you with physics. You'll have to ask your prof."

He lowered his head to resume eating, avoiding my look. I had to take the shot. My father had never shown fear of anything ever before. I was beginning to see the locked door of my bedroom where I studied every night begin to crack open and there was light on the other side.

"No Dad," I said, "It's just ... PHYSICS!!!!" to see what would happen.

My dad jumped back in his chair wide eyed in terror.

"No," he said hurriedly, "I can't help you. You have to ask your teachers." He then jumped up from the table and quickly ran out of the kitchen. His supper was left barely touched on the table.

Needless to say, the next day I was down at the local library begging the librarian to show me everything there was about physics. All they had was the Encyclopaedia Britannica. I looked under "P" for physics and still remember the opening statement on the subject from the most prestigious encyclopaedia in the world at that time.

Physics is in a crisis. No one can agree to its fundamental principles or even to what the subject is about. This terrible circumstance is the result of the fact that no one can understand or comprehend a certain symbol. This symbol is:

$$\psi$$

And it went on. It talked about probability but said the author of this terrible symbol, Schrödinger, declared emphatically that it could not be probability. It was all very important. It all came from this formula:

$$i\hbar\frac{\partial\psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\psi + V\psi$$

I stared in disbelief. I mean, I'm 13 years old, my mother has just been killed in a car accident, I'm still locked in my room and I cannot get out unless I figure out what this stupid symbol means. And all of the best minds in science have been unable to do so, even the guy who came up with the thing in the first place. This was going to take a lot of time. It did.

I took some quantum mechanics and atomic physics earlier on in university but then switched to astrophysics. I was studying quasars. These things are 40 times brighter than an entire galaxy, have a period of luminosity of about a month and a half, (which means they can't be bigger than a light-month-and-a-half or so) and have huge red shifts. Quite a *few have huge blue shifts. I had begun with pencil and paper, as is my lot, and was mapping out the positions of the quasars on a grid. I placed an arrow pointing upwards from the position of each quasar. The length of the arrow was the length of the red shift. If the quasar was blue shifted, the arrow pointed down. It didn't take too long to realize that many quasars come in pairs. I checked to see what was between each pair and found a galaxy. The gravitational field of the galaxy was causing a gravitational lens effect. There seemed to be a lot of them. I ran about the campus and tried to get a paper together and to publish. I was only an undergraduate. I didn't know how to publish a paper. Three months later Physics Today published an article on the gravitational lens effect of galaxies on distant quasars. I was pissed.*

There is not only a lens effect, there is also a prism effect. There is chromatic aberration in the gravitational lens and the gravitational field is causing distant light to red shift as it passes through gravitational fields. The universe is not expanding. There was no big bang. Again, it was going to take a long time to prove it. It did.

Sometimes you get lucky. I have been extremely fortunate in my life to have met and worked with exceptionally nice people who are experts in their fields. Dr. Doug Hube taught me astronomy. Doug was/is the top observational astronomer in the world. I worked with and became very good friends with Dr. Gary Margrave, of geophysics fame, with Dr. Werner Israel, the top expert in the world regarding black holes and gravitation, and my dear friend, Dr. Keith Promislow, number one in applied mathematics. All led me to the discovery of Rout's Law: **The only way to win at mathematics ... is to cheat.**

I worked with Gary doing research into earthquake prediction in the late 70s. He introduced me to tensor calculus and showed me a proposed Unified Field Theory from Misner, Thorne and Wheeler. I went to Werner Israel's office to ask his opinion on the Unified Field Theory. I wrote it on the board. Dr. Israel got very angry with me and said it was crap. He erased it off the board and took about ten minutes or so to work out the Unified Field Theory.

"There," he said, "that is the Unified Field Theory. I don't care what you do. Write it down, memorize it or figure it out. I don't ever want to have to do that again." Of course, I forgot it and had to call him back thirty years later. He was not angry. He was delighted.

Shortly after my first meeting with Dr. Israel, I worked at the Alberta Research Council on recovering oil from the Athabasca tar sands. There I met Dr. Teddy Schmidt and got very heavily into trying to find general solutions to non-linear differential equations. In particular, the free boundary problem. It took 23 years to find the solution. We did it using an approach we called the general operator.

Keith, at Simon Fraser University, showed me a perturbation technique I could use to set up differential equations and, using the general operator, we cracked the free boundary problem. It was time to return to the Einstein Field Equations.

After a few years, I got to play with a radio telescope at the Rothney Observatory in southern Alberta, thanks to Fred Babott, the observatory's head technician. I found a way to measure the redshift of light passing through a gravitational field. I could relate the discovery to the field equations. I could solve Schrödinger's Equation. I knew what ψ *was. I called Werner Israel, after 30 years, at the University of Victoria.*

"Hello Dr. Israel," I said, "You don't remember me but I was a student of yours thrity years ago."

"No, I'm sorry but I do not remember you," he replied.

"I wouldn't doubt that," I said, "However, you gave me a little problem to try and solve way back then and I believe I have something. I wanted to tell you about it."

"Oh yes," he chuckled, "what was the problem?"

"The Unified Field Theory."

"Oh," he said, "The Unified Field Theory... **Physics is in a great crisis. Nothing makes any sense. There are now an infinite number of universes and an infinite number of theories. It is a terrible end to physics.***"*

"Yes, I know," I said quietly, "I think I might have something. I can relate Schrödinger's Equation to the Einstein Field Equations and it looks like it all makes sense."

Silence ... "Well," said Dr. Israel, "If what you are saying is true, it would be a huge breakthrough in field of physics."

More silence ... (with humility) "Yes Dr. Israel, that is correct."

Quite a bit of silence ... and Dr. Israel broke out with a good and hearty laugh.

Shortly after we spent an afternoon going over the Unified Field Theory and an approach to deriving quantum mechanics from classical theory.

And a couple of months later, I was walking by a dry river bed and saw this stone ...

Abstract

A proposal for a unified field theory is presented. A validation of the axiomatic approach to establish mathematical truths is given with discussions on Gödel and Russell. An existence criterion is developed. A general solution to the time-dependent Schrödinger Equation using a new boundary condition is found to derive the Heisenberg uncertainty formulae, an insight to the quantum mechanical photonic energy and a possible calculation of spin-states. A general relativity/quantum mechanical interaction between a photon and the sun's gravitational field is examined to determine the degree of red shifting of light passing through a gravitational field. The Einstein field equations, complete with an arrangement of Faraday tensors, are presented with suggestions to determine the energy of a photon from Einstein's and Maxwell's equations. Schrödinger's Equation coupled with the Einstein field equations and Maxwell's equations is used to derive a postulated foundation for string theory. A distance measure to NGC 3198 is presented and verified. This distance measure is applied to galaxies in the Southern hemisphere invalidating the theory of an expanding universe. The General Theory of Relativity is applied to a rotating reference frame to determine the effects of negative curvature and derive Roxy's Ruler. Cepheid variable measurements are validated. A closed form analytic model is presented to describe the shape, structure and luminosity profile of spiral galaxies. The flat velocity curves of galaxies is determined. An entropy reversal process is found to be possible at the centre of galaxies. High energy jets of fundamental particles is shown to be the product of entropy reversal. Extreme energies in the form of cosmic and gamma rays are explained by the model. A resultant philosophy is presented.

Table of Symbols

$\rightarrow$	means	it follows that, ie. $A \rightarrow B$ means if statement A is true then statement B is true.
$\leftrightarrow$	$''$	if and only if, If A then B *and* if B then A.
$'$	$''$	the compliment of a set. Everything that is not in the set.
$\exists$	$''$	there exists.
$\forall$	$''$	for all
$\in$	$''$	is a member of
$\notin$	$''$	is not a member of
$\{\ldots\}$	$''$	a set defined by its members
$\mid$	$''$	such that
$\neg$	$''$	not. The negation of the statement
$/$	$''$	if through a symbol, the negative of the symbol
$\vee$	$''$	or

Chapter 1

A Little Theorem

To begin our discussion we will explore existence. We will look at numbers and what a number is. We are starting on a path of looking at mathematical truths and then expand to looking at the world of physics and the truths that lie within. As we develop our discussion we will move step by step from established and well-understood concepts and facts. We hope to present an argument with some degree of rigour. Note that because of Gödel's Incompleteness Theorem[36], we can propose a consistent and valid argument which is not complete in that it does not prove the axioms themselves. We present a discussion of axioms to attempt as complete an argument as possible. We begin with the existence of number.

Question: Does a number exist and we discover it or do we just make numbers up as we go along?

Theorem: Numbers exist.

Proof:

Definition: A number is the name of the set of all sets of the magnitude of the number. The magnitude of a set, or number of elements in the set, can be determined through a matching process of its members to a set of ordinals. [30][37]

Example: The number one is the name of the set of all sets having one element. The number two is the name of the set of all sets having two elements, and so on.

Definition: The null set, or $\emptyset$, is the set containing no elements.

Definition: The universal set, or $\mathcal{U}$, is the set containing all elements except itself, which will be demonstrated shortly.

It can be easily shown that:

$$\begin{aligned} \emptyset &= \mathcal{U}' \\ \mathcal{U} &= \emptyset' \end{aligned} \tag{1.1}$$

therefore,

$$\begin{aligned} &\emptyset = \{\} \\ &\emptyset \neq \{\emptyset\} \\ &\emptyset \notin \emptyset \\ &\mathcal{U} \notin \mathcal{U} \end{aligned} \tag{1.2}$$

Consider zero. By definition, zero is the name of all sets having no elements. There is only one set having no elements. We have,

$$0 = \{\emptyset\}. \tag{1.3}$$

Consider the solution set, S, which is the set of all solutions to all problems. If there exists a solution to a particular problem, then it is a member of the set S. If no solution exists to the problem then we say the solution is $\emptyset$. Then $\emptyset$ is a member of S. However, if a solution exists then $\emptyset$ is a member of $\mathcal{S}'$. We then have the well understood situation:

$$\emptyset \in \mathcal{S} \tag{1.4}$$

and

$$\emptyset \in \mathcal{S}'. \tag{1.5}$$

Although this appears as a contradiction, it is a fairly well known property of the null set. The null set is a member of all sets, except itself.

We have for existence properties, if $\mathcal{A}$ is proposed as a possible solution to a problem, using $\neg$ as "not":

$$\begin{array}{rcl} \neg\exists\mathcal{A} & \rightarrow & \exists\emptyset \\ \exists\mathcal{A} & \rightarrow & \exists\mathcal{A}' \vee \exists\emptyset \\ \exists\mathcal{A}' & \rightarrow & \exists\emptyset \end{array} \tag{1.6}$$

We conclude that the non-existence of a set is represented by the empty set.

$$\neg\exists\mathcal{A} \rightarrow \exists\emptyset\forall\mathcal{A} \in \mathcal{U} \tag{1.7}$$

Note that the interior of the null set is nothing, but the null set itself exists.[13][15] This can be shown by:

$$\exists\emptyset \rightarrow \exists\emptyset. \tag{1.8}$$

However, should there not exist a set we have:

$$\neg\exists\emptyset \rightarrow \exists\emptyset. \tag{1.9}$$

We see that whether the null set exists or not, it exists. Whether the interior of the null set exists or not is a matter of philosophical argument and beyond the bounds of this discussion. Nevertheless, the null set itself exists. Therefore:

$$\exists\emptyset \rightarrow \exists\{\emptyset\} \tag{1.10}$$

and

$$\exists\{\emptyset\} \rightarrow \exists 0 \tag{1.11}$$

and, of course:

$$\begin{array}{rcl} \exists 0 & \rightarrow & \exists\{0\} \\ & \rightarrow & \exists 1 \\ & \rightarrow & \exists\{0,1\} \\ & \rightarrow & \exists 2 \end{array} \tag{1.12}$$

and so on.

This, of course, leads to the interesting theorem:

$$(\exists\emptyset \rightarrow \exists\emptyset) \leftrightarrow (\neg\exists\emptyset \rightarrow \exists\emptyset) \tag{1.13}$$

which is a contradiction but not a negation of the theorem since it is a property of the null set. We shall refer to 1.13 as our Little Theorem.

Numbers therefore exist because the null set exists and the number 0 exists. We note that zero represents nothing and the non-existence of something counted, but zero itself exists. Similarly, the members of the null set do not exist yet the null set itself exists.

Note that previously our Little Theorem was presented as a definition of the Null Set in order to bypass the consequences of Russell's Paradox. We show that the same result can be derived from a more direct definition of the Null Set and 1.13 is non-axiomatic.

Chapter 2

Equality

Geometrically, if two triangles can be placed on top of one another such that they coincide, they are said to be congruent [4]. If so, then one triangle can replace the other.

If there are explicit conditions, an entity can be replaced by another. If conditions are considered as a boundary and entities meet these conditions, we say these entities are within this boundary and thereby form a space. All entities which can replace each other within this space are said to be equal under the restrictions of the conditions described by the boundary.

For example, let there be a ruler 10 cm. long. We may measure something that is 10 cm. in length using this ruler. However, let us say we also have two sticks, each 5 cm. in length. If we combine the lengths of the two sticks we have a length that can replace the 10 cm. ruler. Therefore, under the condition of "length", however we wish to define it, the two sticks are equal (in length) to the ruler. Nevertheless, under the condition of counting, or number, the ruler is not equal to the sticks. The number of ruler – one, does not replace the number of sticks – two. There is one ruler and two sticks. But under the conditions of length, the ruler and combination of two sticks are equal. In the space bounded by considerations of length, any combination of anything having lengths that can be replaced by each other are equal in length.

We see that in a bounded space so described, that if things can replace each other then they are equal. Furthermore, all things that can replace a particular entity within the specified boundary, can replace each other. From this we deduce that all things equal to the same thing are equal to each other. Equality requires condition.

Higher restrictions of the boundary condition leads to congruence and various definitions of congruence and resultant properties.

We see that this is nothing more than an axiom of Euclid. We define an axiom as an unprovable truth. A proof is the resultant derivation through defined and substantiated steps to a conclusion from a set of axioms. Considering the field of elements and operations, we say that a proof derives mathematical truths.

Chapter 3

Russell's Paradox

Russell's Paradox [26] can be stated as:

$$(A \to B) \leftrightarrow (\neg A \to B) \tag{3.1}$$

In words, given any predicate there is a contradiction as a result of the predicate and thereby no predicate can be true. We have an exception to this statement in our Little Theorem. Therefore, any theorem based on this paradox is disproved by exception.

Russell's Paradox is based on the definition of proper sets. A proper set is a set that is not a member of itself. The set of all proper sets is called the set $\mathcal{R}$. Since $\mathcal{R}$ is itself a proper set, it supposedly contains itself and thereby results in a contradiction. This forms the basis of difficulties with the axiomatic approach in establishing mathematical proofs which have haunted mathematical logic since the beginnings of the 20th century. However, we see that a contradiction does not neccessarily establish a falsehood. There exist entities of truth that can produce a contradiction yet do not invalidate the entity if it happens to be a property of the entity itself. The null set is one such entity concerning its existence.

There should be an obvious reason for this. Since we are using principles of Aristotelian logic in our deductions we turn to the *Categoriae* of Aristotle [3] that makes three statements upon which set theory is based.

1. We can classify things.
2. There is a difference between a thing being classified and the classification itself.
3. No classification may be a classification of itself.

From this is it easy to see that:

$$\begin{gathered} \mathcal{R} = \mathcal{U} \\ \mathcal{R}' = \mathcal{U}' \\ \mathcal{R}' = \emptyset \\ \emptyset \notin \emptyset \\ \mathcal{U} \notin \mathcal{U} \\ \mathcal{R} \notin \mathcal{R} \end{gathered} \tag{3.2}$$

From the above derivation we note that the statement that, "the set of proper sets must be a member of itself" does not follow. This is because the set of proper sets is the universal set and a property of the universal set is that it is not a member of itself. The universal set is the set of all elements, including sets, except itself. It is an exception to its own definition since it is the compliment of the null set. By definition, the null set is not a member of itself.

Occam's Razor[34]

Occam's Razor is a well known dictum to enforce the reduction of assumptions in logical proofs. Basically, Occam's Razor states that assumptions must be kept to an absolute minimum. [1]

If there are a number of solutions then the one with the least asumptions is the "best". This can be used to resolve paradoxes. An excellent example is "Superman's Beard", which is known as the barber paradox.[2]

Barber Paradox

In Spain, near the beginning of the 1900s, people posed an interesting question; there lives a very special barber in the town of Seville. This very special barber has a most unusual characteristic. This barber shaves every man who does not shave himself. The question is: who shaves the barber?

If someone else shaves the barber then the barber would not be shaving himself. But the barber shaves *every* man who does not shave himself. Therefore, someone else cannot shave the barber.

If the barber shaves himself we note that the barber *must* shave every man who does *not* shave himself. Therefore the barber cannot shave himself.

So, who shaves the barber?

We re-examine the paradox with emphasis on assumptions. [3]

[1] If we see mathematical truths can be established some mention of the razor should be made and it's application to Russell. A postulated lemma of Occam's Razor is quite the opposite to conclusions drawn as a result of Russell's Paradox.
Namely, what I refer to as Miller's Lemma: *Every problem has an infinite number of solutions but only one is the best and* **that** *is Occam's Razor.*
The above statement postulates that there is such a thing as a best solution out of many and that the best solution is given by the reduction of assumptions. It proposes that there is only one "best" solution. It may be an attribute of the human mind to be able to recognize the best solution or even what is meant by "best". From this line of thinking we believe that paradoxes pose contradictions, puzzles and riddles, but all can be resolved. The resolution may not answer the question asked by the paradox itself, but a resolution may trivialize the paradox.

[2] Superman [35] is the famous comic hero from Krypton who is known as the man of steel. Superman was first published in 1938 during the Depression. He was bullet-proof, super strong, could fly and had extraordinary powers. The children reading the comic were invited by the comic staff to find logical reasons critisizing the existence of Superman and the stories in the comics. One child wrote in noting that Superman was clean shaven but not bald. His hair grew. How could Superman shave if no metal on earth was strong enough to cut through his beard? The staff at Action Comics, which published Superman, was delighted with the question and a contest was started to see if anyone could figure out how Superman shaved. Further critisisms to disprove the existence of Superman were encouraged with a year's supply of comics for anyone who could stump the writing staff. Only the question of "how can Superman shave?" survived the attempts of the writing staff to fend off disproofs of Superman's existence or logic of various storylines. The question still remains.

[3] At the time of this paradox, the *Principia*, Russell and various other philisophical discussions, there lived George Bernard Shaw. Shaw was a playwright in love with irony and a staunch socialist. His *Man*

This barber shaves every *man* who does not shave *him*self. Who shaves the barber?

Resolution: Who cares? The barber is a woman.[4]

and Superman was a counter argument to Friedrich Nietzsche's philosophical ideas concerning the evolution of a "superman" or super race. The new Superman is woman. And the only razor sharp enough to shave Superman's Beard, is Occam's Razor.

[4]Wikipedia states this is a trivial solution to the paradox. More formally, the barber cannot be of the class that is being shaved. If the barber shaves every person who does not shave themselves, then the barber is not a person. It may be a machine, etc. If there is the insistence that the barber is shaving every class of the universal set, or no alternative from what is being shaved exists, then the original statement, "There is a very special barber in the town of Seville." is false and therefore has been proved to be false. In other words, it is a lie. Just as every statement included in this discussion is a lie, especially when you are told that you are being lied to. That, of course, is the biggest lie that could be told, that I am lying to you when I tell you I am lying to you. And that is no word of a lie either. The resolution of the Liar's Paradox is left as an exercise for the reader.
The Library Paradox, or List Paradox, is that the alphabetical list of all things beginning with a particular letter would have under the L's an entry that contains the "List of all things begining with the letter L" and thereby contain itself. However, the listing does not contain itself, it contains the name of the list, not the list itself. In order to contain itself, it would require an infinite amount of paper, computer storage space, whatever, since the situation is self-recursive. In sum, we are stating that all paradoxes can be resolved.

Chapter 4

The Observer

Without going into all the references, there has been a great deal of discussion of the rôle of the observer in quantum machanics. This comes from what is termed as the Copenhagen Interpretation, which, in very basic terms, says the ψ-state describes a probability of existence. Both Einstein and Schrödinger opposed this view publicly and privately. This interpretation suggests that without knowing, (or observing), an event, it's quantum state can be anything but will collapse upon measurement to some definite value. Other theories such as an infinite number of universes are "created" as a consequence of every event have also been proposed and supported by the scientific community. We choose to present a different view that is more in line with both Einstein and Schrödinger who came up with the theory in the first place.

We state simply that in order for an event to happen it requires an observer. We begin by first defining an event and then figuring out who is the observer.

Consider a very simple universe in which exists only a photon of light. The photon moves at the speed of light and is nothing more than a disturbance in the space-time continuum obeying the laws of physics as described by the Einstein Field Equations. Nothing happens. Nothing is going to happen. The photon just keeps traveling along.

Consider another very simple universe in which there is only a stone. The stone sits there and obeys all the laws of physics as described by the Einstein Field Equations. Nothing happens. Nothing is going to happen. The stone just sits there.

We define an event as something happens – an event occurs when something happens.

Consider now a universe with only a stone and a photon of light that is going to hit it. Both the stone and photon obey the laws of physics as described by the Einstein Field Equations and Schrödinger's Equation.

The photon hits and bounces off the stone. The stone recoils from the hit. Something happened. Who is the observer? In this universe exist only two things, the stone and the photon. We are not there. The photon is not actually a thing *per se*; it is merely a disturbance in the space-time continuum. However, the stone is a different matter. It causes tension in the field lines. For the sake of argument, we call this tension "curvature". It is not a perfectly formal definition of curvature, but we will use it to describe spacetime that is curved in space and time and also that there is tension along the field lines. It is rather complex when dealing with tensor fields, but let us call any spacetime that is not absolutely flat as being "curved" and the properties of such a region as it's "curvature." (This is an incredibly simplified view.)

Nevertheless, all we have is the stone and the photon. It may be possible to argue the photon is in some way the observer, but we reject the argument for now. However, the stone recoils from being hit. The photon just bounces off. The stone has reacted to changes in its local environment. The only candidate for an observer is the stone. The stone is the observer. Is the stone conscious or sentient? Does the stone percieve?

Perhaps perception, in very simple terms, can be intimated should something react to changes in its environment. If so, then in extremely basic terms, the stone percieves. Consciousness or sentience must wait until we ask the stone how it feels and it actually answers. We doubt that will happen. However, the stone is totally in tune with the changes of the universe. It reacts to everything around it instantly. Metaphysically it is pure consciousness. It is absolutely open and reactive to everything around it.

We say that anything that curves spacetime is a candidate for an observer. The universe observes itself. An electron observes its own interactions with electromagnetic and gravitational fields. Conciousness and sentience are not the domain of this discussion. Physics does not demand sentience or consciousness. However, it demands an observer. If you wish to know who is observing Schrödinger's Cat, ask the cat.

If there is no observer, there is nothing for the photon to bounce off of. If there is no observer, there can be no event. Nothing can happen. An observer bends spacetime. It is the curvature of spacetime, the bending of a path of light, a collission, acceleration, unbalanced forces, differences in potential and so on that cause things to happen. The observer is intrinsically involved in the event. Otherwise, it can't figure out if anything happened, whether it be a cat or something incredibly obedient, like a stone.

In summary, we find it somewhat incredible that a vast and overwhelmingly large number of intelligent and competent scientists would interpret the need for an observer to assume that we as human beings are the observer and nothing can happen in the universe without us. Religious thinkers believe this to be a scientific demand for the existence of a divine observer, or God. It isn't.

The universe exists. It always has. We are born into it. We are given the incredible gift of being able to observe it. We observe it and marvel. We pass on, and the universe continues to exist almost as though we had never been.

We have just begun to open the window to this marvelous cosmological panorama. Less than 100 years ago we were arguing over the existence of our very own Galaxy – our back yard. We have just barely begin to look at the heavens which may well be infinite and eternal. There is a lot of colour out there. There are a lot of bizarre and new things we have never even imagined, let alone seen. It is absurd to think that in such a short time anyone on the face of the Earth has any idea of what we are seeing. A little humility might be in order.

Chapter 5

Jean-Paul Sartre

> "All this talk by Hagel about existence is very fine,
> but what does it have to do with Truth?" [27]
> *-Jean-Paul Sartre*

Sartre talks about Pierre who is not at the café and therefore must be. He has to be in order not to be at the café. And there is some talk about a table. Apparently tables are quite important for philosophy. [27][26][28] We do not present tables here nor someone who is not at a café in order to exist. Furthermore, we find Sartre a little deep, so we take the liberty to simplify.

Consider a stone. Ask yourself, "Does the stone exist because you percieve it to exist, or does your perception exist beause you are looking at a stone?" Which causes which? Does the stone cause your perception of it to exist or does your perception magically cause the stone to appear and thereby exist?

Aristotle, often misquoted, states simply that if the stone ceases to exist, our perception of it ceases to exist along with it. He also states that if our perception of the stone ceases to exist, the stone continues to exist.[3] In spite of all intervening arguments, there is the simple fact that the stone exists independently of our perception. Those who persist in believing a stone's existence is the result of their perception, or that reality is in any way the result of their perception, are mentally ill by definition. It is a fundamental fact for those who are sane that reality, or a stone, exists independently of perception. [1]

If we therefore conclude that something as simple as a stone exists indepentently of our perception, then what about Truth?

To paraphrase the argument of Sartre, does a lie exist? Is there such a thing as a lie?

Has anyone at any time ever lied? Have you?

Is it possible to lie if there is no truth to lie about?

[1]A generation of youth who were reared in the 1960s have experimented with altering perception even to the point of death and perhaps beyond. All such experiments have resulted in the same conclusion: no matter how much perception is altered, reality does not change one iota.

There is a further interesting proof. Your perception is mostly in your brain which is located in your head. We could possibly take a stone and start hitting you repeatedly on your head to see if you could alter your perception of the stone in order to make it go away. There would be only one perception that would cause us to stop striking your head with the stone and that is that you percieve and agree that the stone actually exists independently of your perception. We call this technique, "proof by intimidation".

Alternatively, can there possibly exist a truth without anybody lying about it?

Given F = some falsehood and T = the truth being lied about, we have the following postulate:

$$\exists F \rightarrow \exists T. \tag{5.1}$$

However,

$$\exists T \rightarrow \neg \exists F \tag{5.2}$$

is more than possible.

Therefore, falsehood cannot exist without truth, but truth can exist without falsehood. Because of 5.2 we can pose:

$$\neg (\exists T \rightarrow \exists F) \tag{5.3}$$

So falsehood is not an anti-truth. It is possible that there may exist one truth, ie. a stone exists, and an infinite number of falsehoods concerning that truth. Namely:

- the stone does not exist
- the stone is not a stone
- the stone is only part of your imagination
- there are an infinite number of universes in which there are stones, this stone is not of this universe
- the probability of the existence of the stone makes it to only *appear* to be here. If you wait long enough, it will disappear.
- the stone is only probably here; it's not really here.
- the local probability density is sufficient to cause instruments to measure the approximate spacial and temporal location of a region emitting quantum particles resembling a geophysical object, however the actual existence of a material quantum state is beyond the realm of science at this time
- by the authority invested in me by the supreme Magic Muffin – the respository of all knowledge and power – the existence of the stone is declared illegal and punishable by death
- ignore the stone, it will probably just go away and not bother us any more
- and so on ...

Nevertheless, if there are a huge number of falsehoods, it takes but one truth to dissipate them all. Therefore, there is not a vast amount of truth and an equally vast amount of untruth or falshood, such that when they meet they anhialate each other and there is nothing left. There is, for example, a vast ocean of falsehood and the simplest truth evaporates it immediatly. Truth anhialates falsehood, but no falsehood can anhialate truth. Truth, therefore, exists. It exists in and of itself independently of either an anti-truth or our perception. A reality is truth. Truth is reality.

> **"Truth is that which exists independently of our perception."**
> - *Cameron Rout*

Continuing this line of thought, we note that it is impossible to get a wrong answer to a math exam if there is no right answer. However, the right answer can exist without there being any wrong answers.

Correctness can exist without error but error cannot exist without correctness.

Right can exist without wrong but wrong cannot exist without right.

What about Good and Evil? Is it that virtue can exist without vice but vice cannot exist without virtue?

To respond with a little tongue-in-cheek to Sartre's question: what does Truth have to do with existence? Very simply, existence is truth. Truth is what is. The closer you get to reality, the closer you get to the truth.

This all seems to make sense.

Chapter 6

Schrödinger's Equation

Consider any particle with mass m and some potential electromagnetic energy V which obeys the following:

$$i\hbar\frac{\partial}{\partial t}\psi = -\frac{\hbar^2}{2m}\nabla^2\psi + V\psi \tag{6.1}$$

or:

$$i\hbar\frac{\partial}{\partial t}\psi = -\frac{\hbar^2}{2m}\left\{\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right\}\psi + V\psi \tag{6.2}$$

Let:

$$\psi = T(t)X(x)Y(y)Z(z) \tag{6.3}$$

where, $T(t)$ is a function of t only, $X(x)$ is a function of x only, $Y(y)$ is a function of y only and $Z(z)$ is a function of z only. Then:

$$i\hbar\frac{\partial}{\partial t}TXYZ = -\frac{\hbar^2}{2m}\left\{\frac{\partial^2}{\partial x^2}TXYZ + \frac{\partial^2}{\partial y^2}TXYZ + \frac{\partial^2}{\partial z^2}TXYZ\right\} + VTXYZ \tag{6.4}$$

Under the condition that $\psi \neq 0$ we can divide through by $TXYZ$ to yield:

$$i\hbar\frac{T'}{T} = -\frac{\hbar^2}{2m}\frac{X''}{X} - \frac{\hbar^2}{2m}\frac{Y''}{Y} - \frac{\hbar^2}{2m}\frac{Z''}{Z} + V \tag{6.5}$$

We can see that each term is linearly independent. Since each term is being varied by its independent variable and all variables are linearly independent from each other, and the constant term is also independent from the others, each term must equal a constant. Because we do not want this solution to blow up, we set the following:

$$i\hbar\frac{T'}{T} = -\alpha^2 \tag{6.6}$$

$$\frac{\hbar^2}{2m}\frac{X''}{X} = V - \beta^2 \tag{6.7}$$

$$\frac{\hbar^2}{2m}\frac{Y''}{Y} = -\gamma^2 \tag{6.8}$$

$$\frac{\hbar^2}{2m}\frac{Z''}{Z} = -\xi^2 \tag{6.9}$$

and the equation has been separated. We have placed the constant term with equation 15.17 since it has been chosen as the direction of travel of the particle. ψ is argued to be a measurement of the probability of the existence of the particle, which Schrödinger disagreed with rather strongly. We are going to show that a better interpretation of ψ is that it is a potential of some form, perhaps the potential of existence.

For the time-ordered term, we have,

$$T = e^{i\frac{\alpha^2}{\hbar}t} \tag{6.10}$$

which is an interesting equation. Consider:

$$e^{-k^2\theta} \tag{6.11}$$

and note that if k has any value, then as θ increases, the expression will approach zero. So, if $\alpha \neq 0$ the time factor of ψ will act as a taper and kill the value of ψ. Or, the particle will evolve out of existence with the passage of time, somewhere along the order of $\hbar$. This means the particle is decaying and all particles obeying this equation will decay and cease to exist. There are alternatives which we will get back to, but for now we will consider a fundamental principle:

existence is conserved.

Let us consider the particle as stable and non-decaying. Then $T = 1$ and $\frac{\partial\psi}{\partial t} = 0$ and we are back to the well-known time independent Schrödinger equation. For X we have:

$$X = cos(\frac{\sqrt{2m(\beta^2 - V)}}{\hbar}x) \tag{6.12}$$

This is, in a way, similar to a term in a Fourier series. We set X in a π box[1]and consider a slight re-write as:

$$X = cos(\frac{2\pi\sqrt{2m(\beta^2 - V)}}{\hbar}\frac{x}{2\pi}) \tag{6.13}$$

This results in the boundary condition of the box as $X = 1$ which occurs when;

$$x = \frac{2\pi\hbar}{\sqrt{2m(\beta^2 - V)}} \tag{6.14}$$

and

$$x\sqrt{2m(\beta^2 - V)} = h \tag{6.15}$$

[1]From Fourier-series solutions to differential equations, we note the cos function is harmonic and repeats when the angle it is applied to extends from 0 to 2π. We consider two boundaries to the spacial region, one at angle 0 and the other at angle 2π. For example, consider $y = cos(u)$. The function y repeats and we consider boundaries of the region from $u = 0$ to $u = 2\pi$. Often we refer to this region as a π-box.

since

$$\mathbf{p}^2\psi = -\hbar^2 \frac{\partial^2\psi}{\partial x^2} \tag{6.16}$$

and

$$\psi = 1 \tag{6.17}$$

we get

$$\mathbf{p}^2 = -\hbar^2 \frac{\partial^2\psi}{\partial x^2} \tag{6.18}$$

at the boundary. We also have

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} = \beta^2 - V \tag{6.19}$$

yielding

$$-\hbar^2 \frac{\partial^2\psi}{\partial x^2} = 2m(\beta^2 - V) \tag{6.20}$$

Substitution yields:

$$x\mathbf{p} = h \tag{6.21}$$

at the boundary of the particle. However the "angle" in the π-box goes from 0 to 2π and therefore we have a measure of Δx. Because x varies between the boundaries we have a variable $\mathbf{p}$. We therefore have:

$$\Delta x \Delta\mathbf{p} = h \tag{6.22}$$

We would like to mention here that the boundary happens to yield a probability of existence of one for the particle. Inside this boundary the probability of its existence is less than one. As a matter of fact, at the "centre" of the particle, the probability of existence is -1 and this is absurd. In the derivation of a solution we had said $\psi \neq 0$. So we will deny the particle to exist inside the boundary and, for that matter, outside the boundary as well. For this particular solution to stand, the particle only exists where $\psi = 1$ and does not exist otherwise. We are stating that the particle does not exist when $\psi < 1$. This is a different case than determining the position or time of the particle. In this case we are determining the existence of the particle itself. We are postulating that if the "probability" of existence of something is less than one, then it isn't. We conclude ψ cannot be a measure of probability. It is a potential. When the potential is 1, the particle exists. From these calculations, the particle can only exist at it's boundary.

From outside the particle we have:

$$\Delta x \Delta\mathbf{p} > h \tag{6.23}$$

With the time ordered factor, we have an exponential of $i\frac{\alpha^2}{\hbar}t$ and we had set $\alpha = 0$. Let us now reconsider α. We note the units of measure here. We see that $\hbar$ is in units of joules-sec. We see that t is in seconds and will cancel the time unit of $\hbar$ leaving joules in the denominator. Hence, since the exponential must be unitless, α^2 is in units of joules. To continue the discussion allow α^2 to be some unknown form of energy in joules. We will examine what this means as follows.

Let

$$E = \alpha^2 \tag{6.24}$$

so the exponential of the time ordered factor becomes

$$\frac{iEt}{\hbar} \tag{6.25}$$

and we look at the situation where $\psi = 1$. In other words, the particle definitely exists. We have seen that at the boundary of the box, from before, the spacial ordered factor is one. Therefore the time ordered factor is also one. This can only occur should the exponent of the time ordered factor be something like $2\pi i$. In which case we have:

$$\frac{iEt}{\hbar} = 2\pi i \tag{6.26}$$

rearranging

$$Et = 2\pi\hbar \tag{6.27}$$

$$Et = h \tag{6.28}$$

Here we have time going from 0 to some cyclic value yielding an exponent of $2\pi i$. We will then denote this as Δt and ΔE is the magnitude of fluctuation of energy. We now have:

$$\Delta E \Delta t = h \tag{6.29}$$

and observing from outside the particle in the time dimension, we write:

$$\Delta E \Delta t > h \tag{6.30}$$

This happens outside some time ordered "boundary" where/when the potential of the existence of the particle yields $\psi = 1$. Combining both time and spacial ordered factors we have the situation where

$$\Delta x \Delta \mathbf{p} \geq h \tag{6.31}$$

and

$$\Delta t \Delta E \geq h \tag{6.32}$$

Let us take a closer look at E.

The exponent of the time ordered factor is some sort of phase angle that allows the particle to have a potential of existence equal to one at each cycle.

Let:

$$\frac{E}{\hbar} t = \theta \tag{6.33}$$

And we differentiate by t on each side to yield:

$$\frac{E}{\hbar} = \frac{d\theta}{dt} \tag{6.34}$$

or

$$\frac{E}{\hbar} = \omega \tag{6.35}$$

$$E = \hbar\omega \tag{6.36}$$

and,

$$E = h\nu \tag{6.37}$$

So, this energy, E, is not a form of energy coming from the mass of the particle or it's momentum of motion or even it's charge generating V. It appears to be an energy that is associated with the time ordered frequency of the particle's existence. This energy is not associated with mass or charge.

Let us examine α further.

$$\alpha = \frac{\sqrt{2\pi i\hbar}}{\sqrt{t}} \tag{6.38}$$

and

$$\alpha = \frac{1}{\sqrt{2}}\left(\sqrt{\frac{h}{t}}\right)(1+i) \tag{6.39}$$

and it seems that with the presence of $\sqrt{2}$ there is some indication of spin involved.

Continuing, we see that we can also say:

$$\theta_n = n^2 2\pi i,\ n \in \mathbb{N} \tag{6.40}$$

whenever $\psi = 1$. So this exponential has been quantized by n^2. This can be compared to an orthogonal set of eigenfunctions yielding a complete solution of ψ.[2]

We now put forward a solution to the paradox of Schrödinger's cat.

[2]There are interesting consequences to the general solution of Schrödinger's equation. I call α an eigenvalue in an eigenspace which I often use to find general solutions. Apparently $-\alpha^2$ is the energy of a photon. I am proposing that the magnitude of an infinite number of eigenvalues to the general solution of Schrödinger's equation yield the energy values of subatomic particles. The first order temporal eigenvalue yields the energy of a photon.

Chapter 7

Schrödinger's Cat

The cat is dead. [27] [24][1]

[1] Schrödinger wrote: One can even set up quite ridiculous cases. A cat is penned up in a steel chamber, along with the following device (which must be secured against direct interference by the cat): in a Geiger counter there is a tiny bit of radioactive substance, so small, that perhaps in the course of the hour one of the atoms decays, but also, with equal probability, perhaps none; if it happens, the counter tube discharges and through a relay releases a hammer which shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives if meanwhile no atom has decayed. The psi-function of the entire system would express this by having in it the living and dead cat (pardon the expression) mixed or smeared out in equal parts. It is typical of these cases that an indeterminacy originally restricted to the atomic domain becomes transformed into macroscopic indeterminacy, which can then be resolved by direct observation. That prevents us from so naively accepting as valid a "blurred model" for representing reality. In itself it would not embody anything unclear or contradictory. There is a difference between a shaky or out-of-focus photograph and a snapshot of clouds and fog banks.[29] The above text is a translation of two paragraphs from a much larger original article, which appeared in the German magazine Naturwissenschaften ("Natural Sciences") in 1935.[38]

Chapter 8

The Field Equations

Consider an equation which partially comes from Minkowski and also quoted by Einstein [10]:

$$G_{\mu\nu} = 8\pi \left(T_{\mu\nu} - F_{\mu\alpha}F_{\nu}{}^{\alpha} + \frac{1}{4}g_{\mu\nu}F_{\alpha\beta}F^{\alpha\beta} \right) \tag{8.1}$$

From equation 8.1 we denote $T_{\mu\nu}$ as a material stress energy tensor and the Faraday tensor terms as a field stress energy tensor.

We can see that if there is no charge present we have the formula:

$$G_{\mu\nu} = 8\pi T_{\mu\nu} \tag{8.2}$$

and we have the usual Einstein Field Equations.

Should there be no mass, but charge is present, we have:

$$G_{\mu\nu} = 8\pi \left(-F_{\mu\alpha}F_{\nu}{}^{\alpha} + \frac{1}{4}g_{\mu\nu}F_{\alpha\beta}F^{\alpha\beta} \right) \tag{8.3}$$

Equation 8.1 is the complete field equation resulting from the presence of both mass and charge in boundless space. Equation 15.6 is the gravitational field equation and equation 8.3 describes spacetime under Maxwell's Equations. Note that it was probably Minkowski who developed the tensor equation for Maxwell's electromagnetic theory and Eistein developed the tensor equation for gravity. For the sake of clarity, allow:

$$\Omega_{\mu\nu} = 8\pi \left(-F_{\mu\alpha}F_{\nu}{}^{\alpha} + \frac{1}{4}g_{\mu\nu}F_{\alpha\beta}F^{\alpha\beta} \right) \tag{8.4}$$

and

$$\Xi_{\mu\nu} = 8\pi T_{\mu\nu} \tag{8.5}$$

So we have:

$$G_{\mu\nu} = \Xi_{\mu\nu} + \Omega_{\mu\nu} \tag{8.6}$$

and consider the following situation.[1]

[1] I would like to call $\Xi_{\mu\nu}$ the Hawking Tensor and $\Omega_{\mu\nu}$ the Israel Tensor. that way the Unified Field Theory, without Quantum Mechanics, can simply be expressed as Einstein equals Hawking plus Israel. It has a nice historical ring to it.

In the case of a photon passing by the sun, the mass of the sun yields the material stress energy tensor already described. The fluctuations of the electromagnetic fields from the photon have to be derived from equation 8.1. The $\Omega_{\mu\nu}$ tensor is a microscopic view of the actions of a stationary object having electrostatic charge and magnetic properties. However, to describe the photon itself from these equations we need to take a macroscopic average of the sress energy generated by the $\Omega_{\mu\nu}$ tensor.

A photon is a region of rapidly fluctuating electric and magnetic fields moving at the speed of light. Overall, there is a stress-energy tensor within the region of the photon in which:

$$G_{\mu\nu} = \rho \mathbf{l}_\mu \mathbf{l}_\nu \tag{8.7}$$

where ρ is the energy density, or $h\nu$, per unit volume of the photon, and $\mathbf{l}$ is the four-velocity of the particle of light known as a photon. In this way, it can be seen that the bundle of rapidly fluctuating electric and magnetic fields appears to behave on a macroscopic level as a particle having mass and momentum. Therefore, if the appropriate differentiation is applied to the tensors describing a wave bundle moving at the speed of light, it's energy can be derived from equation 8.1 which must be equal to $h\nu$. In this way Plank's constant enters the field equations.

We know that $G_{\mu\nu}$ describes the curvature of a local region, in this case the local region of a photon. The $(0,0)$ component is the localized energy density. Momentum, pressure and shear stress densities are also contained in the Einstein tensor (i.e. $G_{\mu\nu}$), which has been well known for nearly a hundred years. In this way, the local energy and momentum densities of a localized region of space-time undergoing rapid fluctuations of electric and magnetic fields and moving at the speed of light, can be calculated from well understood mathematical principles and procedures. Obviously, from equation 8.1, the energy and momentum of a photon can be obtained. The photon has momentum.

As the photon travels deeper into the gravitational well of the sun, we see that the energy of the photon increases; it blue shifts. As the photon bypasses the sun and climbs back out of the gravitational well, it red shifts. In the reference frame of the sun, assuming the sun's position is unaffected, the red shift equals the blue shift as the photon follows the geodesic described by the gravitational field of the sun. However, there is one small problem with this approach. We are working in the reference frame of the sun. We are assuming the sun is not moving in our laboratory universe having only the sun and a particular photon. If such were the case, the sun being treated as an inertial reference frame, then there would be no resultant red shift of the photon by-passing the sun. But such is not the case.

The photon has momentum. We must take this into consideration. We must move to an inertial reference frame utilizing the total momentum of the sun and photon. The total momentum of the system must remain constant. In this reference frame, there is a slight change in the photon's momentum due to its change in direction, this change in momentum must be subtracted from the sun's change in momentum so that the total momentum remains constant. This takes energy which comes from the photon, which red shifts to make up for the gain in kinetic energy of the sun. As a result, the bypassing of the photon causes the sun to very slightly shift which in turn alters the region of the photon's local value of $G_{\mu\nu}$ and thereby, the value of $\rho \mathbf{l}_\mu \mathbf{l}_\nu$ for the photon. We see that the slope of the gravitational well is not the same as when the photon exits the well of the sun as when it enters it. This is because the sun very slightly shifts toward the photon as it passes. The well is steeper coming out of it than when entering it.

General Relativity meets Quantum Mechanics.

Since the Faraday tensors describing the local spacetime of a photon affect $G_{\mu\nu}$, a photon therefore adds to the curvature of local space-time and therefore interacts gravitationally with local objects, however, extremely slightly.

We can figure out the red shift of the photon by treating the interaction as a collision using Plank's formula or we can figure it out with momentum considerations from rather difficult and complex operations and differentiations on the photon's quickly moving locality and the interaction it has in changing the sun's momentum. There are two ways to solve the problem and both should be equal.

Furthermore, we can also see the derivation of the very slight red shift of light by-passing the sun has been approximated as linear. Over great distances and with very large masses, this effect becomes more pronounced and non-linear. There is a cosine factor involved which comes into play the more and more the light is "bent". At great distances this would not behave as a linear function and may well match the observations that have formed the basis of an inflationary universe. Any determination concerning an expanding universe must take into account the red shifting of light passing through gravitational fields.

We next work out the red shift using the approach of a collision.

Chapter 9

A Particle/Photon Gravitational Interaction

9.1 Discussion

If a photon having momentum $\frac{h\nu}{c}$ bounces off a sphere "at rest" having mass M and is deflected by a small angle θ, then the sphere would gain momentum [8]. This would mean that the sphere would, in an ideal situation, move very, very slowly. Since the sphere has gained kinetic energy, according to the law of conservation of energy, the photon would lose energy equivalent to the kinetic energy gained by the sphere. As a result, the photon must red shift.

9.2 Elastic Collision

Let us examine this interaction as a gravitational slingshot between a photon and the sun. A slingshot can be estimated as an elastic collision and compared to the interaction of a collision between billiard balls on a frictionless pool table. If the sun is considered an incompressible billiard ball and a photon is considered as an incompressible cue ball barely touching the sun in a so-called "kiss shot", then we can calculate a possible change in frequency as follows:

Let θ be the angle of the photon coming off the "kiss" compared to travelling in a "straight" line as if missing the hit. If the sun has mass M and recoils with velocity V, the conservation of momentum demands:

$$\frac{h\nu}{c} = MVsin(\frac{\theta}{2}) + \frac{h\nu'}{c}cos(\theta) \tag{9.1}$$

for the "x" direction and:

$$MVcos(\frac{\theta}{2}) = -\frac{h\nu'}{c}sin(\theta) \tag{9.2}$$

for the "y" direction.

Substituting for MV from equation 2 into equation 1, we have:

$$\frac{h\nu}{c} = \frac{h\nu'}{c} cos(\theta) - \frac{h\nu'}{c} \frac{sin(\theta) sin(\frac{\theta}{2})}{cos(\frac{\theta}{2})} \tag{9.3}$$

which reduces to:

$$\nu = \nu' (\frac{sin(\theta) sin(\frac{\theta}{2})}{cos(\frac{\theta}{2})} + cos(\theta)) \tag{9.4}$$

For very small θ:

$$\nu \simeq \nu' (\frac{\theta^2}{2} + 1) \tag{9.5}$$

Let $\nu - \nu' = \Delta\nu$. Then, subtracting ν' from both sides:

$$\Delta\nu \simeq \nu' \frac{\theta^2}{2} \tag{9.6}$$

Since $\nu' \simeq \nu$ we have:

$$\Delta\nu \simeq \nu \frac{\theta^2}{2} \tag{9.7}$$

9.3 Calculations from General Relativity

The first approximation of a solution to a solar/photon interaction was done by Einstein [8] in which the following equation was derived:

$$\theta_{rad} = \frac{4M}{R} \tag{9.8}$$

in which θ_{rad} is the angle coming off the interaction in radians, M is the mass of the sun in meters, (Schwartzchild radius). The mass of the Sun is about $M = 1475$ meters. R is the distance from the centre of the sun to the point of perihelion of the hyperbolic orbit of the photon in the path around the sun following the geodesic, also in meters. To convert R to the angular separation from the star to the sun in radians, divide R by an astronomical unit.

The formula derived previously is:

$$\Delta\nu = \frac{\theta_{deg}^2}{2} \nu \tag{9.9}$$

where θ_{deg} is the angle coming off the interaction in degrees, $\Delta\nu$ is the change in frequency and ν is the frequency of the signal.

Combine both formulae to yield:

$$\Delta\nu = \frac{M^2 \pi^2}{2025 R^2} \nu \tag{9.10}$$

or:

$$\Delta E = \frac{M^2 \pi^2}{2025 R^2} E \tag{9.11}$$

or:

$$\Delta p = \frac{M^2 \pi^2}{2025 R^2} p \tag{9.12}$$

By-passing the sun, a photon is red-shifted by a factor of about 10^{-7}.

Chapter 10

String Theory

We have looked at Schrödinger's Equation, which is a diffusion equation with a linear term added on the end. Diffusion is an interesting mathematical phenomena. Mathematically, effects occur instantly throughout the media into which diffusion is penetrating. That means things happen faster than the speed of light; they happen instantly.

Consider three classes of differential equations. The diffusion equation, of which Schrödinger is included, the harmonic equation and the biharmonic equation.

Setting these out:

$$\begin{aligned} &\text{The diffusion equation:} & \tfrac{\partial\psi}{\partial t} &= \nabla^2\psi \\ &\text{The harmonic equation:} & \tfrac{\partial^2\psi}{\partial t^2} &= \nabla^2\psi \\ &\text{The biharmonic equation:} & 0 &= \nabla^4\psi \end{aligned} \tag{10.1}$$

These three cover a great deal within the field of applied mathematics. There are, of course, many variations. ψ is almost always defined as some unknown potential.

The second formula above, the harmonic equation, has the property that alterations propogate at a particular speed. That the speed of propogation within the media described by the differential equation has some definite finite value such as the speed of light. However, space-time is a tensor field and the harmonic equation can only describe a vector field. This has possibilities for electromagnetism but not for gravity.

The third formula above is the biharmonic equation and describes the world of elasticity. It is used in geophysics to describe movements of plate techtonics. It contains various stress tensors of an elastic media.

Consider the Heisenberg shell previously derived. Consider a potential ψ within a shell bounded by $r = \frac{h}{2mc}$ and $t = \frac{h}{mc^2}$. If we use the Schrödinger Equation as follows:

$$\left\{\frac{\partial}{\partial t}\right\}\psi = \left\{\frac{i\hbar^2\nabla^2}{2m} - iV\right\}\psi \tag{10.2}$$

as a "Schrödinger operator". In order to find a measure of acceleration or force, or second time ordered differential, we re-apply the operator within the shell to obtain:

$$\frac{\partial^2\psi}{\partial t^2} = \frac{\hbar^4}{4m^2}\nabla^4\psi - \frac{\hbar^2 V}{m}\nabla^2\psi + V^2\psi \tag{10.3}$$

In spherical coordinates this is: $\frac{\partial^2}{\partial t^2}\psi(t,r,\theta,\phi) = \frac{\hbar^4}{4m^2}$ ($2\ r\ \sin(\theta)$ (- 2 ($2\ r\ \sin(\theta)$ $\frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + r^2 \sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) r^{-3} ($\sin(\theta)$) $^{-1}$ + ($2\sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + 4\ r\ \sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + r^2 \sin(\theta)\ \frac{\partial^3}{\partial r^3}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial^2}{\partial r \partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^3}{\partial \theta \partial r \partial \theta}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^3}{\partial \phi^2 \partial r}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $r^{-2}\ (\sin(\theta))^{-1}$) + $r^2\ \sin(\theta)$ (6 ($2\ r\ \sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + r^2\ \sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + sin(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) r^{-4} $(\sin(\theta)$) $^{-1}$ - 4 ($2\ \sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + 4\ r\ \sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + r^2\ \sin(\theta)\ \frac{\partial^3}{\partial r^3}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial^2}{\partial r \partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^3}{\partial \theta \partial r \partial \theta}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^3}{\partial \phi^2 \partial r}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $r^{-3}\ (\sin(\theta))^{-1}$ + ($6\ \sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + 6\ r\sin(\theta)\ \frac{\partial^3}{\partial r^3}\psi(t,r,\theta,\phi) + r^2\sin(\theta)\ \frac{\partial^4}{\partial r^4}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial^3}{\partial r^2 \partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^4}{\partial \theta \partial r^2 \partial \theta}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^4}{\partial r \partial \phi^2 \partial r}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $r^{-2}\ (\sin(\theta))^{-1}$) + $\cos(\theta)$ (- ($2\ r\ \sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + r^2\sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $\cos(\theta)\ r^{-2}\ (\sin(\theta))^{-2}$ + ($2\ r\cos(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + 2\ r\sin(\theta)\ \frac{\partial^2}{\partial r \partial \theta}\psi(t,r,\theta,\phi) + r^2\ \cos(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + r^2\ \sin(\theta)\ \frac{\partial^3}{\partial r^2 \partial \theta}\psi(t,r,\theta,\phi)$ - $\sin(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + 2\ \cos(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^3}{\partial \theta^3}\psi(t,r,\theta,\phi)$ - $\frac{\left(\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)\right)\cos(\theta)}{(\sin(\theta))^2} + \frac{\frac{\partial^3}{\partial \phi^2 \partial \theta}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) r^{-2} ($\sin(\theta)$) $^{-1}$) + $\sin(\theta)$ (2 ($2\ r\sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + r^2\sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $(\cos(\theta))^2\ r^{-2}$ ($\sin(\theta)$) $^{-3}$ -2 ($2\ r\cos(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + 2\ r\ \sin(\theta)\ \frac{\partial^2}{\partial r \partial \theta}\psi(t,r,\theta,\phi) + r^2\ \cos(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + r^2\ \sin(\theta)\ \frac{\partial^3}{\partial r^2 \partial \theta}\psi(t,r,\theta,\phi)$ - $\sin(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + 2\cos(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^3}{\partial \theta^3}\psi(t,r,\theta,\phi)$ - $\frac{\left(\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)\right)\cos(\theta)}{(\sin(\theta))^2} + \frac{\frac{\partial^3}{\partial \phi^2 \partial \theta}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $\cos(\theta)\ r^{-2}$ ($\sin(\theta)$) $^{-2}$ + ($2\ r\ sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + r^2\ \sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $r^{-2}\ (\sin(\theta))^{-1}$ + (- $2\ r\sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + 4\ r\cos(\theta)\ \frac{\partial^2}{\partial r \partial \theta}\psi(t,r,\theta,\phi) + 2\ r\sin(\theta)\ \frac{\partial^3}{\partial \theta \partial r \partial \theta}\psi(t,r,\theta,\phi)$ - $r^2\ \sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + 2\ r^2\cos(\theta)\ \frac{\partial^3}{\partial r^2 \partial \theta}\psi(t,r,\theta,\phi) + r^2\sin(\theta)\ \frac{\partial^4}{\partial \theta \partial r^2 \partial \theta}\psi(t,r,\theta,\phi)$ - $\cos(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi)$ - $3\ \sin(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + 3\ \cos(\theta)\ \frac{\partial^3}{\partial \theta^3}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^4}{\partial \theta^4}\psi(t,r,\theta,\phi) + 2\ \frac{\left(\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)\right)(\cos(\theta))^2}{(\sin(\theta))^3}$ - $2\ \frac{\cos(\theta)\frac{\partial^3}{\partial \phi^2 \partial \theta}\psi(t,r,\theta,\phi)}{(\sin(\theta))^2} + \frac{\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)}{\sin(\theta)} + \frac{\frac{\partial^4}{\partial \theta \partial \phi^2 \partial \theta}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) r^{-2} $(\sin(\theta))^{-1}$) + ($2\sin(\theta)\ \frac{\partial^3}{\partial \phi^2 \partial r}\psi(t,r,\theta,\phi) + r^2\sin(\theta)\ \frac{\partial^4}{\partial r \partial \phi^2 \partial r}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial^3}{\partial \phi^2 \partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^4}{\partial \theta \partial \phi^2 \partial \theta}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^4}{\partial \phi^4}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) $r^{-2}\ (\sin(\theta))^{-2}$) $r^{-2}\ (\sin(\theta))^{-1}$ - $\frac{\hbar^2 V}{m}$ (2 r $\sin(\theta)\ \frac{\partial}{\partial r}\psi(t,r,\theta,\phi) + r^2\sin(\theta)\ \frac{\partial^2}{\partial r^2}\psi(t,r,\theta,\phi) + \cos(\theta)\ \frac{\partial}{\partial \theta}\psi(t,r,\theta,\phi) + \sin(\theta)\ \frac{\partial^2}{\partial \theta^2}\psi(t,r,\theta,\phi) + \frac{\frac{\partial^2}{\partial \phi^2}\psi(t,r,\theta,\phi)}{\sin(\theta)}$) r^{-2} ($\sin(\theta)$) $^{-1}$ + $V^2\ \psi(t,r,\theta,\phi)$

From the general solution to the above equation we can apply boundary conditions: $r = \frac{h}{2mc}$ and initial condition $t = \frac{h}{mc^2}$ to show that the resultant Bessel functions and their zeros along with Legendre polynomials lead to zeta functions appropriate to develop string theory.

First we resolve the harmonic equation, which also solves the biharmonic, as follows:

$$\begin{aligned}
&\psi^*(t,r,\theta,\phi) = T(t)\,R(r)\,\Theta(\theta)\,\Phi(\phi),\\
&\tfrac{d^2}{dt^2}T(t) = -\alpha^2 T(t),\\
&\tfrac{d^2}{dr^2}R(r) = -\alpha^2 R(r) + \beta^2\tfrac{R(r)}{r^2} - 2\,\tfrac{\frac{d}{dr}R(r)}{r},\\
&\tfrac{d^2}{d\theta^2}\Theta(\theta) = -\Theta(\theta)\,\beta^2 + \tfrac{\Theta(\theta)\gamma}{(\sin(\theta))^2} - \tfrac{\cos(\theta)\frac{d}{d\theta}\Theta(\theta)}{\sin(\theta)},\\
&\tfrac{d^2}{d\phi^2}\Phi(\phi) = -\gamma^2\Phi(\phi)
\end{aligned}$$

Where:

$$\begin{aligned}
&\tfrac{\partial^2}{\partial t^2}\psi^*(t,r,\theta,\phi) =\\
&\left(\begin{array}{l}
2\,r\sin(\theta)\,\frac{\partial}{\partial r}\psi^*(t,r,\theta,\phi)\\
+r^2\sin(\theta)\,\frac{\partial^2}{\partial r^2}\psi^*(t,r,\theta,\phi)\\
+\cos(\theta)\,\frac{\partial}{\partial\theta}\psi^*(t,r,\theta,\phi)\\
+\sin(\theta)\,\frac{\partial^2}{\partial\theta^2}\psi^*(t,r,\theta,\phi)\\
+\frac{\frac{\partial^2}{\partial\phi^2}\psi^*(t,r,\theta,\phi)}{\sin(\theta)}
\end{array}\right)\frac{1}{r^2(\sin(\theta))}
\end{aligned} \tag{10.4}$$

and

$$\begin{aligned}
T(t) = {} & A\sin(\alpha t) + B\cos(\alpha t)\\
R(r) = {} & \tfrac{C}{\sqrt{r}}\,BesselJ\left(1/2\sqrt{1+4\beta^2},\alpha r\right) + \tfrac{D}{\sqrt{r}}\,BesselY\left(1/2\sqrt{1+4\beta^2},\alpha r\right)\\
\Theta(\theta) = {} & E\,LegendreP\left(1/2\sqrt{1+4\beta^2}-1/2,\sqrt{\gamma},\cos(\theta)\right)\\
& +F\,LegendreQ\left(1/2\sqrt{1+4\beta^2}-1/2,\sqrt{\gamma},\cos(\theta)\right)\\
\Phi(\phi) = {} & G\sin(\gamma\phi) + H\cos(\gamma\phi)
\end{aligned} \tag{10.5}$$

Now we resolve the linear part which is:

$$\frac{\partial^2\psi(t,r,\theta,\phi)}{\partial t^2} = k\psi(t,r,\theta,\phi) \tag{10.6}$$

having solution:

$$\psi(t,r,\theta,\phi) = f_1(r,\theta,\phi)e^{\sqrt{k}t} + f_2(r,\theta,\phi)e^{-\sqrt{k}t} \tag{10.7}$$

Now, we will show a little of the biharmonic part in Cartesian coordinates.

Note that if:

$$\begin{aligned}
&\tfrac{\partial^4\psi(x)}{\partial x^4} = \alpha^4\psi(x)\\
&(D^4-\alpha^4)\psi(x) = 0\\
&(D-\alpha)(D+\alpha)(D^2+\alpha^2)\psi(x) = 0\\
&(D-\alpha)(D+\alpha)(D-i\alpha)(D+i\alpha)\psi(x) = 0\\
&\psi(x) = Ae^{\alpha x} + Be^{-\alpha x} + Ce^{i\alpha x} + De^{-i\alpha x}\\
&\psi(x) = F\cos(\alpha x) + G\sin(\alpha x) + H\cosh(\alpha x) + I\sinh(\alpha x)
\end{aligned} \tag{10.8}$$

So, both the real and the imaginary parts to the harmonic equation work as a solution to the biharmonic equation in Cartesian coodinates. In this case, we can use both x and ix in the harmonic term for a solution to the biharmonic term which doubles the number of solutions for each dimension; however, only half can be used at a time. This is because all the reals have to be equal on both sides of the equation and all the imaginaries must also be equal on both sides.

You can then apply the boundary conditions to the equation in spherical coordinates to solve for the arbitrary constants resulting in the appearance of zeta functions.

It may be interpreted that in eigenspace each of the eigenvalues, α, β, etc. are summed over an infinite number of values in such a way that each term of the solution is orthogonal in order to match the boundary conditions. In Cartesian coodrdinates we could have α_n, β_n, γ_n and ξ_n and possibly sum n^2 over the general solution as n goes from one to infinity. Each value of n results in an "eigenset" and each set of eigenvalues forms a vector space containing orthogonal eigenvectors. These eigenvalues therefore form a multidimensional orthogonal space. There are twelve spacial for the biharmonic term, six for the harmonic term and two for the temporal term. That makes a 20-dimensional eigenspace. However, only half the eigenspace can be used at a time as previously explained. We therefore have a ten-dimensional eigenspace.

This forms an interesting approach which may possibly be used in string theory.

Chapter 11

Galaxies and the Unified Field Theory

We have travelled some way to get here. I have established a Unified Field Theory. My son tells me that there can only be one Unified Field Theory, that it exists and that it is unique. Therefore, let us say, I have established the Unified Field Theory. And apart from the exotic, fantastic and bizarre theories previously postulated as overall explanations of physical reality, we have neatly tied up a rather straightforward, mundane and boring theory that elegantly combines the three great closed theories of the past into a very simple overview, that they are all part of one overall complete and closed theory of physics.

These three theories are Gravity, Electromagnetism and Quantum Mechanics. You may think that only Gravity and Electromagnetism are closed theories and that Quantum Mechanics is still open, but you would be in error. Quantum Mechanics became a closed theory the moment I solved the general time-dependant Schrödinger Equation with Heisenberg boundary conditions. What does this mean?

First, please allow me to state that I am absolutely stunned and gob-smacked that a reader would trudge and grapple his or her way through endless chapters of obtuse physical theory and mathematical derivations and not have a clue why they were doing so. And, to let you in on a little secret, I have no idea what I am writing either until I actually get to writing it down. I have taken a break in writing this treatise for about two years until I could figure out what to write next. And I believe I have come to the point where we must pause, look around and answer the age-old question: "Where the heck are we?" We know that we are going from darkness into light. And that is always a worthwhile journey. For example, when I was locked up in my room for years trying to trisect an angle, I thought it was possible to do even though I was told it wasn't. Then, in second year university, the proof that one cannot trisect an angle was presented. I think it was supposed to be by Minkowski or perhaps by Riemann. I have now found out that Archimedes trisected angles by using an Archimedes spiral millennia ago. So the guy beat me to it. I always thought the proof that it was impossible was convoluted and, in a word, crap. But now I know for sure. Minkowski and Riemann never postulated such a "proof". It is all a lie. Archimedes was the greatest mathematician who ever lived. Nevertheless, it was by attempting the impossible that I have an appreciation for genius. I don't exactly know where we are going with this, but we are going somewhere. And somewhere else is better than where we are.

If I may explain, Schrödinger's Equation is a description of the potential of space and time within certain boundary limits. Within these limits, we can describe the physical state and properties of this region as though we were dealing with a particle. These particles are considered as within and of themselves, independently of other particles and without any causation of events before and after. They just be as they are. And their description is determined by the eigenvalues within the solution of the equation known as Schröginer's Equation. When α has the value of $2\pi i/h$, or $n = 1$ and we are dealing with the time oriented solution, we have a photon. In other words, $E = h\nu$ where ν is a collection of frequencies centred around a signature, or central frequency, that is determined by its energy. Both its energy and momentum are determined the boundary conditions predicted by Heisenberg.

However, outside of this boundary, we utilize an entirely different set of differential equations known as the Einstein Field Equations which also include Maxwell's Equations. It is still all the same time and space, but time and space behave according to the size of the measure involved. If we are measuring time and space within the Heisenberg boundary conditions, we are dealing with Schrödinger and Quantum Mechanics. Outside of these boundary conditions, we deal with Einstein, Maxwell, Gravity and Electromagnetism. Where there is no particle, there is time and space and a measure of ψ; where we are dealing with a particle, there is a different measure of time and space and ψ. If we are dealing with particles that are described by α_n where:

$$\frac{i\hbar\partial\psi}{\partial t} = -\alpha_n^2\psi$$

we have a "massless" particle that moves at the speed of light. If this wave bundle, which is the collection of all of the frequencies described by α_n, are treated as a particle having energy $h\nu$ then we can treat this particle within the larger bounds of space-time as:

$$G_{\mu\nu} = \rho l_\mu l_\nu$$

where l is the four-velocity of the bundle. In our case, c. Here ρ is the energy density found by applying the Lagrangian to the Faraday tensor arrangement previously presented. Or,

$$G_{\mu\nu} = -8\pi F_{\mu\alpha}F_\nu{}^\alpha + 2\pi g_{\mu\nu}F_{\alpha\beta}F^{\alpha\beta}$$

where α and β are not eigenvalues, but dummy indexes. Sorry for using the same variable to mean two different things, like α, but I am trying to follow convention. Of course, me saying I am trying to follow convention has just caused great hilarity among the giants of the past. As we used to say in the 60s: "Behind your back the Universe is laughing."

The value of ψ is a measure of the potential of existence. This existence comes into being where $\psi = 1$. This is at the boundary of the particle. Space and time can be bent or curved by various forces. The measure of this curvature is the value of $G_{\mu\nu}$. We can see the effects of this curvature as a measure of acceleration, or as $\partial^2\psi/\partial t^2$. As spacetime is bent more and more by the application of greater forces, the value of ψ increases. And it seems you can only bend spacetime so far. If you bend it too much it "crimps" and becomes a particle, or a space-time knot, if you like, having the Heisenberg boundary conditions and interior described by Schrödinger. At the boundary, spacetime "crystallizes" into mass and charge described by the boundary conditions which I have previously presented.

We must now find some physical phenomenon or some evidence somewhere that proves this true. Even though I have described the red shifting of light travelling through a gravitational field, that is a difficult measurement. There is another direct piece of evidence that can be easily seen by everyone. And that evidence is presented by galaxies. Spiral galaxies and galaxies in general have presented modern science with the greatest enigma in history.

And it is through the resolution of this enigma that we can firmly establish the validity of the Unified Field Theorem. Yum.

The enigma is that the scientific community at large believes there was a beginning to the universe about 13.6 billion years ago and that the universe has been expanding ever since. This is balderdash. Lately it has been postulated that the universe is not only expanding but that it is accelerating outwardly. Further, there has also been postulated that there exists an exotic substance and ethereal fantasy known together as dark matter and dark energy. This results in a cosmology that is both bizarre and completely mad. There is no dark matter, the universe is not expanding, there was no big bang. The universe is infinite; eternal in the past, eternal in the future. We can measure the distances to galaxies and show there is no analytical relationship to galactic red shift which proves that the universe is not expanding. And we can demonstrate that the universe can break the second law of thermodynamics to prove the universe is eternal. I shall show that the measure of the distance to galaxies proves the universe is not expanding. Actually, the universe is not accelerating outwardly from our galaxy; we are accelerating towards the centre of the galaxy away from the rest of the universe as a result of circular motion around the galaxy. The demonstration of the ability of the universe to reverse the flow of entropy has been done through the unique and iridescent genius of Dr. Werner Israel.

Werner and I are on opposite ends of the spectrum. Werner is as conservative as you could imagine. An absolute gentleman, kindly and a pure soul. I, on the other hand, am some what of a social bull in a china shop – crass – and my soul appears fresh from the latest apocalypse. I try to spare Werner too much exposure to the ethereal realm of my mathematical indulgences. Actually, I have only met with him twice in recent years, and then I got very excited about some stuff, like finding out there is no dark matter, and it was at the same time Werner lost his son. It must have been devastating. So I remain reserved and hope that someday I may be able to restart correspondence in more earnest. I remember the time I went to Victoria a couple of years ago and met with Werner in his office. Things started out rather pleasant and soon deteriorated into an incredibly polite argument over billiard balls. It was to demonstrate that light had to red shift as it passed through a gravitational field. I at least felt I had held my own. During the conversation, Werner had proposed a theory based on the expansion of the universe. I interrupted with the question, “What happens to your theory if the universe is not expanding?” To date there has been no answer to that question.

However, if the universe is not expanding and has been around forever, what happens to the second law of thermodynamics? If entropy always increases, then the universe must run down. It must eventually run out of fuel. How do we get around this?

The second (and last) time I saw Werner in recent times, I had postulated the existence of an upper limit to the mass of a black hole. That, perhaps, at the mass of a galaxy, a black hole explodes.

Werner, patiently listening to me sitting in his office, was taken aback at hearing this postulate.

“And what could possibly cause a black hole to explode?” he asked quite incredulously.

“I was thinking,” I said, “that it somehow hit absolute zero. That it bounced off of a thermodynamic barrier and exploded. Perhaps entropy reversed somehow and the black hole explodes to form another galaxy.”

“Oh,” replied Werner kindly, “Black holes are already very cold. they are around 10^{-20} degrees Absolute.”

“Yes,” I ventured, “but it is not absolute zero. It is not exactly zero. What is the temperature of a black hole?”

“One over M,” he replied.

“Ah,” I said, “it is a dead end. You would need an infinite mass to hit absolute zero.”

Werner sat and thought. I waited. (Very quietly).

“It would be possible,” he finally said, “for a black hole to actually hit absolute zero if it was spinning or if it had charge.”

Hey, charge I don’t care about, but everything has got to spin, I thought. But I kept quiet.

Werner concentrated.

“It would hit absolute zero if its angular momentum was equal to one over its mass squared,” he concluded, fairly satisfied. Of course I reeled from the on-coming tidal wave of mathematics that I was going to have to go through to follow that thought. However, Werner looked at me and smiled, “Of course that is in these silly relativistic unit-less units.”

Of course.

I began to think and mutter about spinning black holes, but Werner was lost in thought.

“It would have to be spinning very fast,” he said still in thought. I held my breath. “It would have to be spinning so fast,” he added, “that the surface of the black hole at its equator would be moving at the speed of light.”

Bingo.

But first, let us look at the structure of galaxies themselves.

Chapter 12

The Spiral Structure of NGC 3198

It was the discovery of the spiral structure of NGC 3198 and resultant analytical model of galaxies that has formed a huge breakthrough for me in the discovery of the knowledge of everything. My Daughter Tara found out when she was 12 that I didn't know everything and she has been so angry with me as a result. This requires some explanation. You know how it is that our parents lied to us? It happens to everyone. We grow up and at some point, when we become adults, we find out that our parents lied to us. We all go through it. Well, I knew that my children would also go through it. I figured that I should tell them a deliberate lie so that when they hit some semblance of adulthood, they would see it as funny, not take the shock of it too hard and get on with life not trusting anyone without figuring things out for themselves. So, every time my kids asked me something like: "Why is the sky blue?" I could answer: "Because the absorption coefficient of the atmosphere varies as λ to the fifth." And they would then ask: "How do you know that?" And I would answer that because I am a father, I have to know everything. It has taken be quite some time to do so, however, I finally did it and now I know everything. Of course, when any of them caught me making a mistake, I just said: "I knew that. I just forgot. I know everything, I just can't remember it all." They figured it out pretty quickly. However, Tara is very special. We used to talk about infinity, eternity and how to add proper fractions in your head. She was three. Then she found out I had lied and didn't know everything. She was devastated. She was 12. So, now I actually have to learn and know everything to make it up to her. This treatise is a work of love for her. She taught me about infinity and true genius. I didn't think such a thing as true genius existed until I had deep discussions about infinity and adding proper fractions when she was three. I work this hard at learning everything just to try and keep ahead of her. I have three kids, and keeping ahead of any of them is a full time job.

I was on an internet chess team, the amateur astronomer chess team actually, when one of the players posted a note asking what we thought dark matter was. I said it doesn't exist. I was then asked to explain the flat velocity profile of galaxies. I said, "What do you mean?" He said that the stars all go around the galaxy with the same tangential velocity. I said I didn't believe it. He sent me the data. Sure enough, the stars go around the galaxy at the same speed. Stars closer to the centre go around slower, but a little ways out from the centre, all the stars go around the centre of the galaxy at the same tangential velocity. So I did a fundamental straight forward analysis of the gravitational shape of what is causing this.

First, we have the fundamental equation of circular motion:

$$\frac{v^2}{r} = a$$

where v is the tangential velocity of some object in circular motion about some centre. r is the distance from the object to the centre and a is the centripetal acceleration the object experiences as a result of travelling in circular motion rather than travelling in a straight line at a constant speed. Note that v is a constant in this scenario. Since we are dealing with some object, let's say it has a mass m. We mutiply both sides by m to yield:

$$m\frac{v^2}{r} = ma$$

and as we all know $F = ma$ so we stick in force.

$$m\frac{v^2}{r} = F_g$$

I have put in F_g to denote gravitational force pulling the object into a circular orbit about some centre. I feel this is reasonable since I doubt the force acting on the object is electromagnetic nor a strong nuclear binding force. Now, according to my friend Newton, from some time ago, gravitational forces are inversely square and are attracted to the centre of mass of different bodies. So we treat our object as one body as being attracted to a collection of stuff which acts as though it has a centre of mass at the centre of the orbital motion of our object. Since the effective mass at the centre of orbit could possibly vary as the distance from the centre, we can say there exists a function, $M(r)$ which is the effective mass at the centre of orbit which depends on the distance from the centre, r, in order for the object to be in circular orbit. (It's a cheat, but a valid one). So from Newton we have:

$$F_g = G\frac{mM(r)}{r^2}$$

plugging this into the stuff above we have:

$$m\frac{v^2}{r} = G\frac{mM(r)}{r^2}$$

and hacking around and rearranging we have

$$\left(\frac{v^2}{G}\right) r = M(r)$$

and since v and G are constants we have a linear equation. In other words, galaxies are sticks. They behave as though they have a linear orientation of matter and overall the galaxy has a constant linear density. It is the only way that the tangential velocity of all the material can be constant. And, of course, this makes no sense at all. If it's a stick, the material would orbit faster and faster further out from the centre like a rigid body. But it can't rotate like a rigid body because, to put it bluntly, it doesn't and yet, because the attractive force, a la gravity by Newton, it must. It's gotta be a stick. And on top of all that, galaxies don't look like sticks, they look like spirals ... and that is where Minkowski, Lorentz and Einstein step onto the playing field.

What follows is a formal solution ...

12.1 Introduction

Present explanations for the behaviour of the orbital revolution of stars in galaxies involve the hypothesized presence of an exotic substance known as dark matter. A very early mention of the existence of dark matter was made by Zwicky[87] as a result of observing nebulosities which are now known as galaxies. However, at that time, Zwicky did not give any definition or detailed properties of this substance, nor suggest it was anything exotic. The term "dark matter" was mentioned simply as matter that is dark or non-luminous. He also points out that he could not explain the luminosity distribution of galactic nebulae by relating it to the calculated mass distribution using the assumptions of a Keplerian system. We shall refer to this relationship between mass and luminous material as the mass-luminosity relationship. Although dark matter was first described as simply non-luminous matter by Zwicky, Rubin et al.[79], in their measurements of the tangential velocities of stars in orbit about M31, discovered a peculiar relationship, which has since risen to the suspicion that this dark material may have certain exotic properties yet to be defined. This relationship has been substantiated, notably, by Mathewson[73], Begeman[50] and Persic[76] as well as many others. A rotation curve for a galaxy is a graph of the calculated tangential velocity of stars and material about the centre of the galaxy vs. the angular distance, in arcsec or arcmin, of the stars and material from the centre of the galaxy. These calculations are based on the Doppler shifts of these stars, the red shift of the galaxy itself and the galaxy's angle of incline to the celestial sphere. We show an example in Figure 12.2 along with other examples in Figure 12.1. These figures are described in detail later. Rotation curves show a distinctive relationship between tangential velocity and radial distance to the centre of the galaxy. The graph grows linearly from the centre of the galaxy and then flattens in the outer regions. We denote this distinctive curve as the flat velocity rotation curve of galaxies. A cursory examination of the expected rotation curve of a Keplerian system and the flat velocity rotation curve observed, leads to the conclusion that galaxies either portray inexplicable behaviour or that galaxies do not meet the requirements of a Keplerian system and yet have explicable behaviour using some other model or system.

Kepler[69] determined certain laws of the orbits of planets around the sun. Notably that the orbits were elliptical and that the period of the planet's orbit varied cubically as its distance from the sun squared. Newton[75] in turn, determined that this discovery was the result of the sun's gravitational field that obeyed an inverse square relationship. A Keplerian system consists of a central massive region, i.e. the sun, surrounded by light objects, i.e. planets, which do not have sufficient masses themselves to effect the overall system. Apart from small orbital perturbations as a result of neighbouring planets, this model has stood the test of time for more than 350 years. A Keplerian model has a very important requirement: it must consist of an overwhelmingly massive central body or region so that the gravitational fields of orbiting material or objects can be discounted and ignored.

Because of the apparent discrepancy between Keplerian gravitational theory and observations of rotational velocity profiles of galaxies, an investigation using the general theory of relativity[60] was conducted to resolve this discrepancy and an analytic galactic model has been derived as a result. The consequences of this model were then compared to other galactic parameters in order to validate the model. These parameters include the distances to galaxies, their luminosity profiles and masses. We have also attempted to compare the lengths of bars in barred spirals to that predicted by the model in order to add to its verification. We begin a presentation of this investigation by examining the rotation curve of NGC 3198.

12.2 An Examination of the Rotation Curve of NGC 3198

Begeman has provided an accurate and extensive measurement of the rotational velocities of stars in the spiral arms of NGC 3198. Under the heading "Discussion", Begeman states the following:

A further analysis of the mass distribution in NGC 3198 has been given by Albada[48]. The main conclusions from that paper are (i) the rotation curve of NGC 3198 can be described by a two-component mass model consisting of an exponential disk and a spherical halo, and (ii) the amount of dark matter needed to explain the observed rotation curve out to the last measured point is at least a factor 4 larger than the amount of visible matter.

Re-examining Begeman's observations and conclusions, let us take a different approach by considering a large polar coordinate system that is rotating about its origin. Clocks that are circulating with the coordinate system further from the origin would have a greater tangential velocity than clocks closer to the origin. The Lorentz transformations would then dictate that the outer clocks would record the passage of time more slowly than the inner clocks. Also, standard measuring rods would be comparatively foreshortened if oriented in the tangential direction due to the Lorentz transformations.

The Lorentz factor is given as:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{12.1}$$

Consider two observers, one at rest relative to the centre of a rotating polar coordinate system which we denote as a non-revolving observer, and a second observer in motion revolving about the described centre along with the coordinates of the rotating polar coordinate system, which we denote as a revolving observer. Also, let us consider that the centre of the rotating polar coordinate system is not accelerating. For simplification, one may compare this to a merry-go-round with one observer riding on the merry-go-round and another standing on solid ground nearby watching. Also, that the entire merry-go-round and ground-based observer are firmly entrenched in an inertial reference frame. Note that in the derivations that follow, we would be considering an extremely large merry-go-round.

The measure of an angle in radians is defined as the arc length subtended by the angle divided by the radial distance to the arc from the vertex of the angle. However, the measure of the arc length by the revolving observer is effected by the rotation of the coordinate system due to Lorentz foreshortening. If the angle measured by a revolving observer is denoted as θ and the angle measured by a non-revolving observer is denoted as θ_0 then:

$$\theta_0 = \frac{\theta}{\gamma} \tag{12.2}$$

where γ is the Lorentz factor at the coincident point of measure. This is because of the foreshortening of the measure of arc length compared between the two observers. However, the measure of radial distance would be the same for both observers since the radial direction is orthogonal to the direction of travel of the rotating coordinate system. Considering time measured by the non-revolving observer as t and differentiating both sides, we have:

$$\frac{d\theta}{dt} = \frac{d\theta_0}{\gamma dt} \tag{12.3}$$

since $d\theta/dt = \omega$ we have:

$$\omega = \frac{\omega_0}{\gamma} \tag{12.4}$$

where γ is dependant on the radial distance from the centre.

This would mean the measure of rotational angular velocity would be different for a revolving observer as for a non-revolving observer. The clocks and rulers of a revolving observer measure differently than for a non-revolving observer. Since, for rotating bodies and coordinate systems:

$$v = \omega r \tag{12.5}$$

we substitute back in to equation 12.1 to obtain;

$$\gamma = \frac{1}{\sqrt{1 - \frac{\omega^2 r^2}{c^2}}} \tag{12.6}$$

and substituting for the Lorentz factor we have:

$$\gamma = \frac{1}{\sqrt{1 - \frac{\omega_0^2 r^2}{\gamma c^2}}} \tag{12.7}$$

Solving for γ we have:

$$\gamma = \sqrt{1 + \frac{\omega_0^2 r^2}{c^2}} \tag{12.8}$$

This yields the spatially two-dimensional time dependent metric,

$$ds^2 = \frac{c^2}{\gamma^2} dt^2 - dr^2 - \gamma^2 r^2 d\theta^2 \tag{12.9}$$

In order to describe the path of a geodesic in a rotating polar coordinate system we consider a photon travelling radially outwardly from the centre of such a rotating system. The photon would travel in a straight line according to a non-revolving observer but would appear to have a curved path to a revolving observer. If the coordinate system we are considering is rotating with an angular velocity of ω_0, then the path of the photon would appear as an Archimedes' Spiral[49] to a revolving observer.

As the photon travels outwardly, it passes over sections of the rotating coordinate system whose local clocks and tangential distance measures deviate from those measured by a non-revolving observer according to the Lorentz factor as described in equation 12.1.

If the rotating system is considered as a rigid body, the period, T, of a system's rotation would be constant throughout the rotating body. However, because of the Lorentz factor involved, the period of rotation alters by a factor of γ which increases as R increases. We see from equation 12.4 that a linear relationship between γ and R is reached very quickly after a distance $R > \frac{c}{\omega_0}$ from the centre of the rotating system. As a result, the tangential velocity would approach an asymptote which we denote as v_{max}.

In examining the metric of equation 12.9, and the equation for the Lorentz factor in equation 12.1, we see an interchangeability between time and space coordinates by either multiplying the time coordinate by the speed of light or by dividing spacial coordinates by the same value. Coordinates in a Cartesian Minkowski space are (ict, x, y, z). Here the coordinates are in meters in the MKS system. However, we could use seconds for time and light-seconds for distance as in $(it, x/c, y/c, z/c)$, or we may also use years and light-years. Converting from MKS to completely unit-less dimensions such as $\tilde{R}$ for radial distance, $\tilde{v}_{max}$ for the asymptote of tangential velocity and $\tilde{\omega}_0$ for angular velocity we have:

$$\tilde{v}_{max} = \frac{v_{max}}{c} \tag{12.10}$$

$$\tilde{R} = \frac{R}{c\tau} \tag{12.11}$$

$$\tilde{\omega}_0 = \omega_0 \tau \tag{12.12}$$

where τ is the number of seconds in a year. The resultant constant of proportionality between the radial dimension and the orthogonal angular dimension, θ, is 2π. Therefore:

$$2\pi\tilde{\omega}_0 = \tilde{v}_{max} \tag{12.13}$$

and

$$\tilde{\omega}_0 = \frac{\tilde{v}_{max}}{2\pi} \tag{12.14}$$

The equation of a spiral geodesic witnessed by a revolving observer further than $1/\tilde{\omega}_0$ from the centre of the rotating system is:

$$\tilde{R} = \frac{\theta}{\tilde{\omega}_0} \tag{12.15}$$

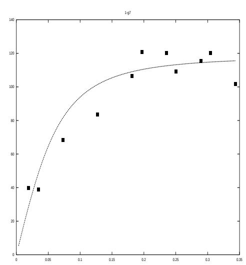
Upon inspection it can be seen that $\tilde{R}$, although unit-less, is the value of a spacial measurement in light years and $\tilde{\omega}_0$, equates to a measure of radians per year. The authors had chosen a time unit of years for this derivation. Should other time units and corresponding spacial measurements be used, equations 12.13 and 12.15 would again be obtained and conversion back to MKS units would yield identical results.

Applying equation 12.8 to the measured tangential velocity by a non-revolving observer, we now have:

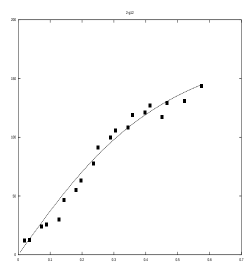
$$v_{tan} = v_{max} \cdot \frac{\tilde{\omega}_0 \tilde{R}}{\sqrt{1 + \tilde{\omega}_0^2 \tilde{R}^2}} \tag{12.16}$$

As $\tilde{R}$ becomes very large, v_{tan} approaches the asymptote for the maximum tangential velocity as determined by the restrictions of the Lorentz transformation denoted as v_{max}. We have curve fitted equation 12.16 with a survey of 878 velocity rotation profiles[76] to obtain an average normalized standard error of 0.0756 with a standard deviation of .049. (Some examples are shown in Figure 12.1)

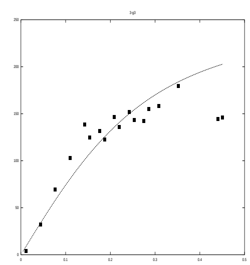
Returning to NGC 3198, we apply a rotational tangential velocity of 151 km s^{-1}, as given by Begeman, to the above equations and compare the resultant curve as described by a geodesic traced out on an equivalent rotating coordinate system to a photograph of the galaxy as in Figure 12.3. The left side of Figure 12.3 is a graph of a double Archimedes spiral which closely resembles the photo on the right of NGC 3198. Note the scale of the graph on the left which is in light years as per equation 12.15. There appears to be a remarkable morphological similarity and a possibility of determining the intrinsic size of the



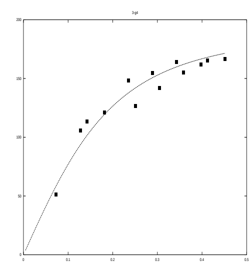
(a) 1-g7



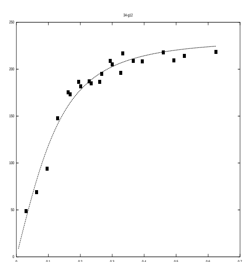
(b) 2-g12



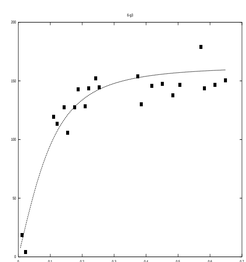
(c) 3-g3



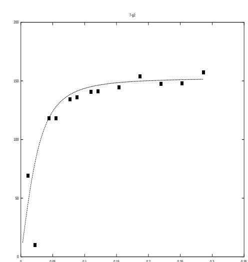
(d) 3-g4



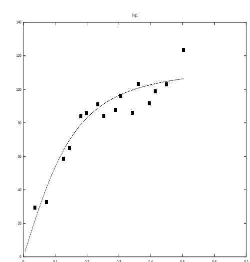
(e) 34-g12



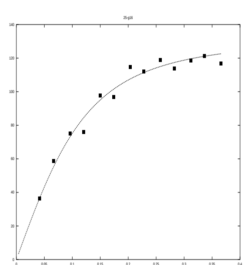
(f) 6-g3



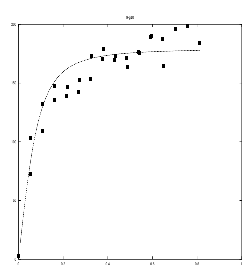
(g) 7-g2



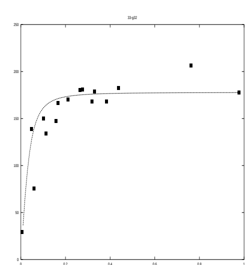
(h) 8-g1



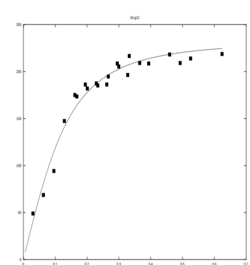
(i) 25-g16



(j) 9-g10



(k) 33-g32



(l) 34-g12

Figure 12.1: Twelve velocity rotation profiles with Equation 12.16 overlaid. Rotation profiles courtesy of Salucci

galaxy itself. This can be used as a distance measure to the galaxy which is described in more detail further on. Note further in the photograph on the right that the luminosity of the galaxy appears more intense at the centre of the galaxy and tapers off outwardly from the centre.

We have curve fitted equation 12.16 to the observations of Begeman and compare the results as in Figure 12.2. In this figure, the data points provided by Begeman have a reported error in rotational velocity of 5 k s^{-1} and an error in angular measure of $15''$ of arc. The calculated fit, shown as a continuous line, has a normalized sigma of 0.04 from the data points provided and yields a fitted v_{max} of 152.9 k s^{-1}.

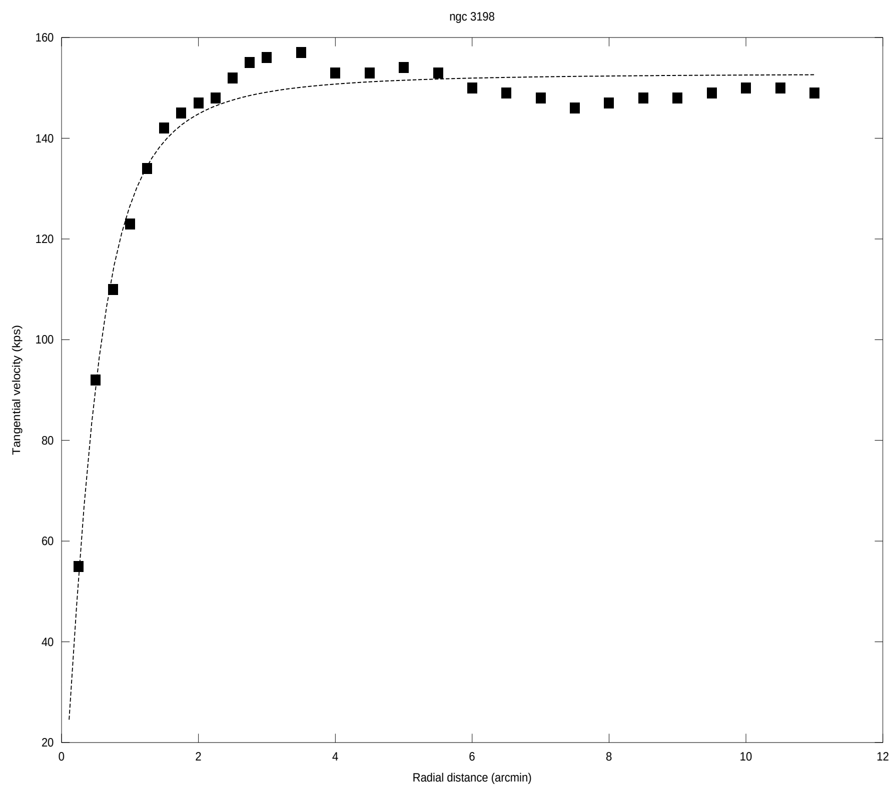


Figure 12.2: Begeman's rotational data overlaid with a curve fit of equation 12.16. The fit yields a normalized sigma of 0.04 and a v_{max} of 152.9 k s^{-1}.

There are two parameters involved in the curve fitting procedure in order to produce Figure 12.2. One is v_{max} and the other is an angular-distance ratio to couple the values given by Bergeman and Equation 12.16. This ratio can also be used to estimate the distance to the galaxy and then compared to other established distance measurements. (Please refer to a later section in this paper).

12.3 Spiral Morphology

The analytical model presented is simply a mathematical spiral. The classification of spiral galaxies was originally coined by Hubble[66] who noted their spiral morphology. We have investigated whether or not such galaxies are in fact mathematical spirals by applying a least-squares fit[58] to the digital photographs of six galaxies in the visible spectrum. The fit was made without correcting for the angle of incline, with the exception of NGC 3198, to the curve described as an Archimedes' Spiral. The fit shows a normalized average standard error of 0.078 with a standard deviation in the error of 0.014. See Table 12.3. In this table, the name of each galaxy is in the column on the left and the normalized sigma of the fit of the pixel greyscale of a digital photograph of the galaxy to an Archimedes' Spiral is given in the right column. These galaxies were chosen since they have a very small angle of incline and a fitting algorithm could be applied with no manipulation of the pixels of the digital photograph used. An exception is NGC 3198, which required a transformation of 1.18 radians to account for the angle of incline. We conclude that it is not unreasonable to model spiral galaxies portrayed in digital photographs in the visible spectrum as Archimededean spirals having an Archimedes' exponent of 1. Digital photographs from the Mast Digital Sky Survey with maximum response wavelengths between 6400 and 6700 Å[1] were used.

Name	Normalized Sigma of Fit
IC 239	0.064
IC 512	0.072
NGC 6412	0.085
NGC 4321	0.061
NGC 3198	0.098
M101	0.086

Table of six galaxies and normalized standard error to a least-squared fit to an Archimedes' spiral.

12.4 Using Distance Measures to Validate the Model

We have noticed that the faster a galaxy is "spinning", the more "wound up" it appears to be. If we look at Equation 12.15, we can see that a greater value of v_{max} or $\tilde{\omega}_0$ will result in a spiral being more tightly wound and having a smaller pitch. Therefore we can validate this particular model by comparing the predicted intrinsic size of the spiral to the apparent size of a galaxy each having the same v_{max} parameter. Comparing the size of the spiral generated as in Figure 12.3 and angular dimensions of NGC 3198 according to photographic plates, a distance measurement can be presented. We can then compare the distance measure derived to other distance measures to determine a degree of validation for the model. We call the derived spiral distance measure, "Roxy's Ruler" and is given by the equation:

$$D = \frac{3.12 \times 10^9}{v_{max} \times \alpha_s} \tag{12.17}$$

where 3.12×10^9 is in pc arcmin K s^{-1}.

[1] Mast Phase 2 (GSC2) Survey, 2006, http://archive.stsci.edu/dss/

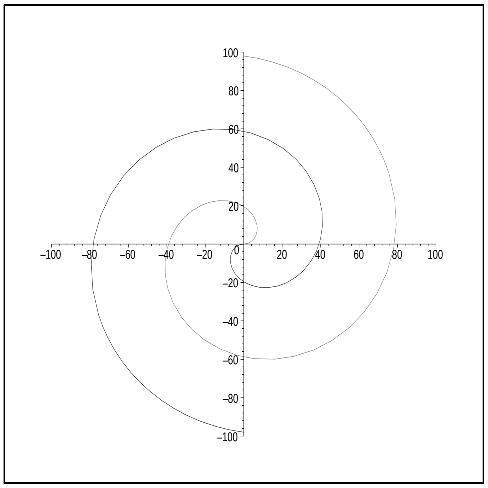


Figure 12.3: A spiral generated from tracing the outward path of a geodesic upon a large rotating polar coordinate system having a v_{max} of 151 km s^{-1}. The scale is in thousands of light years.

Figure 12.4: NGC 3198 in Ursa Major. NGC 3198 is classified SBc(R)[32].

In the case of NGC 3198, v_{max} is taken as 151 K s^{-1} as per Bergeman and α_s is a angular measure of spiral pitch equal to 1.38 arcmin. The pitch of the apparent spiral is found by applying an FFT to the local minima and maxima of the greyscale values of pixels along the major axis on the afore mentioned digital photograph.

From equation 12.17 we determine NGC 3198 to be 14.97 (± 2.5) Mpc distant. The allowable error in v_{max} is calculated as 7.5 k s^{-1} and in α_s as 0.14 arcmin.

Referring to Figure 12.2, it is possible to find another method to determine the distance to NGC 3198. This utilizes the angular-distance ratio as mentioned above. In Figure 12.2 we used a ratio of 1.8221×10^4 between arcsec and ly which results from the curve fit to equation 12.16. Using the well known arc length formula, we calculate NGC 3198 at 19.2 Mpc distance. We denote this method of determining the distance to galaxies as “Cam's Ruler”.

These measurements compare to 13.8 Mpc by Freedman[63], 12 Mpc using Cepheid variables and 13.8 Mpc using Tully-Fisher by Tully[83], 10.92 Mpc using redshift by Crook[57] and 17 Mpc by Gil de Pas[64].

These measures have a mean of 14.5 Mpc with a standard deviation of 2.8 Mpc. Of the seven measurements presented here, only those using redshift and Cam's Ruler lie outside σ. We note that in using Cam's ruler in the curve fitting of NGC 3198, we included a σ of .098 and combined error of .065 in velocity and angular measurements. Although there is a remarkably close fit between the prediction of equation 12.16 and the observed values as in Figure 12.2, because of the convolutions required in deriving the angular-distance ratio, we calculate an associated margin of error of 3.13 Mpc using Cam's Ruler.

From Equation 12.17 the fractional margin of error is the sum of the fractional error in measurement of α_s, which is given by the FFT used and the fractional error in determining v_{max}. We have reviewed a number of distance measurements to galaxies which were made by Ferrarese[61] using Cepheid variables[71] and combined these measurements using Roxy's Ruler with the rotation curves cited in Table 12.4. Figure 12.5 is a presentation of a comparison between Cepheid measurements and Roxy's Ruler showing a discrepancy from matching a one to one linear fit by 1.7%. The confidence variable is 0.9104. Also see Table 12.4. This table lists the name of the galaxy in the left column. The next column lists estimates of v_{max} from rotation curves given by the cited papers below the table with an allowance of 10% as listed in the following column. The next column lists the measure of α_s from an FFT, as described, with the resultant σ of the FFT listed on the right. The next column lists the distance calculated by Equation 12.17 and the normalized error in the distance measure is to the right. The next column lists the magnitude difference from observing Cepheid variables within the galaxy and the σ of the measurement to the right. The next column lists the distance measure calculated from using Cepheid variables and the final column lists the normalized error in the distance measure using Cepheids.

0.94293

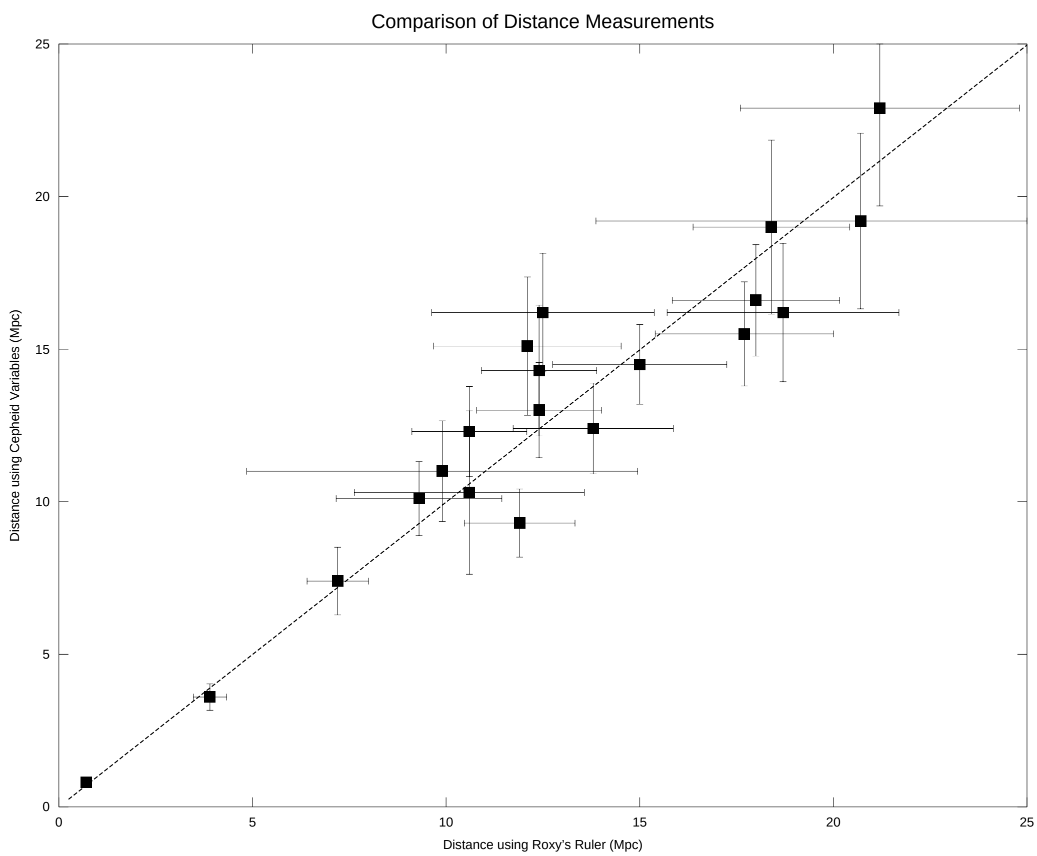


Figure 12.5: Cepheid distance vs. Roxy's Ruler showing a discrepancy from matching a one to one linear fit by 1.7%. The confidence variable is 0.9104.

Another method to measure the distance to galaxies can be found through the behaviour of water masers by Herrnstein[65]. In this method, the magnitudes of orbits of gases containing masers can be measured directly and then compared to the angular measure of these orbits. Herrnstein has measured a distance of 7.3 ± 3 Mpc to NGC 4258 using the behavior of water masers within the galaxy while Roxy's Ruler, described above, yields a distance measure of 7.16 ± 0.034 Mpc. (Note that Herrnstein used an angle of incline of 82.3° in his calculations.) The apparent angle of incline of this galaxy reported in the NASA/IPEC Extragalactic Database[2], (NED), is 63.68°. Another distance measurement to a galaxy using water maser behaviour was conducted by Braatz[52]. Braatz measured the distance to UGC 3789 as 49.9 $\pm$ 7.0 Mpc. Unfortunately, no rotation curve for UGC 3789 has been reported for this galaxy. Nevertheless, an H-I line width is available through NED. Using the spectrum reported for UGC 3789 and reported measurements of the angle of incline of the galaxy, 44.8°, a v_{max} of 306.97 $\pm$ 50.7 K s^{-1} was calculated. An FFT across the galaxy's major axis gave a pitch for the galaxy of 0.29 $\pm$ 0.045 arcmin. The resultant distance to UGC 3789 using Roxy's Ruler is 34.9 Mpc $\pm$ 5.4 Mpc. We note that Braatz reported that UGC 3789 contained an edge-on maser disk and did not apply an angle of incline to his measurement. If we also treat UGC 3789 as an edge-on galaxy and do not include an angle of incline into our measurement, we would obtain a distance measure of 49.5 $\pm$ 7.69 Mpc. Braatz[53] is planing a distance measurement to NGC 6323 and has substantiated that the maser disk in UGC 3789 is an edge-on disk as a result of using VLBI data, (personal conversation).

Yet another method for measuring the distances to galaxies is the Tully-Fisher (T-F)[82]. This method involves an observed relationship between the width of spectral lines and luminosity of spiral galaxies. The spectral line widths are caused by the rotational velocity of the galaxy. This orbital velocity is denoted as v_{rot} and corresponds to v_{max}. Calculations from the analytical galactic model, presented in the following section, show a relationship between v_{max}, the length of the galaxy's major axis, it's pitch and its mass. The intrinsic luminosity of galaxies results from the number of light sources, which Tully associated with mass, and how tightly packed these light sources are within the galaxy, which is its linear density. The model shows that the density of luminous material is proportional to v_{max}^2 and therefore the logarithm of the intrinsic luminosity compared to v_{max} would have a slope of 2 which corresponds to observation.

In Figure 12.6, we present a graph of Roxy Ruler measurements vs. distance measurements using T-F. The graph shows a linear fit through the origin with a discrepancy from a one to one match of .0272 and a sigma of 1.38 Mpc. The associated data can be found in Table 12.4. The first column in this table is the name of the galaxy being measured. The second column is the value of v_{max} using the Cam's Ruler fitting procedure described above. The third column is distance measure using T-F as reported in the Simbad database[3]. The fourth column is the reported error in the T-F measure in Mpc. The fifth column is the distance measure using RR and the sixth column is the allowable error of the measure in Mpc. The error bars in Figure 12.6 reflect the reported errors in Table 12.4.

[2]This research has made use of the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

[3]http://simbad.u-strasbg.fr/simbad/

Name	v_{max} (Ks^{-1})	Error (Ks^{-1})	α (arcmin)	σ	RR distance (Mpc)	Normalized Error	m-M	σ	Cepheid distance (Mpc)	Normalized Error
NGC 7331	225	22.5	1.15	0.096	12.1	0.20	30.89	0.1	15.1	0.15
NGC 4725	210	21	1.2	0.028	12.4	0.13	30.57	0.08	13.0	0.12
NGC 3319	130	13	1.94	0.017	12.4	0.12	30.78	0.1	14.3	0.15
NGC 4321	260	26	0.641	0.056	18.7	0.16	31.04	0.09	16.2	0.14
NGC 4535	140	14	1.24	0.022	18.0	0.12	31.1	0.07	16.6	0.11
NGC 3368	220	22	1.44	0.410	9.9	0.51	30.2	0.1	11.0	0.15
NGC 1365	50	5	3.4	0.012	18.4	0.11	31.39	0.1	19.0	0.15
NGC 4414	230	23	0.657	0.227	20.7	0.33	31.41	0.1	19.2	0.15
NGC 4639	200	20	0.735	0.075	21.2	0.17	31.8	0.09	22.9	0.14
NGC 224	241	24.1	18.94	0.090	.7	0.19	24.44	0.1	.8	0.15
NGC 3627	190	19	1.55	0.181	10.6	0.28	30.06	0.17	10.3	0.26
NGC 4536	125	12.5	1.41	0.031	17.7	0.13	30.95	0.07	15.5	0.11
NGC 3031	140	14	5.77	0.005	3.9	0.11	27.8	0.08	3.6	0.12
NGC 3351	220	22	1.53	0.130	9.3	0.23	30.01	0.08	10.1	0.12
NGC 2090	150	15	1.96	0.043	10.6	0.14	30.45	0.08	12.3	0.12
NGC 4548	157	15.7	1.59	0.132	12.5	0.23	31.04	0.08	16.2	0.12
NGC 925	120	12	2.18	0.024	11.9	0.12	29.84	0.08	9.3	0.12
NGC 2541	95	9.5	2.39	0.052	13.8	0.15	30.47	0.08	12.4	0.12
NGC 5457	190	19	2.29	0.009	7.2	0.11	29.34	0.1	7.4	0.15
NGC 3198	151	15.1	1.3817	0.046	15.0	0.15	30.8	0.06	14.5	0.09
NGC 598	130	13	33.8	0.001	.7	0.10	24.64	0.09	.8	0.14

NGC 7331: [79], NGC 3319: [74], NGC 4321: [70], NGC 4414: [54], NGC 224: [46], NGC 3627: [56], NGC 4536: [47], NGC 3031: [78], NGC 3351: [59], NGC 2090: [68], NGC 4548: [85], NGC 925: m[77], NGC 2541: [67], NGC 3198: [50], NGC 4414: [84], NGC 4639: [80], NGC 4725, NGC 3368, NGC 5457, NGC 598: [55]. See also [86]

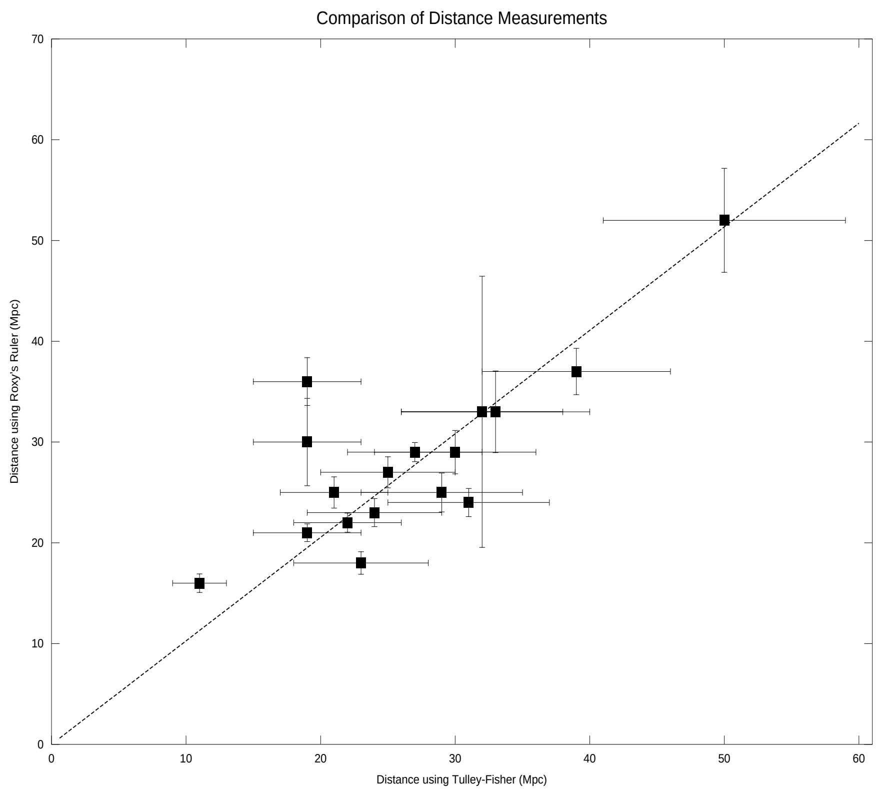


Figure 12.6: Comparisson graph between measures using Roxy's Ruler vs Tully-Fisher. The fitted line passes through the origin and has a slope of 1.0272 and the fit yields a sigma of 1.3846 Mpc.

Name	v_{max} (km/s)	T-F Distance (Mpc)	Error (Mpc)	RR Distance (Mpc)	Error (Mpc)
ESO 284-24	135.073	29	6	25	1.93
ESO 378-11	131.681	50	9	52	5.16
ESO 576-11	146.63	31	6	24	1.40
IC 5078	119.393	19	4	21	0.88
UGCA 17	109.892	23	5	18	1.12
NGC 1090	180.845	27	5	29	0.95
NGC 1163	160.503	39	7	37	2.30
NGC 1337	112.9	11	2	16	0.92
NGC 1832	198.743	25	5	27	1.54
NGC 2763	145.929	24	5	23	1.39
NGC 3321	144.019	33	7	33	4.05
NGC 4348	182.247	30	6	29	2.15
NGC 701	125.347	19	4	30	4.33
NGC 7218	128.406	21	4	25	1.55
NGC 7339	156.265	22	4	22	0.95
NGC 755	133.339	19	4	36	2.37
NGC 7606	273.5	32	6	33	13.45

12.5 Mass, Linear Density and Luminosity

(This part was written by Cam. I'm so proud.)

In the model we are presenting, gravitationally self bound particles are oriented along the path of the spiral shaped geodesic as in equation 12.15. An examination of the presented model yields a straightforward transformation into L-1 space and using the Lebesgue[72] measure of linear density in a singular dimension, we have:

$$\rho_l = \frac{v_{max}^2}{2G} \tag{12.18}$$

This matches the measurements of Fish[62] in which it was found that galaxies have a luminosity profile of a structure having a constant radial luminosity. Fish used a series of concentric rings measuring the luminosity determined by photographic photometry centred on NGC 5055 to discover this relation. We repeat this measurement on photographs of M 101, with comments, in a following section.

Using previously described distance measures and the angular length of the major axis, the intrinsic major axis length, L, can be determined. Using equation 12.18 we can determine the mass of the galaxy as:

$$M_g = L\rho_l \tag{12.19}$$

From this we can calculate the angular momentum of a galaxy as:

$$l = v_{max}\rho_l L^2 \tag{12.20}$$

12.6 Using Luminosity to Measure Density

A photograph of a galaxy can be modelled as a two dimensional projection of light from a three dimensional cloud of stars. For such a projection, the variances in luminosity could reflect the variances in mass if certain assumptions are made regarding the ratio of luminosity to mass if there are no irregular distributions of undetectable material and stars of different light/mass ratio are distributed evenly along the radial dimension. M 101 is an interesting galaxy where young and old stars are distributed rather evenly throughout the galaxy[81]. More specifically: "The distribution of the cold dust is mostly concentrated near the center, and exhibits smoothly distributed over the entire extent of the galaxy, whereas the distribution of the warm dust indicates some correlation with the spiral arms, and has spotty structures..."

The L/M ratio is expected to be higher in areas of warm dust due to the formation of young bright stars. Since the radial arms are distributed throughout the galaxy in the radial direction, for the analysis of M 101 it can be assumed that the L/M ratio is constant for any spherical surface of radius r. Under this assumption, the presence of any irregular distributions of undetectable material will be apparent as a discrepancy between the luminosity curve and the linear mass function.

For a cloud with a constant rotation profile, the mass subtended at radius r must be linearly proportional to r. If young and old stars are distributed such that the M/L ratio for M 101 is the same for any spherical surface of radius r from the center, then the presence of any non-luminous material will become evident if the luminosity curve $L(r)$ does not correlate to that expected of a linear mass function.

Considering a galaxy as cloud comprised of stars and particles in three dimensions, the density of the galaxy subtended by a sphere of radius r is given as:

$$\rho(r) = \frac{M(r)}{V(r)} \tag{12.21}$$

Where,

$$\begin{aligned} \rho(r) &= \text{the density of the cloud contained by a sphere of radius } r \\ M(r) &= \text{the mass of the cloud contained by a sphere of radius } r \\ V(r) &= \text{the volume of a sphere of radius } r \end{aligned} \tag{12.22}$$

M 101 has a tangential rotation profile of approximately 250 K s^{-1}[7]. From Equation 12.18, the distribution of matter orbiting a mutual center of mass with the same tangential velocity, is given as:

$$M(r) = kr \tag{12.23}$$

Where,

$$\begin{aligned} M(r) &= \text{the mass of all stars subtended by a sphere of radius } r \\ k &= \text{some constant} \\ r &= \text{radial distance from the center of the galaxy} \end{aligned} \tag{12.24}$$

For spiral galaxies with constant rotation profiles:

$$\begin{aligned} \rho(r) &= \tfrac{kr}{\frac{4}{3}\pi r^3} \\ &= \tfrac{3k}{4\pi}\tfrac{1}{r^2} \end{aligned} \tag{12.25}$$

and,

$$\rho_{G_s} \quad \propto \tfrac{1}{r^2} \tag{12.26}$$

Where, ρ_{G_s} = The density of a spiral galaxy with constant rotation profile.

12.6.1 Two Dimensional Projection

Projecting onto two dimensions, such as in Figure 12.7, the area density subtended by r on the surface of the photograph is:

$$\rho' = \frac{M(r)}{A(r)} \tag{12.27}$$

$$\rho' = \frac{kr}{\pi r^2} \tag{12.28}$$

$$\rho' = \frac{k}{\pi r} \tag{12.29}$$

Where, $\rho' G_s$ = the area density of a 2D projection of a spiral galaxy with constant rotation profile.

The mass of any material between two concentric circles on a photograph

$$M(\Delta r) = \frac{k}{\pi}\left(\frac{1}{r_2}A_2 - \frac{1}{r_1}A_1\right) \tag{12.30}$$

$$M(\Delta r) = \frac{k}{\pi}\left(\frac{1}{r_2}\pi r_2^2 - \frac{1}{r_1}\pi r_1^2\right) \tag{12.31}$$

$$M(\Delta r) = k\left(r_2 - r_1\right) \tag{12.32}$$

$$M(\Delta r) = k\Delta r \tag{12.33}$$

For any concentric spheres of r_1 and r_2 where $r_1 - r_2 = \Delta r$, the same mass will exist between the two spheres when Δr is the same.

We present Figure 12.8 in which two different geometrical orientations of matter show distinctive theoretical profiles. Luminous matter (stars) oriented in the shape of a disc would show a luminosity profile of a line having some non-zero slope through the origin. A linear orientation of stars would show a luminosity profile of a horizontal line. In Figure 12.9 we see the two straight lines and the measured relative luminosity from digital photographs of M 101 indicating a match with a linear orientation of stars rather than that of a disk.

12.7 Using the Length of the Bar in Barred Spirals to Validate the Model

Equation 12.8 describes a non-linear function between γ, the Lorentz factor and r, the distance from the centre of the galaxy. It is smooth, having a value of very nearly 1 until

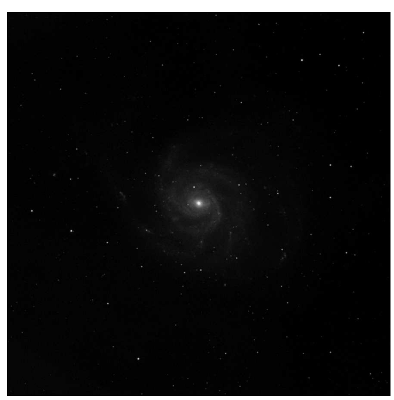
(a) Blue Image POSSII-J Sky Survey Filter: GG395 $>$ 400nm

(b) Red Image POSSII-F Sky Survey Filter: RG610 $>$ 600nm

(c) IR Image POSSII-N Sky Survey Filter: RG9 $>$ 750nm

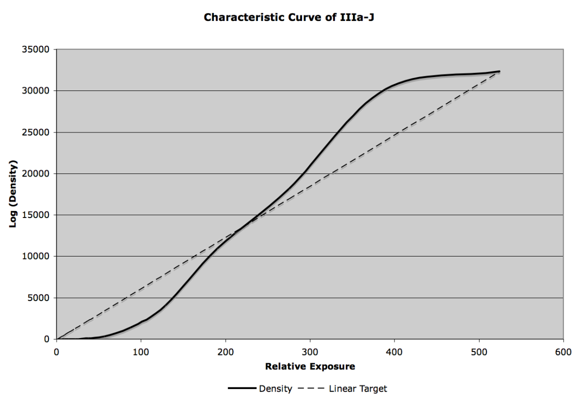
(d) Blue Image Linear Reduction Grey Value -23/255

(e) Red Image Linear Reduction Grey Value -23/255

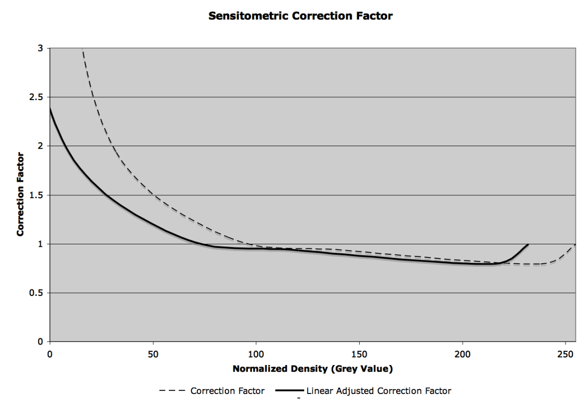


(f) Near-IR Image Linear Reduction Grey Value -23/255

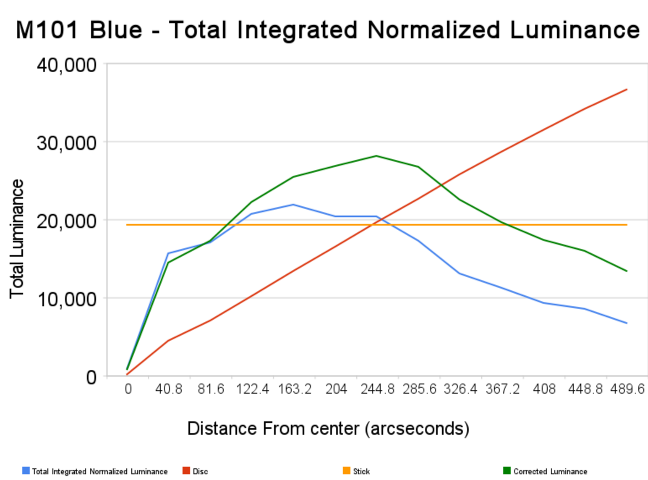
Figure 12.7: Reducing the grey value uniformly to correct for noise, film fog, background light, and foreground light. The STScI Digitized Sky Survey provided digitised scans of the above three images of M 101 with vertical and horizontal separation of 30 arcseconds.



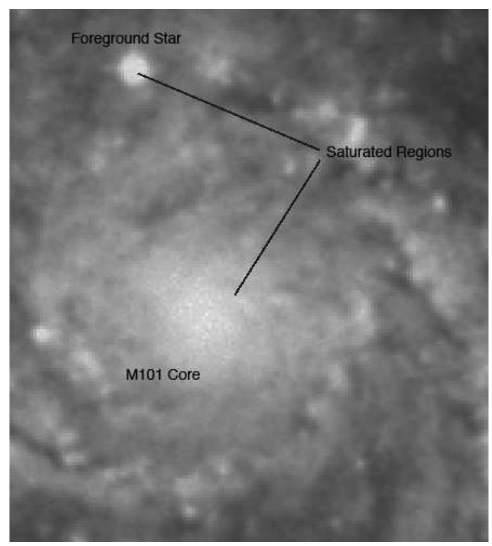
(a) light density against relative exposure



(b) Correction factor over normalized density



(c) Blue filter luminance of M 101



(d) Foreground star and galactic core

Figure 12.8: Total luminance decreases it's value drastically closer to the center due to saturation of the emulsion. The original image files show a region of aberration on the original images in the brightest regions. This pattern is assumed to be due to saturation of the IIIa-J film. Note the presence of a foreground star near the centre of M 101

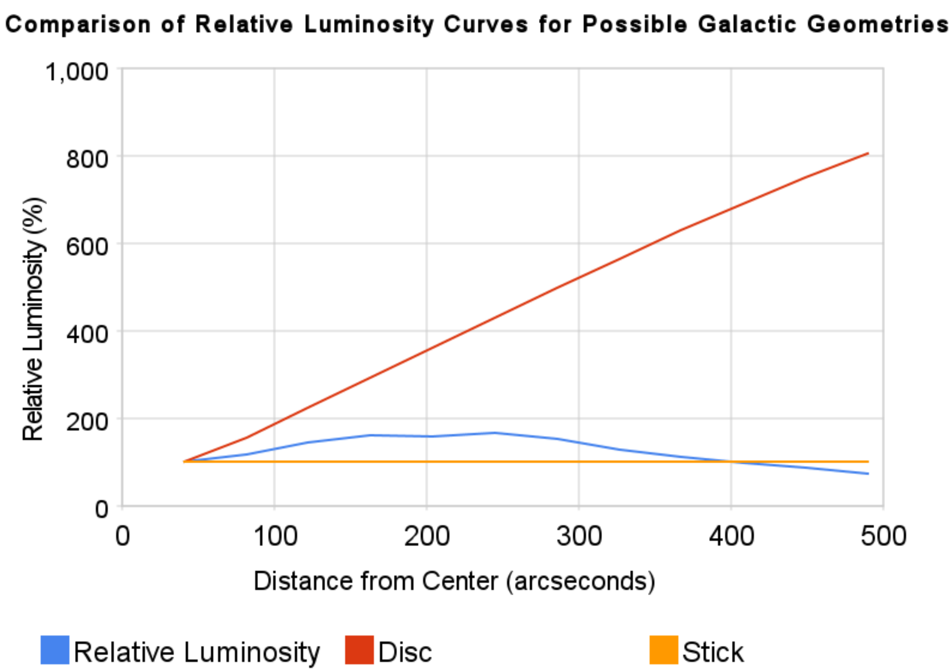


Figure 12.9: The relative luminosity profile of M 101 and the comparative theoretical luminosity profiles of a disk and a linear orientation. The measured relative luminosity shows a very close match to a linear orientation of stars.

r reaches a value of c/ω_0. At this point, the function increases and approaches a linear asymptote having a slope of c/ω_0. A geodesic is usually a straight line in most circumstances, unless there is some fairly high degree of curvature in the space-time continuum for it to not be "straight" in the usual way that such a concept is thought of. Although the concept of a straight line can be thought of as the path of light, or a line of sight. Perhaps it can also be thought of as a line having a constant direction. If this is the case, then a radial geodesic would appear as "straight" in a large rotating coordinate system from the centre to a distance of $c/\omega 0$. Further from the centre, this geodesic would appear as a spiral as described in this paper. Some galaxies appear as barred spirals. Since we know the distance to the galaxies, we can measure the length of the apparent bar and compare that to the length of c/ω_0 for each galaxy. We have estimated the lengths of bars in six barred spirals by measuring the lengths of the bar in pixels and adjusting for the estimated angle of incline of the galaxy and the angle of orientation of the bar to the major axis. These measurements have a high degree of error since the length of a bar is not an exact measurement for all barred spirals. Some barred spirals, such as NGC 1365, have a well defined bar with a distinct transition region between bar and spiral areas. Other barred spirals, such as NGC 925, have a large transition region and there is an indistinct transition between the bar and spiral. Nevertheless, some estimate can be made and reasonable error estimates can be presented. We list these galaxies in Table 12.7. The first column is the name of the galaxy, the second is the measured length of the bar in Kpc, the third, the sigma of the measure, the fourth is the predicted length of the bar in Kpc and the fifth is the sigma of the prediction based on v_{max} and RR distance according to Table 12.4. Two figures are also presented. Figure 12.10 shows the predicted bar length vs the measured bar length and Figure 12.11 shows the predicted curve of bar length vs v_{max} as well as the measured bar lengths. The fitted slope through the origin of Figure 12.10 is 0.943 and the sigma standard deviation of the comparison is 1.51 Kpc. Even though there is a high allowance for error, there is still a valid correspondence between bar length and $1/\tilde{\omega}_0$ as derived in the model.

Name	Length of bar (Kpc)	σ (Kpc)	Predicted length of bar (Kpc)	σ (Kpc)
NGC 1365	10.9	6.02	11.8	1.18
NGC 925	7.4	4.17	4.9	0.49
NGC 4536	6.1	3.48	4.7	0.47
NGC 3319	3.9	2.19	4.5	0.45
NGC 4535	2.7	1.53	4.2	0.42
NGC 4548	4.6	3.11	3.8	0.38

12.8 Conclusions

The Fundamental Theorem of algebra demands a unique and existent solution to the problem of modelling a body consisting of many particles, each having a circular orbit about a common centre, each have approximately the same mass, and the body held together by mutual gravitational attraction between the particles making up the body entire. The derivation is very straightforward and rather simple. However, the derivation of linear density began with a Newtonian non-relativistic approach. This approach does not take into account the finite value of the speed of light or time delay in gravitational influences. Once the gravitational influences have perpetrated to some other body, the body from which the gravitational attraction has emitted, has moved. Over long distances, this can be significant.

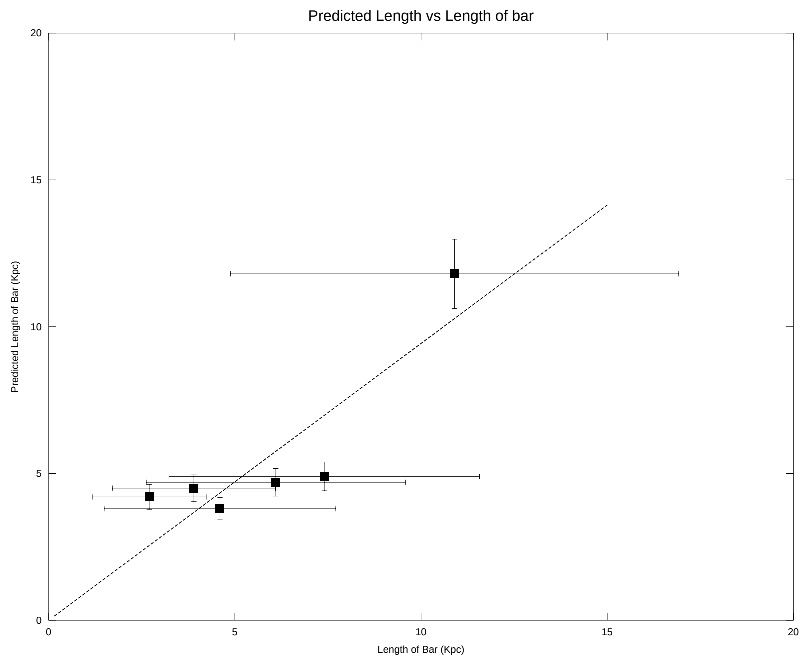


Figure 12.10: Graph comparing the predicted bar length vs the measured bar length. The slope of the fitted line is 0.94293 and the standard deviation of the comparison is 1.52 Kpc.

It is much easier in calculating the mathematical requirements of this model to begin with a Newtonian approach to gravitational influences so long as an understanding is firmly held in mind that the calculations must be rectified to take into account Minkowski, Lorentz and Einstein's little theorem of time and space dilation. (Or at least the measurements thereof). A physical model which can be brought to mind is that of a stick of constant density made up of stars and held together by mutual gravitational attraction between the stars making up the stick. This analogy is comparable to an ordinary stick made up of molecules whereby the stick is held together by the mutual electrostatic attraction between the molecules making up the stick. In both cases the two sticks are held together by mutual inverse-square forces. The difference between them is merely a matter of scale. The electrostatic attractive forces are much stronger than gravitational forces by about 40 orders of magnitude. However, even though stars are distributed light years apart, the overall linear density of a galaxy is about 10^{20} Kg per meter. That is a very dense stick indeed and has sufficient mass per unit length, or linear density, to keep it "stuck" together. If an approach is taken that there is a gravitational force contracting the stick and a pseudo-centrifugal force pulling it apart as a result of the rotation of the stick, the two forces would counteract exactly. This approach would meet requirements for being in a non-Euclidean space, or L-1 space. Without this model, that of a stick of stars rotating in space, a pseudo-mass to create pseudo-gravity would be required to explain the behaviour of NGC 3198. Of course, the application of relativity to this accelerating coordinate system to match the rotation of NGC 3198, explains the spiral shape and flat velocity rotation profile. It is a stick in L-1 space and a spiral in either L-2 or L-4 space.

If the stars of NGC 3198 were in any orbit other than circular and in a single plane, the

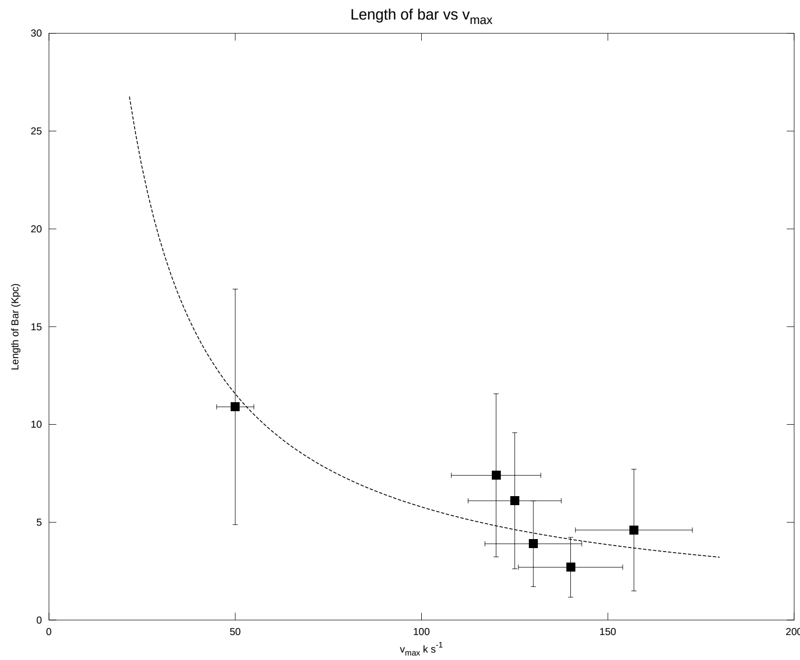


Figure 12.11: Graph of bar length vs v_{max}. The curved line shows the theoretical length as a function of v_{max}.

galaxy would not maintain its distinct spiral shape. Because there are many other spiral shaped galaxies with a morphology similar to that of NGC 3198, it is not unreasonable to believe this spiral morphology is somewhat stable. The orbital speed is determined by measuring the shifting of spectral lines of sections of the galaxy. It is not determined by the distance travelled by stars divided by the time it takes for stars to get farther along in its orbit. The distances the stars are travelling are so vast that we have not observed galaxies for a long enough time to detect circular motion directly. The shift in spectral lines may not, and indeed cannot, be the result of the distance travelled divided by time measured using local clocks and rulers. Things must be thought of locally. And in the galaxy's stars' local reference frames, the stars are not moving at all; each star is stationary relative to itself. However, the clocks and rulers in each local reference frame differ from the clocks and rulers of different stars in the galaxy due to the variation of the Lorentz transformations at different radial distances from the centre. The clocks of each Hydrogen atom in this distant galaxy vary from our local clocks since the distant orbiting atoms are in a region of curved space and time. Therefore, the shifting of the spectral line by a Hydrogen atom is affected by both the Lorentz transformation of Doppler effects and from the Lorentz factor as a result of the curvature of space-time in a large rotating system. The Lorentz-Doppler effect varies directly with r and the Lorentz-curvature effect varies inversely with r. The two effects cancel in outer regions of the galaxy and result in the constant velocity rotation profile.

We therefore conclude:

1. NGC 3198 is gravitationally self bound having a linear mass distribution function of

Figure 12.12: The central region of our galaxy. There is no spiral arm structure visible since we are looking down a geodesic into the centre. The geodesic is a line of sight straight down into the photograph like looking into a deep well. The central region of the galaxy here appears at the bottom of the well. By the time the light and gravitational influence of the stars in the central region have reached us they have all moved in their respective orbits. In our reference frame, there appears to be a ball of stars surrounding the central region. This ball of stars is pulling us towards the centre of the galaxy while our tangential rotational velocity keeps us in a circular orbit.[31]

constant linear density.

2. There is no requirement for exotic material in the galaxy's mass distribution to explain the galaxy's rotation curve or its luminosity profile. There is no gravitationally detectable "dark matter" in NGC 3198.

3. Einstein's general theory of relativity and Newton's principles of gravitational attraction hold over very great distances.

Acknowledgments The authors wish to acknowledge the kindness of P. Salucci for access to his data following the loss of the original data tape of Mathewson in a library fire in Australia, the technical assistance of W. Israel, the wide band support of SARA and the encouragement, suggestions and guidance of Roxy.

Chapter 13

An Unlucky Chapter

This chapter has been left deliberately blank except for this notice which means that the chapter is not completely blank but almost so.

Chapter 14

111 Spiral Galaxies

Previously a way to determine the distance to galaxy NGC 3198 was determined from its spiral morphology and rotational velocity. It was also seen that the stars of the galaxy orbit the galaxy with the same orbital velocity independently of the distance from the centre of the galaxy. This is only possible if the member stars of spiral galaxies detect gravitationally and visually that galactic matter, notably stars and interstellar dust and gas, have a linear orientation with constant linear density. However, spiral galaxies also have a spiral morphology which is the result of the finite velocity of light and gravitational interactions over very large distances coupled with a relatively high rotational velocity. This is an excellent example of delayed gravitational interaction and the Lorentz transformations applied to a rotating reference frame. Each star orbiting within the galaxy detects all of the other stars in a stationary linear orientation. Observers not orbiting the galaxy, and in a comparatively inertial reference frame, see the orientation of stars as a spiral. Since the orbital velocity of the stars is constant throughout the galaxy, since gravitational interactions travel at the speed of light, and since the relativistic time/distance dilations are known; the absolute size of the galaxy can be calculated and a direct measure of its distance can be made.

The spiral shape of the galaxy is determined by:

$$r = \frac{2\pi\theta}{(v/c)} \tag{14.1}$$

where r is in light years and θ is in radians. From this we can determine the distance to the galaxy by:

$$\Delta r = \tfrac{2\pi^2}{(v/c)}$$

$$d = \tfrac{\Delta r \times 360 \times 60}{4\pi\alpha} \tag{14.2}$$

$$d = \tfrac{2\pi^2 \times 360 \times 60}{(v/c)4\pi\alpha}$$

where Δr is the distance between spiral arms along the major axis of the galaxy in light years, α is the angular separation between spiral arms along the major axis of the galaxy in minutes of arc, v is the rotational velocity of stars in the galaxy, c is the speed of light and d is the distance to the galaxy in light years. The above distance formula to galaxies is known as "Roxy's Ruler".

The rotational velocities of galaxies studied were originally taken from a survey of 1,355 galaxies in the southern hemisphere by Mathewson[22]. We have included a typical page of Mathewson's rotation profiles, Figure 14.1, to show that the member stars of spiral galaxies orbit the galactic centre with a common rotational velocity. It can be seen that each of the velocity profiles show lines of constant rotational velocity extending to the ends of the graphs, one showing the receding arm and the other showing the advancing arm. There is an adjoining line between these two extensions crossing the central location of each galaxy. The shape is somewhat like a pulled apart "Z". We interpret this as a horizontal line representing one side of the galaxy where all the member stars have the same velocity, say, of recession, then the opposite side of the galaxy containing stars approaching us, as in this example, mixes with the measurements as a slit, or beam of a radio telescope, begins to cross the central region. This causes the line portraying the measurements in the central region to be diagonal. As the slit, or beam, finishes crossing the central region and only detects stars on the other side of the galaxy, the line returns to a horizontal orientation portraying the velocity of, say, approaching stars.

We have taken the analysis and results of Persic[21] for rotation velocities of each galaxy presented here. The data has been corrected for angle of inclination for each galaxy and transformed into a heliocentric reference frame.

We have then measured the distances to 111 galaxies in the southern hemisphere using the above described method. Since the distance to each galaxy is known, we can then measure its total length, mass and angular momentum. This data is presented in the following table of galactic data. Various graphs are displayed as well.

We note from figure 14.2 that there appears to be no relationship between galactic red shift and distance. The analysis shows a statistical $\mathbf{R}^2$, or coefficient of determination, of -1.0558, (less than one), upon an attempted linear fit. There is, therefore, no acceptable linear fit and the data appears completely random. However, it is obvious that all of the galaxies displayed are indeed red shifted. It appears unlikely, therefore, that this red shift is the result of a Doppler effect.

We call the rotational velocity of the stars within the galaxy the spin velocity or spin of the entire galaxy.

We can also see that:

1. more massive galaxies spin faster

2. more slowly spinning galaxies tend to be more spread out and therefore larger than faster spinning ones

3. spiral galaxies have similar masses to within an order of magnitude

Error

The distance to the galaxies are determined from measurements of angular distance between galactic arms along the major axis of the galaxy and their spin velocity. Mathewson reports an error within 10 Kps in spin velocity and upon examining the data, we feel that this is acceptable. The angular distance between galactic arms is determined from noting the pixel locations at either end of each galaxy on well defined digital photographs from the Hubble space telescope. We submit an error estimate of 2 pixels for each measurement. The angular width along the major axis of each galaxy was taken from the Simbad data base. This angular width, combined with the described distance measure, yields the mass of each galaxy and resultant angular momentum. The linear density of a galaxy is given as, $\rho = v^2/(2G)$.

Table of Galactic Data

Name	Rotation Velocity (Kps)	Dist. (MPc)	Red Shift (Kps)	Length (10^3 LY)	Mass (10^{11}solar masses)	Angular Momentum (10^{67} J-s)
1-G6	137	49	2245	139	0.93	3.34
1-G7	120	158	4994	176	0.9	3.6
101-G20	178	97	5845	172	1.94	11.16
101-G5	178	103	6638	154	1.74	9.01
102-G10	178	74	4698	161	1.82	9.84
102-G15	178	104	5018	188	2.12	13.35
102-G7	227	99	5014	82	1.5	5.22
103-G13	210	32	4664	71	1.11	3.12
105-G20	122	84	5672	138	0.73	2.32
105-G3	162	72	4860	103	0.97	3.05
106-G12	130	103	4155	145	0.87	3.09
107-G36	208	23	3096	74	1.14	3.29
108-G11	214	97	2979	183	2.99	21.98
108-G19	165	47	2956	76	0.73	1.72
113-G21	90	107	4822	136	0.39	0.91
114-G21	166	101	6378	123	1.21	4.67
116-G14	152	55	5417	91	0.75	1.94
117-G18	206	80	5795	98	1.48	5.6
117-G19	177	58	5386	106	1.19	4.2
120-G16	138	71	3674	120	0.81	2.54
121-G26	226	34	2220	94	1.72	6.87
121-G6	146	33	1228	125	0.95	3.26
123-G15	232	45	3215	121	2.32	12.24
123-G16	100	84	3194	144	0.51	1.4
123-G23	160	46	2910	100	0.91	2.76
123-G9	151	63	3183	117	0.95	3.17
140-G24	206	76	3183	117	1.77	8.02
140-G25	100	76	2047	194	0.69	2.52
109-G32	112	85	3362	137	0.61	1.78
116-G12	145	42	1153	141	1.06	4.06
140-G28	111	100	4875	150	0.66	2.06
140-G34	103	70	3405	100	0.38	0.73

Name	Rotation Velocity (Kps)	Dist. (MPc)	Red Shift (Kps)	Length (10^3 LY)	Mass (10^{11}solar masses)	Angular Momentum (10^{67} J-s)
141-G20	238	51	4349	100	2.03	9.1
141-G34	271	50	4404	139	3.64	25.8
141-G37	282	50	4386	81	2.31	9.98
141-G9	219	40	3636	125	2.13	10.94
142-G30	181	70	4201	115	1.34	5.26
142-G35	223	44	2031	139	2.46	14.36
145-G22	198	71	4465	104	1.45	5.62
146-G6	108	110	4598	165	0.69	2.31
151-G30	180	91	5335	140	1.61	7.64
155-G6	105	24	1070	90	0.35	0.63
162-G15	93	205	2839	281	0.87	4.26
162-G17	60	128	2839	253	0.32	0.93
163-G11	198	45	2839	102	1.42	5.41
18-G13	219	58	2839	114	1.95	9.18
183-G5	90	117	2839	167	0.48	1.37
184-G51	230	69	2839	142	2.68	16.46
184-G54	160	44	2839	62	0.57	1.05
184-G63	170	57	2839	124	1.28	5.09
184-G67	242	43	2839	126	2.62	15
185-G36	155	71	2839	104	0.89	2.7
185-G68	114	94	2839	132	0.61	1.72
185-G70	133	79	2839	99	0.62	1.54
186-G21	188	90	2839	144	1.82	9.3
186-G75	180	86	2839	126	1.46	6.24
186-G8	141	93	5709	136	0.97	3.49
187-G6	105	95	4652	150	0.59	1.74
187-G8	121	130	4404	182	0.95	3.93
196-G11	116	51	3637	79	0.38	0.65
197-G2	172	131	6306	192	2.02	12.54
197-G24	157	113	5877	178	1.57	8.24
200-G3	105	68	1034	249	0.98	4.82
202-G26	134	69	5111	93	0.59	1.39
204-G19	122	79	4516	121	0.64	1.79
208-G31	155	59	3068	99	0.85	2.45
215-G39	140	104	4335	136	0.95	3.42
216-G21	181	49	5086	65	0.76	1.68

Name	Rotation Velocity (Kps)	Dist. (MPc)	Red Shift (Kps)	Length (10^3 LY)	Mass (10^{11}solar masses)	Angular Momentum (10^{67} J-s)
220-G8	145	61	3013	110	0.82	2.46
231-G23	230	67	5024	111	2.08	9.97
233-G36	116	118	3291	155	0.74	2.51
233-G41	267	45	2951	106	2.69	14.3
233-G42	86	189	2561	253	0.67	2.72
234-G13	135	77	3186	108	0.7	1.93
235-G16	196	48	7147	64	0.88	2.09
235-G20	150	105	4671	172	1.38	6.7
236-G37	180	57	5558	84	0.97	2.74
237-G49	87	158	2913	343	0.92	5.18
238-G24	209	72	7013	101	1.57	6.19
240-G11	235	31	2876	143	2.82	17.9
240-G13	143	70	3267	87	0.63	1.49
243-G8	174	85	7323	120	1.29	5.06
244-G31	242	48	6726	70	1.47	4.69
244-G43	160	79	6231	96	0.88	2.56
249-G16	186	27	1179	194	2.39	16.19
25-G16	125	113	6136	115	0.64	1.72
250-G17	261	25	4541	60	1.45	4.27
251-G10	230	53	4451	89	1.68	6.51
251-G6	142	107	4981	147	1.06	4.16
265-G16	174	84	5166	144	1.55	7.33
266-G8	113	118	3225	178	0.81	3.05
267-G29	200	66	5445	90	1.28	4.33
267-G38	225	81	5884	97	1.75	7.19
268-G11	231	31	8517	32	0.6	0.82
268-G33	215	49	5502	97	1.6	6.32
269-G63	146	100	3189	154	1.17	4.94
27-G24	200	106	4079	133	1.89	9.44
124-G15	129	78	2606	129	0.76	2.39
2-G12	137	101	4643	138	0.92	3.28
22-G3	107	131	2737	216	0.88	3.83
231-G29	113	88	4940	136	0.62	1.78
249-G35	50	197	1035	282	0.25	0.67

Name	Rotation Velocity (Kps)	Dist. (MPc)	Red Shift (Kps)	Length (10^3 LY)	Mass (10^{11}solar masses)	Angular Momentum (10^{67} J-s)
26-G6	110	75	2743	166	0.72	2.47
269-G15	149	76	3376	193	1.53	8.24
269-G19	189	37	2173	154	1.96	10.72
269-G49	94	112	3238	153	0.48	1.3
269-G61	247	44	4917	105	2.27	11.05
284-G21	150	69	5773	75	0.6	1.27
285-G40	240	73	6735	110	2.25	11.13
286-G18	303	46	9150	115	3.77	24.75
287-G13	172	40	2703	86	0.9	2.51

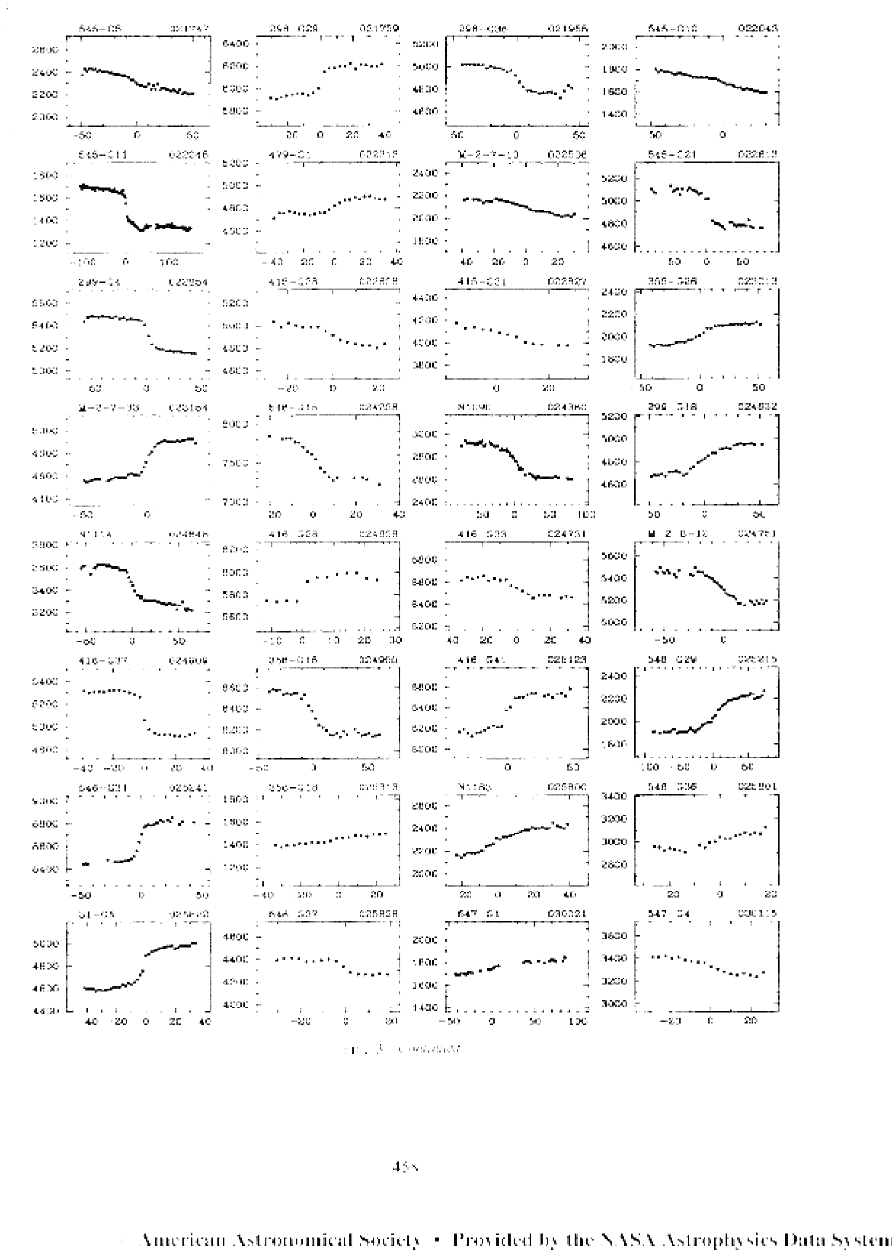


Figure 14.1: A typical page from the Mathewson Survey.

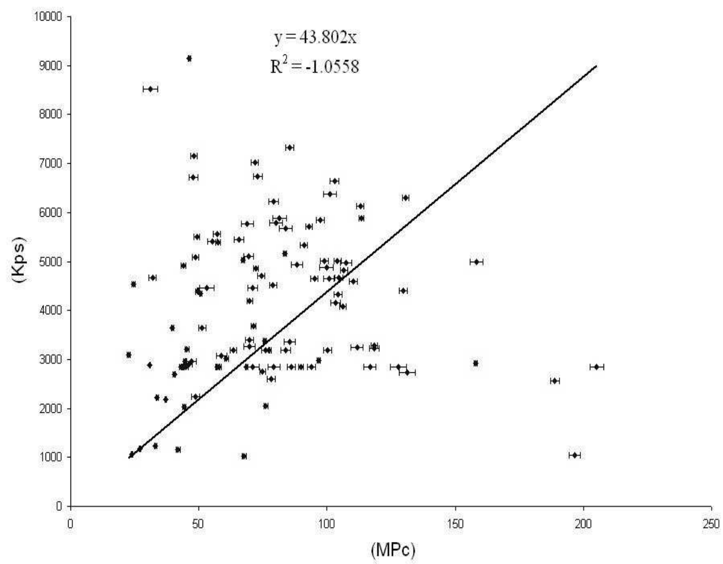


Figure 14.2: A Hubble diagram of 111 galaxies in the Southern Hemisphere with error bars for distance measurements. Red shift is in Kps and distance in MPc. There appears to be no linear relationship of red shift to distance.

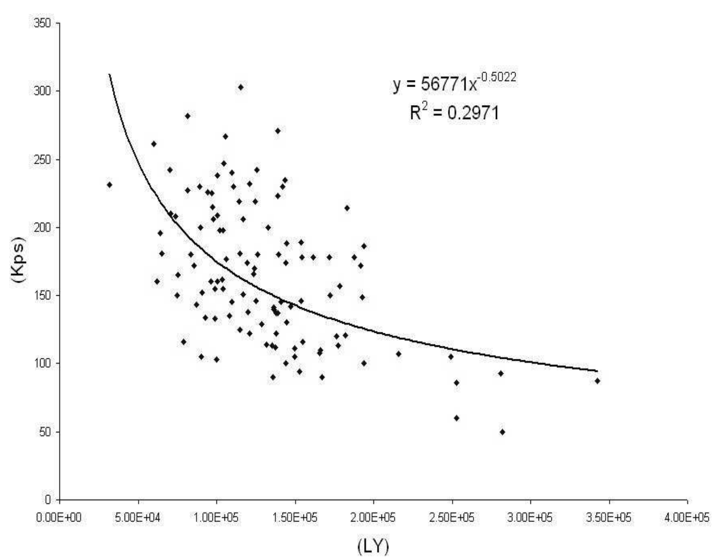


Figure 14.3: Rotational velocity of stars of galaxies vs. overall length of the galaxy in the reference frame of the member stars.

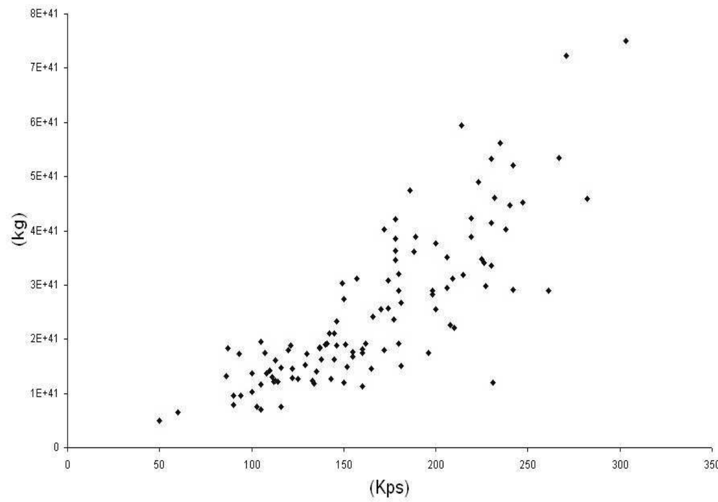


Figure 14.4: Mass of each galaxy vs. rotational velocity of stars within the galaxy.

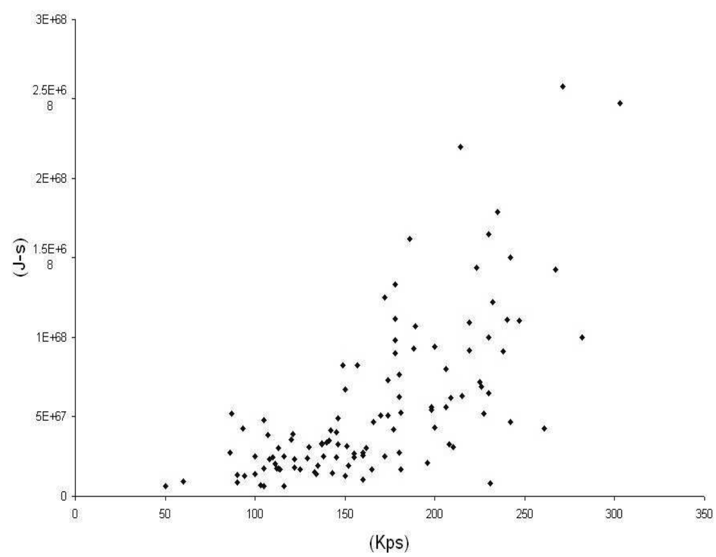


Figure 14.5: Angular momentum of each galaxy vs. rotational velocity of stars within the galaxy.

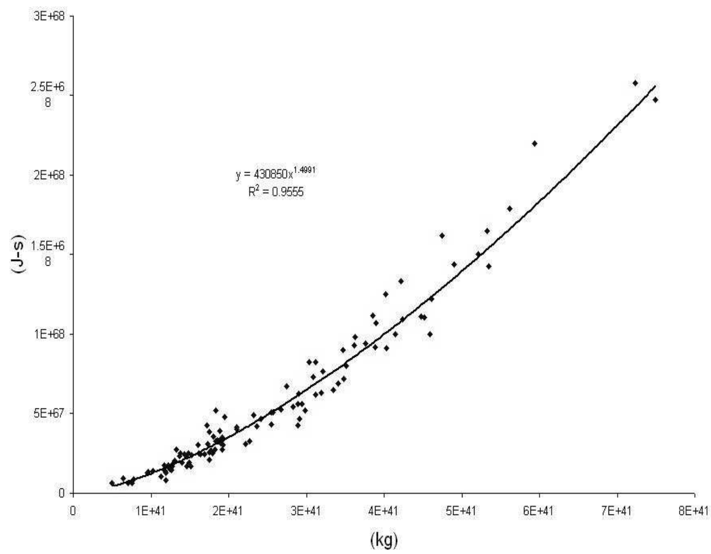


Figure 14.6: Angular momentum of each galaxy vs. mass of galaxy.

Chapter 15

Entropy Reversal at Galactic Centres

Consider the thermodynamic equation of a spinning black hole with charge from Brandon Carter, Stephen Hawking and James Bardeen.

$$dM = \frac{\kappa}{8\pi} dA + \omega dJ + V dQ$$

where M is the mass, κ relates to the temperature, A is the surface area, ω is the angular velocity, J is the angular momentum, V is the electrostatic potential and Q is the charge. Each of the terms are forms of energy: The mass energy, (total energy) equals the heat energy plus the energy of angular momentum plus the electrical energy. However, to make all the units agree, let us add c^2 to the left to make:

$$c^2 dM = \frac{\kappa}{8\pi} dA + \omega dJ + V dQ$$

The heat energy term, $\frac{\kappa}{8\pi} dA$ can be thought of as the temperature of the black hole times the surface heat capacity times the area. Or:

$$\frac{\kappa}{8\pi} dA = C_A T dA$$

And looking at the angular momentum we have:

$$\omega dJ = \frac{v}{R} R \times v dM$$

$$\omega dJ = v^2 dM$$

where $J = R \times vM$ and v is the tangential velocity of the black hole at its equator. Let us say the black hole is spinning but electrostatically neutral. Rewriting:

$$\frac{1}{C_A} \frac{dM}{dA} (c^2 - v^2) = T$$

and here we see that as v approaches c the temperature of the black hole decreases and when $v = c$ the temperature of the black hole is at absolute zero.

At first it may seem that certain inviolable laws of Physics have been broken, (which is true) but that is not really important. Let's examine this step by step. Let us say there is a black hole and stuff falls into it at some angle increasing its spin. Sooner or later it is spinning so fast that the equator is moving at the speed of light. Please remember that a black hole is not a material object, it is a region where the measure of the escape velocity is the speed of light from a central point or singularity. We cannot measure, detect or discuss anything within this radius, however, we can discuss what happens at the surface of a black hole. The surface is made up of a measure and we shall denote the clocks and rulers involved in that measure as space-time. It is convenient to consider space-time as having certain properties similar to a fluid which has in itself a natural speed of interaction, i.e. the speed of light, and a Young's modulus as a result of the stresses and strains of a gravitational field. It also has stresses and strains from an electric and magnetic field, however we will restrict our discussion to gravitational fields. This set of measures is moving from the spin of the black hole, as frame dragging, in order to conserve angular momentum. Once the surface of a black hole at its equator has reached the speed of light, it cannot spin any faster.

An important property of space-time is that it cannot move faster than the speed of light. It cannot even appear or be measured to move faster than the speed of light. Furthermore, there are circumstances in which the space-time continuum is under tension, strain and shear in order to compress or dilate clocks and rulers in order to maintain this important dictum. We ask that the reader consider that space-time is a medium which can transport electromagnetic radiation as disturbances moving at the speed of light within it. It can also carry gravitational influences in a similar way, however gravitational disturbances involve tidal effects as well as stresses and strains along the field lines. Gravitational influences also involve shears in the off-diagonals of both the Einstein and Stress-Energy tensors. These stresses, strains and shears are often denoted as forces between bodies and are described in the Stress-Energy tensor. The alteration of the corresponding Einstein tensor from having zero-valued components is what I have come to call curvature, in that it deviates from what is understood as flat space-time. This curvature can also linked to terms of acceleration, or caused by acceleration.

Once a black hole is spinning so fast that its equator is moving at the speed of light it has no further degrees of freedom. It is at absolute zero. The surface of the black hole is not a material object. It can be thought of as a set of equi-potential lines which are capable of moving at speeds up to and including the speed of light. They can also be so wound as to abut against the thermodynamic limit of absolute zero. We present a derivation of the Einstein tensor describing sets of equi-potential lines on the surface of a black hole. We then present the consequent measures of these equi-potential lines to a black hole whose equator is moving at the speed of light and follow by throwing a brick into it and mathematically predict certain results which can be verified through observation.

Techniques for mathematically deriving the Einstein Field Equations can be found in the literature. What we present here is a derivation and explanation of the Einstein tensor on the spherical surface of a black hole. It may be that those in the field of observational astronomy may be unfamiliar with or have not seen the usefulness and ease with which tensor can work in simple geometries. Let us begin with basic principles and develop step by step the geometry of a curved manifold in a four-dimensional Minkowski space.

Consider the surface of a stationary non-spinning black hole, i.e. the event horizon, as a spherical manifold. This manifold has a constant curvature of K. Let us also consider this manifold has radius ρ and a two-dimensional surface described by angles θ and ϕ. We consider the application of a Minkowski space of $(ict, x, y, z) = X_\mu$ where:

$$\begin{aligned} ict &= ict \\ x &= R_s \cos(\theta)\sin(\phi) \\ y &= R_s \sin(\theta)\sin(\phi) \\ z &= R_s \cos(\phi) \end{aligned} \tag{15.1}$$

If γ is the Lorentz transformation of this manifold as a result of the spinning of the black hole, and ds is considered the measure between events, then the metric would be:

$$ds^2 = \frac{cdt^2}{\gamma^2} - dR_s^2 - \gamma^2 R_s^2 \sin^2(\phi) d\theta^2 - R_s^2 \cos^2(\phi) d\phi^2 \tag{15.2}$$

The manifold determined by the surface of the black hole is the projection of a four dimensional Minkowski space onto a spherical surface. Let us consider the parametric equation of some function $f(t, R_s, \theta, \phi)$ which is bounded by the dictates of the Lorentz transformations. Note that the function $f(t, R_s, \theta, \phi)$ is a vector where t will be considered constant, and R_s is the Schwartzchild radius which will also be considered a constant. In this way the four dimensional Minkowski space is collapsed and projected onto the surface of a sphere. The angle brackets below denote the dot product of the vectors produced by indicated partial differentiations.

We are using the parametrisation of the sphere of radius R_s centered on the origin as

$$f(\theta, \phi) = (t, R_s \sin(\theta)\sin(\phi), R_s \sin(\theta)\sin(\phi), R_s \cos(\phi)) \tag{15.3}$$

$g_{\mu\nu}$ is the metric tensor describing the geometry of the local region of space-time. The components of the metric tensors are then:

$$\begin{aligned} g_{00}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial t}, \tfrac{\partial f}{\partial t} > \\ g_{01}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial t}, \tfrac{\partial f}{\partial \theta} > \\ g_{02}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial t}, \tfrac{\partial f}{\partial \phi} > \\ g_{10}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial \theta}, \tfrac{\partial f}{\partial t} > \\ g_{11}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial \theta}, \tfrac{\partial f}{\partial \theta} > \\ g_{12}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial \theta}, \tfrac{\partial f}{\partial \phi} > \\ g_{20}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial \phi}, \tfrac{\partial f}{\partial t} > \\ g_{21}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial \phi}, \tfrac{\partial f}{\partial \theta} > \\ g_{22}(t,\theta,\phi) &=< \tfrac{\partial f}{\partial \phi}, \tfrac{\partial f}{\partial \phi} > \end{aligned} \tag{15.4}$$

The matrix form is then

$$G_{\mu\nu} = \begin{pmatrix} g_{00} & g_{01} & g_{02} \\ g_{10} & g_{11} & g_{12} \\ g_{20} & g_{21} & g_{22} \end{pmatrix} \tag{15.5}$$

We now have a tensor equation which describes the geometry of the surface of the sphere. If we wish to draw curves or examine various lines and paths on the surface of this sphere, we can create a function $\theta(\phi)$, for example, then substitute it into Equation 15.3 to obtain a curve resulting from $f(t, R_s, \theta(\phi), \phi)$, where R_s is a constant. We can then derive values required for $G_{\mu\nu}$ and from

$$G_{\mu\nu} = 8\pi T_{\mu\nu} \tag{15.6}$$

obtain the complete values of stresses, strains and shears on the surface of the black hole.

If we draw a sphere with lines of latitude and longitude, we can outline or emphasise some lines of longitude, from the poles to the equator which represent longitudinal lines of equal potential. See Figure 15.1.

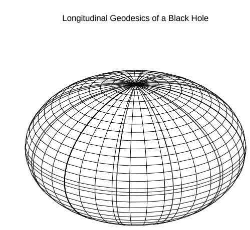


Figure 15.1: Lines of equal Schwartzchild gravitational potential from the poles of a stationary non-spinning black hole to the equator.

It may be helpful go through the logistics of drawing such equi-potential lines. Recalling ancient techniques of mathematics which preceded the use of algebra and was restricted to using only compass and straight edge, without numbers and without coordinate system, the construction of various curves and ability to do things such as bisect angles, construct parallel lines and so on; we may entertain the idea that solutions to mathematical problems during those times relied on the ability to successfully complete geometrical constructions. The construction of a line on the surface of a sphere which indicates the path of a photon in highly curved space, yields the mathematical solution to determining local curvature. The Einstein Equations of Equation 15.6 then show the interactions between physical and material interactions as a result of local geometries. If we are to draw an equi-potential line from the pole of a non-spinning black hole to the equator, we would simply draw a line of longitude. The light, or photon considered, cannot escape from the surface of the black hole and the resultant equi-potential line is therefore on the spherical surface – a line of longitude running from pole to equator. First, we set R_s to unity. We then set θ to some value θ_0 and keep it constant while increasing the value of ϕ from zero to $\pi/2$. That line describes the top equi-potential line. On the bottom half, we again keep θ as θ_0 and decrease the value of ϕ from π to $\pi/2$. We would then have a set of values of ϕ while θ and R_s are constant. We take these sets of values and substitute into Equations 15.1. From there, should one wish, the elements of the Einstein tensor can be determined and resultant stresses and so on be found along the paths of equi-potential lines so described. The resultant curvature is some constant K as previously stated. This is the technique that was used to draw Figure 15.1.

Let us now see what these longitudinal equi-potential lines would look like if the black hole was spinning. As we traverse in the local reference frame on the surface of the black hole following the equi-potential lines from the pole to the equator, we would rotate as we moved toward the equator. If some point, $P(t, R_s, \theta, \phi)$ over which we traverse, was moving with a tangential velocity of v_t then it would have moved through some angle θ_t by the time we had travelled from the pole to the point under consideration. Furthermore, the local clocks and rulers at the point P have altered from clocks and rulers in inertial flat space-time by the Lorentz factor

$$\gamma = \frac{1}{\sqrt{1 - v_t^2}} \tag{15.7}$$

where v_t is in terms of the speed of light and unit-less. Therefore, if the tangential speed of the surface of the sphere is dependent on its latitude and time is dependent on the Lorentz factor, then the measure of θ in the local frame of the surface of the black hole is:

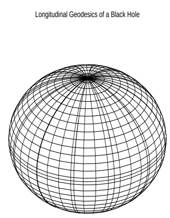
$$\begin{aligned} v_t &= v_e \sin(\phi) \\ \gamma &= \tfrac{1}{\sqrt{1-v_t^2}} \\ \theta &= \gamma v_t \end{aligned} \tag{15.8}$$

where v_e is the tangential velocity of the surface of the black hole at the equator. We show various equi-potential lines of longitude of black holes spinning with different speeds in Figure 15.2.

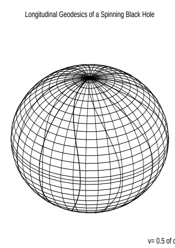
Now we toss in a brick.

Let us suppose a brick crosses the event horizon, enters the black hole and leaves our further consideration forever. It has added angular momentum to the black hole. Let us also surmise that the brick has no charge or does not add to the electrostatic potential of the black hole. Say it has entered the black hole at some point, say at a point of entry of $\pi/6$ radians above the equator. Due to frame dragging and the fact that the brick crosses the event horizon at the speed of light in the local reference frame of the surface of the black hole, a perturbation forms on the function describing the tangential velocity going from the pole of the black hole to the equator. If the black hole is spinning at maximum spin, then the tangential velocity of the surface is zero at the poles and is the speed of light at the equator. This is described by a smooth and analytical sine function. However, at the entry point, this function forms a soliton. This soliton is an increase in the curvature of space-time on the surface of the black hole. It equals the amount of angular momentum added to the surface of the black hole. There is a tidal effect which forms another soliton in the opposing hemisphere. This addition to the overall angular momentum of the black hole would lower the temperature of its surface to below absolute zero unless this additional curvature can be removed from the system. Since there are differences between the stresses below and above the point of entry the perturbations are forced towards the pole. At the poles, the tangential velocity is zero and differentials in curvature along the equi-potential lines attempt to force the perturbations into singularities at the poles. Let us look at this phenomenon step by step. First let us look at the equi-potential lines as the brick crosses the event horizon. See Figure 15.3

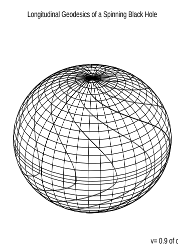
Of course, we must not forget about tidal effects. Gravity is not just a set of vectors describing a vector field of forces and so on, there are tidal effects to take into account since gravity is a vector field involving shears as well as stresses and strains. An every day example is given by the behaviour of tides. The Moon's gravitational field pulls the surface of the oceans towards it to form a high tide. But this effect is not just on the side of the Earth which is facing the Moon. The Moon also pulls the Earth towards it and "leaves behind" the ocean on the far side. As a result there is a high tide on the surface of the Earth which faces the Moon and a high tide on the surface of the Earth that faces away from the Moon. It appears there is a squeeze on the Earth's oceans at the poles which cause the surface of the oceans to bulge both towards and away from the Moon. This is the tidal effect of a gravitational field. This must also be brought into play in the case of throwing a brick into a very fast spinning black hole. The black hole's gravitational field pulls the brick across its event horizon and at the same time, the brick's gravitational field pulls the black hole up just as suddenly in



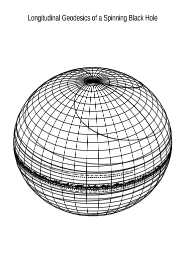
(a) Equi-potential lines from the poles of a stationary non-spinning black hole to the equator.



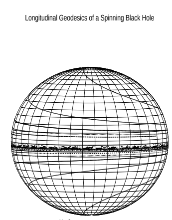
(b) The black hole is spinning an equator moving at half the speed of light.



(c) The black hole is spinning with an equator moving at 0.9 times the speed of light.



(d) The black hole is spinning with an equator moving at the speed of light.



(e) The black hole is spinning with an equator moving at the speed of light. Side view.

Figure 15.2: A progression of black holes spinning at faster and faster rates. Note the bending of equi-potential lines at the equator until, at the speed of light, it is an infinite path which joins the equator at infinity.

the opposite direction. As a result, a perturbation on the bottom half of the black hole forms which equals the perturbation on the top half. Actually the total curvature which results from the perturbations caused by the brick is evenly distributed top and bottom. Half the curvature is in the top hemisphere and half is in the bottom. The total energy content throughout the surface of the black hole resulting from the change in curvature is equal to the mass of the brick times the speed of light squared. One may simply apply the total energy content of the brick:

$$\rho l_\mu l_\nu = G_{\mu\nu} \tag{15.9}$$

Where ρ is the density of the brick and l_μ is the four-velocity of the brick crossing the event horizon. From there, simply integrate through Equations 15.4 to determine the resultant path of the equi-potential lines. We have applied a Maxwellian distribution of curvature due to the perturbation caused by the brick with total curvature on the upper hemisphere equal to the curvature on the lower hemisphere. We have shown the various orientations of equi-potential lines from the time the brick crosses the black hole, to its resultant tidal effect and eventual transit towards the poles in Figure 15.4.

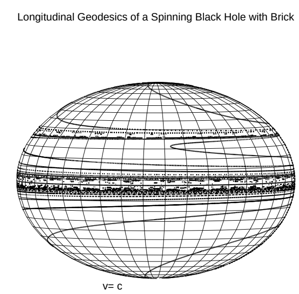


Figure 15.3: Equi-potential lines from the poles of a spinning black hole to the equator at the time a brick is thrown into it at a point $\pi/6$ radians above the equator.

The resultant solitons are a shock waves and move to the pole at the speed of light. But each perturbation cannot be completely squeezed into one point at the pole. A two-dimensional perturbation of curved space-time cannot be compressed completely into the point where there is no tangential velocity because space-time cannot be curved indefinitely. There is a limit to its bending and squeezing into a singular point at the pole, because of the boundary conditions of Schrödinger's Equation. A small sphere of space-time forms at the pole. All of the curvature contained in each soliton cannot remain completely on the surface of the black hole. It forms a "pimple" at the pole. A very small part of space-time is lifted slightly from the Schwartzchild radial distance at which the escape velocity is the speed of light. This bit of space-time is squeezed and forced directly away from the pole at a speed very close to the speed of light. Let us examine this bubble of space-time.

Bringing back Schrödinger's Equation as before... (if you read the previous chapter on Schrödinger's Equation then you don't have to wade through the following and can take a bit of a break while the slow ones get to go through this.)

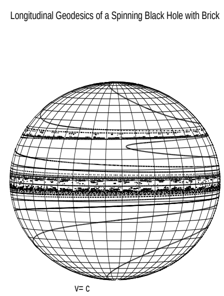
15.1 Boundary Conditions to Schrödinger's Equation

Consider any particle with mass m and negative charge resulting in a potential energy V which obeys the following:

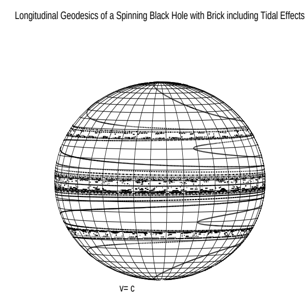
$$i\hbar\frac{\partial}{\partial t}\psi = -\frac{\hbar^2}{2m}\nabla^2\psi + V\psi \tag{15.10}$$

which is derived from:

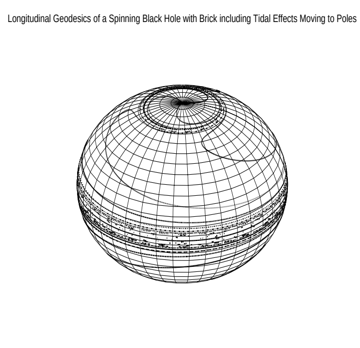
$$-\hbar^2\nabla^2\psi = \mathbf{p}^2\psi \tag{15.11}$$



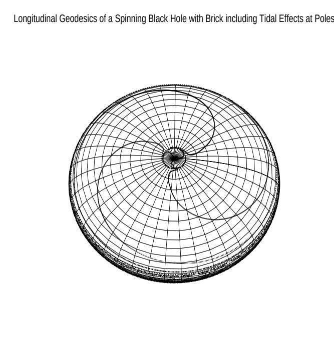
(a) Brick crosses event horizon.



(b) Tidal effects cause a second perturbation.



(c) The perturbations are pushed to the poles.



(d) Very close to the poles, the perturbations are squeezed into a possible singularity.

Figure 15.4: A progression of a perturbation resulting from throwing a brick into a very fast spinning black hole. The initial perturbation at $pi/6$ radians above the equator causes a second matching perturbation below the equator. These perturbations are forced to the poles due to the differences in tension above and below the perturbation caused by differing curvatures on the surface of the black hole.

where **p** is the momentum of the particle. It is well known that if there are infinite or semi-infinite boundary conditions, the above equation is commonly solved through a singularity solution. We reject assuming infinite boundary conditions and present a well established and common method, known as the separation of variables, to find a general solution in a finite domain following which the boundary condition becomes obvious.

Rewriting the differential equation we have:

$$i\hbar\frac{\partial}{\partial t}\psi = -\frac{\hbar^2}{2m}\left\{\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}\right\}\psi + V\psi \tag{15.12}$$

Let:

$$\psi = T(t)X(x)Y(y)Z(z) \tag{15.13}$$

where, $T(t)$ is a function of t only, $X(x)$ is a function of x only, $Y(y)$ is a function of y only and $Z(z)$ is a function of z only. Then:

$$i\hbar\frac{\partial}{\partial t}TXYZ = -\frac{\hbar^2}{2m}\left\{\frac{\partial^2}{\partial x^2}TXYZ + \frac{\partial^2}{\partial y^2}TXYZ + \frac{\partial^2}{\partial z^2}TXYZ\right\} + VTXYZ \tag{15.14}$$

Under the condition that $\psi \neq 0$ we can divide through by $TXYZ$ to yield:

$$i\hbar\frac{T'}{T} = -\frac{\hbar^2}{2m}\frac{X''}{X} - \frac{\hbar^2}{2m}\frac{Y''}{Y} - \frac{\hbar^2}{2m}\frac{Z''}{Z} + V \tag{15.15}$$

We can see that each term is linearly independent. Since each term is being varied by its independent variable and all variables are linearly independent from each other, and the constant term is also independent from the others, each term must equal a constant. Therefore:

$$i\hbar\frac{T'}{T} = -\alpha^2 \tag{15.16}$$

$$\frac{\hbar^2}{2m}\frac{X''}{X} = V - \beta^2 \tag{15.17}$$

$$\frac{\hbar^2}{2m}\frac{Y''}{Y} = -\gamma^2 \tag{15.18}$$

$$\frac{\hbar^2}{2m}\frac{Z''}{Z} = -\xi^2 \tag{15.19}$$

where α, β, γ and ξ are constants, and the equation has been separated. We have placed the constant term, $-V$, with equation 15.17 since it has been chosen as the direction of travel of the particle.

Then:

$$X = \cos\left(\frac{\sqrt{2m(\beta^2 - V)}}{\hbar}x\right) \tag{15.20}$$

This is, in a way, similar to a term in a Fourier series. We consider a slight re-write as:

$$X = \cos\left(\frac{2\pi\sqrt{2m(\beta^2 - V)}}{\hbar}\frac{x}{2\pi}\right) \tag{15.21}$$

Consider the boundary condition of $X = 1$ which occurs when:

$$x = \frac{2\pi\hbar}{\sqrt{2m(\beta^2 - V)}} \tag{15.22}$$

and

$$x\sqrt{2m(\beta^2 - V)} = h \tag{15.23}$$

since

$$\mathbf{p}^2\psi = -\hbar^2\frac{\partial^2\psi}{\partial x^2} \tag{15.24}$$

and using boundary condition . . .

$$\psi = 1 \tag{15.25}$$

we get

$$\mathbf{p}^2 = -\hbar^2\frac{\partial^2\psi}{\partial x^2} \tag{15.26}$$

We also have

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2} = \beta^2 - V \tag{15.27}$$

yielding

$$-\hbar^2\frac{\partial^2\psi}{\partial x^2} = 2m(\beta^2 - V) \tag{15.28}$$

Substitution yields:

$$x\mathbf{p} = h \tag{15.29}$$

at the boundary of the particle. However the "angle" within the cosine goes from 0 to 2π and therefore we have a measure of Δx. Because x varies between the boundaries we have a non-constant $\mathbf{p}$. We therefore have:

$$\Delta x\Delta\mathbf{p} = h. \tag{15.30}$$

Note that any boundary condition other than $\psi = 1$ substituted into equation 15.24 invalidates the previous equation.

We would like to mention here that the boundary would yield a "probability" of one for the particle should ψ represent probability. Inside this boundary this probability would be less than one. At the "centre" of the particle, the probability would be -1 and this is absurd. In the derivation of a solution we had said $\psi \neq 0$. So we will deny the particle to exist inside the boundary and, for that matter, outside the boundary as well. For this particular solution to stand, the particle only exists where $\psi = 1$ and does not exist otherwise. We are stating that the particle does not exist when $\psi < 1$. This is a different case than determining the position or time of the particle. In this case we are determining the existence of the particle itself. We are postulating that if ψ is less than one, then it isn't. We conclude ψ cannot be a measure of probability. It is a potential. When the potential is 1, the particle exists. From these considerations, the particle can only exist at it's boundary.

From outside the particle we can only measure to an accuracy of:

$$\Delta x\Delta\mathbf{p} \geq h \tag{15.31}$$

With the time ordered factor, we have an exponential of $i\frac{\alpha^2}{\hbar}t$. Let us now consider α. We note the units of measure. We see that $\hbar$ is in units of joules-sec. We see that t is in seconds and will cancel the time unit of $\hbar$ leaving joules in the denominator. Hence, since the exponential must be unitless, α^2 is in units of joules. To continue the discussion allow α^2 to be some unknown form of energy in joules. We will examine what this means as follows.

Let

$$E = \alpha^2 \tag{15.32}$$

so the exponential of the time ordered factor becomes

$$\frac{iEt}{\hbar} \tag{15.33}$$

and we look at the situation where $\psi = 1$. In other words, the particle definitely exists. We have seen that at the boundary, from before, the spacial ordered factor is one. Therefore the time ordered factor is also one for a time ordered boundary. This can only occur should the exponent of the time ordered factor be something like $2\pi i$. In which case we have:

$$\frac{iEt}{\hbar} = 2\pi i \tag{15.34}$$

rearranging

$$Et = 2\pi\hbar \tag{15.35}$$

$$Et = h \tag{15.36}$$

Here we have time going from 0 to some cyclic value yielding an exponent of $2\pi i$. We will then denote this as Δt and ΔE is the magnitude of fluctuation of energy. We now have:

$$\Delta E \Delta t = h \tag{15.37}$$

and observing from outside the particle in the time dimension, we can only measure to an accuracy of:

$$\Delta E \Delta t \geq h \tag{15.38}$$

This happens outside some time ordered "boundary" where/when the potential of the existence of the particle yields $\psi = 1$. Combining both time and spacial ordered factors we have the situation where any measurement of the time, location, momentum or energy of the particle must obey the following;

$$\Delta x \Delta \mathbf{p} \geq h \tag{15.39}$$

and

$$\Delta t \Delta E \geq h \tag{15.40}$$

because that is determined by the boundary conditions of any particle adhering to Schrödinger's equation. Since this has been validated by an overwhelming amount of experimental and, now, theoretical evidence, we propose that the Heisenberg Uncertainty Postulate be classified as a theory.

Let us take a closer look at E.

The exponent of the time ordered factor is some sort of phase angle that allows the particle to have a potential of existence equal to one at each cycle.

Let:

$$\frac{E}{\hbar}t = \theta \tag{15.41}$$

And we differentiate by t on each side to yield:

$$\frac{E}{\hbar} = \frac{d\theta}{dt} \tag{15.42}$$

or

$$\frac{E}{\hbar} = \omega \tag{15.43}$$

$$E = \hbar\omega \tag{15.44}$$

and,

$$E = h\nu \tag{15.45}$$

So, this energy, E, is not a form of energy coming from the mass of the particle or it's momentum of motion or even it's charge generating V. It appears to be an energy that is associated with the time ordered frequency of the particle's existence. This energy is not associated with mass or charge.

Let us examine α further.

$$\alpha = \frac{\sqrt{2\pi i\hbar}}{\sqrt{t}} \tag{15.46}$$

and

$$\alpha = \frac{1}{\sqrt{2}}\left(\sqrt{\frac{h}{t}}\right)(1+i) \tag{15.47}$$

Continuing, we see that we can also say:

$$\theta_n = n^2 2\pi i,\ n \in \mathbb{N} \tag{15.48}$$

whenever $\psi = 1$. So this exponential has been quantized by n^2. This can be compared to an orthogonal set of eigenfunctions yielding a complete solution of ψ. There are interesting consequences to the general solution of Schrödinger's equation. We call α an eigenvalue in an eigenspace which we often use to find general solutions. Apparently α^2 is the energy of a photon. We are proposing that the magnitudes of an infinite number of eigenvalues to the general solution of Schrödinger's equation yield the energy values of an infinite number of subatomic particles. The first order temporal eigenvalue yields the energy of a photon.

From the behaviour of this class of differential equations, ψ can be considered as a conserved scalar potential field. Since electromagnetic radiation can be thought of as a moving disturbance within a scalar potential field, and this field is conserved, there is a slight alteration in the surrounding potential field should any disturbance move through it. We believe there is the possibility that a bundle of rapidly fluctuating electromagnetic fields moving at the speed of light, commonly known as a photon, would behave as though it had a very small gravitational field.

A cosine function represents a solution for the value of the spacial dimensions of ψ. The boundary conditions are $\psi = 1$. Therefore, if there is a bubble or sphere of space-time and the value of ψ is one at $x = 0$, then the value of ψ is also one at the other boundary where $x = \frac{p}{h}$. Inside the cosine function if θ is the function of x which solves the Schrödinger Equation, then:

$$\psi = cos(\theta(x)),\ \theta = 0, 2\pi$$

and when $\theta(0) = 0$, $\psi = 1$ and when $\theta(p/h) = 2\pi$, $\psi = 1$. However, at the centre $\theta(x = p/(2h)) \rightarrow \theta = \pi$ and $\psi = -1$. What can it mean that $\psi = -1$? We speculate that there exists a sphere of consisting of the potential of existence. The middle of the sphere, up to half the radius, has a negative potential of existence and the outer shell, past half the radius, has a positive potential of existence. Consider that this potential is realized in the hostile environment just above the pole of the spinning black hole. The positive shell has 7/8 of the volume, while the negative inner sphere has 1/8 of the volume, of this bubble of space-time. There would then be a 1 : 7 ratio between the two volumes. If we postulate that the negative volume ends up being anti-matter and the positive volume ends up being matter, then we would predict a 1 : 7 ratio between anti-matter and matter or 0.14 : 1. However, if the bubble became matter, or condensed into matter and anti-matter, the two types of matter would annihilate each other leaving only 3/4 of the original material. This would result in 1/4 of the material being annihilated in matter-anti-matter explosions. This would result in a great deal of energy. If there is such a fast spinning black hole at the centre of a galaxy, it would have material, probably pure Hydrogen and some neutrons, pouring out from its poles at a very high speed and have a great deal of energy, probably in the form of gamma and cosmic rays, also being emitted.

In terms of energy and the Einstein tensor, using the Legrangian in a complex derivation we can say:

$$G_{\mu\nu} = \rho l_\mu l_\nu \tag{15.49}$$

where ρ is the energy density of the area we are examining. l_μ and l_ν are the four-velocities of the area. The energy density from the boundary conditions of Schrödinger's Equation yields:

$$t_b = \frac{h}{E} \tag{15.50}$$

where t_b describes the boundary in the time dimension.

The curvature of an arc is given as:

$$k = \frac{1}{R} \tag{15.51}$$

where

$$R = G\frac{M}{c^2} \tag{15.52}$$

$$k = \frac{c^2}{GM} \tag{15.53}$$

For a non-spinning black hole:

$$
\begin{aligned}
T &= c^2 \frac{dM}{dA} \frac{1}{C_A} \\
&= c^2 \frac{dM}{dR} \frac{dR}{dA} \frac{1}{C_A} \\
&= c^2 \frac{c^2}{G} \frac{1}{\frac{dA}{dR}} \frac{1}{C_A} \\
&= \frac{c^4}{G} \frac{1}{\frac{d(4\pi R^2)}{dR}} \frac{1}{C_A} \\
&= \frac{c^4}{G} \frac{1}{8\pi R} \frac{1}{C_A} \\
&= \frac{c^4}{8\pi G} \frac{1}{R} \frac{1}{C_A}
\end{aligned}
\tag{15.54}
$$

From this we see that either $C_A = 1$ in which case $T = \frac{1}{8\pi R}$, or we may set $C_A = \frac{1}{8\pi}$ which would make the temperature equal to $1/R$ if both c and G are set equal to one. This would have some elegance since it would mean that the temperature would be equal to the curvature of the surface of space-time. In either case, the curvature of a non-spinning black hole is a non-zero constant. As the equi-potential lines from poles to equator become longer and longer as the black hole increases its spin, so the measure of the curvature of the surface drops to zero. And as a result, the temperature correspondingly drops to zero as well. Under this condition, and only under this condition, is there a possibility for a reversal in the flow of entropy.

Looking at this thermodynamically. We began with a brick. The brick has a lot of information attached to it and has a high amount of entropy. We throw the brick into this fast spinning black hole and we end up with pure Hydrogen, Helium and radiation. Material coming out has very little information and low entropy. We can make stars out of it. We can't make stars out of bricks. It appears this model would allow for high entropic material to accrete into a black hole and have low entropic material come out of it, along with some energy. Some anti-matter would escape. This is just what we see coming from very fast spinning galaxies having jets of material. The faster the galaxy is spinning, the more prominent the jets.

Furthermore, the jets are shooting straight out from the poles of the spinning black hole. In order for something to escape a gravitational field, it must exit the field at an angle. It cannot escape from exiting the field straight up. The Hydrogen and Helium gasses escaping from the poles of the spinning black hole, would then fall back towards the plane of the galaxy. A very fast spinning black hole would eject renewed star making stuff vertically from the galactic disk. This stuff would in turn fall back onto the disk as a sprinkler system of Hydrogen and Helium gas renewing the material in the galactic disk. This stuff becomes stars, planets and human beings, which all eventually accrete back into the black hole at the centre of the galaxy, to be lost forever, while the remnant angular momentum so generated causes space-time pimples to burst forth from the poles of the black hole. It ain't pretty, but it works.

Chapter 16

Roxy's Statement

This will actually blow your mind. It did mine.

Roxy is my wife. Either that, or I'm Roxy's husband. We have had a little disagreement for the past 35 years. A couple can have rather long-standing discussions and disagreements that last their entire lives. This is actually a good thing. Roxy is a professional tap dancer and I am a mathematician. So we have had to work on this compatibility thing and have a lot of fun doing so. This little discussion is a disagreement over Truth. I have been saying that Truth is objective and Roxy says it is subjective. Roxy's study is in the arena of social evolution during the late 1700's as well as an in-depth life long study into First Nations cultures. I also write poetry.

Nevertheless, Roxy was saying that if we cannot know the difference between reality and our perception then who really cares and that reality is just how we see the world. I am saying that it makes no difference how we see the universe, reality is what is. I am sure you are all familiar with this particular debate. So I continue for 30 years or so on my quest and figure that if ever Roxy agrees with me, then I will truly have something. So I do some math, discover the equation of everything, see Werner a couple of times, discuss and talk about it with Cam, and figure I have it all worked out.

So I'm feeling pretty good here and somewhat proud of myself. And it so happens during springtime in the Yukon that I am leaving a friend's cabin and walking down a mountainside towards town one beautiful sunny morning. The snow is melting, the sun is up and I am lost in contemplation walking through the jack pine. I looked at the sun glistening over the mountains in the morning sky and I visualized the light coming from the sun being bent through extreme curvatures of space and time, perhaps at the centre of our galaxy, and matter being formed. Just like this rock here beside me ... woah! Something flew quickly through the edge of my field of view while I was looking at this rock. It was a mosquito. I was startled and looked around. There, again beside me by the rock, was an intricate spider web glistening in the sunlight streaming in through the trees. It was breathtakingly intricate and beautiful. Each dewdrop was distinct and each fibre of the web reflected light like a beaded string of diamonds. This had been made by a living thing. The mosquito was alive. I stepped back under the weight of the revelation. My God, it is all alive. I looked around at the jack pine, carefully. The pine needles were not just mineral existence, they were living matter. All of the trees were alive, I listened to the forest; it was filled with the sound of birds and humming insects. The deep dark green of the nearby pines and gray-black stands of tree trunks contrasted with shining white melting snow banks, a stunning portrait. This planet, this small segment of the Universe, was teaming with life. How the hell was I going to explain life in the unified field theory? Like, I know that biology is only for kids that can't do physics; but this time the bio students had the upper hand. I also know that I can traverse a line of logic and rational thought all the way from a measure of distance and time to the complex world of chemistry and crystallography, and I know you can add sparks and electrical stimulation to chemicals and get amino acids and I know you can make RNA and DNA in a test tube, (I've seen it done); but I also know you can shake, rattle and roll a test tube of chemicals all you like and wait forever and a day and you will never, ever, ever, make a mosquito. Life is a barrier in the line of logic from mathematics to outward reality. Life – biology – is river we can only cross on a bridge of Faith. OK, we're alive. This is life. How the hell did we get here?

Needless to say, I was devastated. I no longer felt pride in any of my mathematical or physics accomplishments. It was all for nothing. There was no way I could complete the theory. The universe had been on my side throughout this derivation, but life itself had delivered the fatal coup. I didn't give up; but I knew I was defeated.

Then, a few months later, I looked at dark matter.

Actually, I looked at a digital photo of NGC 3198. I had transformed the pixels of a digital photo of NGC 3198 so that the galaxy would be portrayed as seen from directly above. Then I used a negative of the transformed photo, black on white. I printed this digital photo out. It was obviously a spiral. I knew that. I also knew it was a straight line. I took the picture into the living room and sat on the couch by Roxy. I showed her the photo.

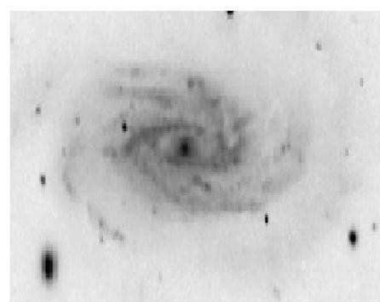


Figure 16.1: The transformed photo of NGC 3198. The galaxy that saved our marriage.

"Hi," I said, "You'll never guess what this is."

"Looks like a galaxy," she said.

"Yes," I said, "But I know something that no one else in the world knows. This galaxy looks like a spiral, but it is actually a straight line."

"What do you mean it is a straight line?" she asked.

"The galaxy is rotating," I said, "It is very large. Gravity travels at the same speed as the speed of light. By the time the gravitational influence has gone from the centre of the galaxy to the outer parts, the galaxy rotates and ends up looking like a spiral. But it is really a straight line."

"I don't see that at all," she said, "How can a spiral be a straight line?"

"Remember in New Zealand?" I asked, "Remember when we were way away from everywhere in Taumarunui on the rugby field in the dark at night?"

"Yes," she said.

"Remember the centre of the galaxy and what it looked like? Remember the optical illusion, that it is really just a cylinder filled with stars and goes straight into the centre of the galaxy and out the other side. That it all is just a straight cylinder of stars?" I said.

Roxy looked confused.

I continued, "This is just a spiral. If I can figure out the equation of the spiral it will be one of the greatest discoveries in all of science. It will completely change our understanding of the universe and physics itself."

"Can you do that?" she asked.

"Yes," I said, "but it will take a little time."

"How much time?" she asked.

"Couple of weeks," I said.

"Well what the hell are you doing sitting here on the couch?" she demanded, "Get back in there and get the formula."

So I did.

And Cam, my son, got very excited and we had this formula and I was busy measuring the distances to galaxies and it was all very much fun except for Roxy.

I walked into my office one morning to find Roxy staring at the compluter displaying the transformed photo of NGC 3198. She was in tears.

"I don't get it," she said, "You and Cam say it all so simple and I don't get it. How can this be a straight line? How is it a spiral?"

I didn't know what to say or do.

"Don't try so hard," I ventured, "It is not so difficult, it is subtle. Just try to let the ideas come to you rather than forcing yourself to understand it. It's OK."

Se was still very frustrated and I walked quietly out of my office leaving her to her rather frustrated thoughts. The next day I was cleaning up in the kitchen when Roxy walked in and asked:

"Do you mean to tell me, that we have all these really intelligent and important scientists who are studying astronomy, looking through telescopes, and they study this stuff. You mean to tell me ... I mean ... are they looking at the same galaxy I have looked at and they haven't taken into account that the stars they are looking at have moved by the time they are seeing them?"

"I don't know," I said, "If I ever get the chance, I'll ask them."

"You've got to be kidding," she said, "Even I know that. Those stars are thousands of light years away. I knew that as a child. They haven't figured out that the stars are no longer where they are looking at them? I don't believe that."

And she stormed out of the kitchen.

The next day, Roxy came up to me in the hallway.

"I get it!" she said forcefully, "I get it. I get what you have been talking about all these years, the mathematics isn't the result of the physics and what we are looking at; the physics is the result of the mathematics! It's so obvious.

"This bookshelf," she exclaimed hitting the bookshelf standing beside me, "This bookshelf is a bookshelf because it follows the mathematics of a bookshelf. We don't come along and see the bookshelf and then go and make up a mathematics of bookshelves. The mathematics determines the physics. The physics does not determine the mathematics. I get it!"

I said that she had discovered the pinnacle of mathematical physics and theoretical physics. "You have now reached the place where I am," I said, "That is the height of my mathematical insight and I cannot go any further. If you stick to, and remember what you have just discovered, no one can argue scientifically against you. You have the key to it all."

She looked confident with an air of anger at the world of academia.

I then told her about biology. I told her about being in the Yukon and that I could not complete the theory. However, we did have a great deal of it covered, but there was no way I could include biology or life in the theory of everything.

A few days later Roxy and I went for an evening walk. It was one of those rare days in Calgary when it is not snowing and it is reasonably warm. There were blossoms on the trees. It was nice. After walking for a while, Roxy started talking:

"I notice," she began, "That there is order in the universe. If we look at the smallest things like atoms, and protons and electrons there are rules that tell us what they do, how they behave. We have quarks and they have rules on how they behave. And even smaller than that, what makes up quarks and so on and so on. Things get infinitely smaller and smaller without end. And each world, smaller and smaller, no matter how much we search, there will always be rules that govern them.

"There is always order," she continued, "Nothing is chaotic; nothing is random. There are laws that govern the world of the quantum, the world of the atoms. And there are rules of chemistry. It is not chaotic. There is order in chemistry and in physics. And if we look at a blade of grass," she said stopping on the sidewalk to point to a lawn beside us, "There is order describing the structure of the blade of grass and even how it grows. It may be very complicated and we may not understand it, but that doesn't matter. There is order in the way a blade of grass grows because that is what makes it a blade of grass.

"Also," she went on pointing out a bough of apple blossoms just overhead, "There is order in the growth of a tree, in its leaves and branches and its roots. It is not just growing randomly, there is order to it.

"And the sun and the planets," she said as we looked up at the evening sky, "There is order in how the Earth rotates and goes around the sun, in the behaviour of earthquakes and the weather and the ecology. We may not understand it, but there is still order to it all. Nothing is chaotic. Nothing is random. The way the solar system is, the planets going around the sun, the way the sun and stars go around the galaxy; there is order to it. It is all ordered. And how all the galaxies are, and the clusters and super clusters of galaxies and however they are and even bigger than that, to an infinitely large structure of never ending structures containing structures. It is worlds within worlds, infinitely large and infinitesimally small, and throughout it all there is order. Nothing is chaotic.

"And," she said stopping to face me, "If you are going to make a bookshelf, or a building, you have to have some plan in order to build it. If you just take mud and sticks and try to make a building without some plan, the building will not stand; it will have no structure.

It will collapse. It won't be a building. If there is order to everything, then there has to be a plan; there has to be a blueprint for anything to exist for it to have order.

"Therefore," she said to me, "Since there is order throughout the universe, the universe has to have a blueprint. And the blueprint of the universe is mathematics.

"And you, my Love, have discovered a very small piece of the blueprint. This thing with galaxies, it is just a small part of the blueprint. And because you have uncovered some small part of the blueprint, you can see, not completely and only a very small bit, but nevertheless, you can see how everything works. That's why you can see it and no one else can. You have discovered a small part of the blueprint of the universe."

I have been speechless ever since. The Universe has a blueprint and the blueprint of the Universe is mathematics. The universe has order and nothing is chaotic. In viewing reality, there is no probability of outcomes.

And so, we have a response to the Copenhagen Interpretation. And I, nearing the end of my life, know why I married Roxy.

What Does it all Mean?

This has been an interesting journey. We come to a plateau and draw a few conclusions.

Firstly, ψ is the potential of existence. We also see that Truth itself is the essence of existence.

We see that the space-time continuum is the infinite array of a four dimensional coordinate system. The coordinate system is a measure between events. This measure involves numbers. Numbers exist. The coordinate system therefore exists.

A simplified coordinate system could be compared to a ruler. The ruler measures distance. Whether there are numbers printed on the ruler or not is irrelevant; they exist. There are a couple of rulers, half the ruler, etc. The numbers exist as a measure provided by the ruler. The ruler may be straight or, perhaps, or we could bend it. But what is the ruler made of?

The ruler, the lines of the space-time continuum, the coordinate system at the root of the Einstein/Minkowski equations, is made up of ψ. The potential of existence as determined by Schrödinger, ψ, forms the coordinate system which is the Universe itself. The rulers, the coordinate system, ψ, can be bent or "curved". We propose that the second time ordered differential of ψ and the biharmonic of ψ are measures of this curvature. The more the coordinate system is bent or curved, the greater the potential of existence. This coordinate system can only be bent so far. The limit of bending is determined by Heisenberg. At that limit, the lines of the coordinate system, the rulers, crimp and in effect is "knotted" into a particle. The energy of creating the particle from the bending of space-time is equal to its mass times the speed of light squared.

But what is ψ?

Very simply, we conclude that ψ is Truth. As we develop and pursue Truth, we raise the potential of existence until this potential achieves reality. If the universe is flat, there is no potential of existence and nothing exists. Nothing can exist, not ever.

This is a time of great excitement within the field of gravitational study. We postulate that information, a further measure of Truth, continues to exist within an event horizon as determined by Schwartzchild and that the direction of entropy perhaps reverses. This is a matter of further study.

Furthermore, there is nothing to guarantee that the laws of physics have remained constant throughout eternity. They may well have changed. Perhaps, to paraphrase and alter Einstein's famous quote, God is not only subtle, He has a particularly nasty streak when it comes to pushing back the frontiers of science.

If, as we say, ψ consists of Truth, the foundation of Virtue, perhaps it would not be outside the realm of reason to conjecture that the entire Universe somehow consists of

“Goodness”. The question I would like to ask the reader is: Who in their right mind would go and create and entire universe out of Goodness?

Truth is objective, not subjective. Truth is. Truth is in and of itself. Truth is what it is. Consider the following:

> Truth is beauty, beauty Truth.
> That is all ye know in the world,
> And that is all ye need to know.

- John Keats

There have been a number of hinderences to discovering a Unified Field Theory. One is the inability to derive Heisenberg from Schrödinger. However, we see that this inability is merely the result of pursuing an incorrect philosophy based on an incorrect assumption. It is remarkably easy to derive Heisenberg from Schrödinger given a more reasonable assumption at the beginning. I would also like personally to add that Heisenberg used h rather than $\hbar$ in his uncertainty equations. I have fought long and hard to show that Heisenberg was right in the first place and people should not have messed with his formulae. He remarked quite often that people have misinterpreted his theory to mean a great deal more that it was supposed to.

Einstein had worked for the latter half of his life to find the Unified Field Theory. Many have said he was not that good at mathematics. They are wrong. Einstein was a brilliant mathematician. Of course, you are free to go through his papers and point out any errors in his calculations. So far, I have been unable to find any myself. But don’t let that stop you.

The axiomatic approach to discovering mathematical truths has been used for thousands of years and has been assailed throughout. In the early 1800s there was a movement to overthrow the axioms in order to substantiate arbitrary measures in the dissemination of justice. For the past hundred years or so it has succeeded and as a result humanity has suffered through many wars and abject poverty disguised under the cloak of materialism. The world is now burdened by those in authority who are doing everything possible to control everyone and they can’t even control themselves.

There are alternative societies to ours. And these are societies that have existed for thousands of years. There is no reason for us to cling to a way of life based on the premise that we must all increasingly consume stuff made from non-renewable resources or else we all die. We have ended up being forced to work ardently to obtain more and more stuff we simply don’t need. Life is not that hard if we work together. The things humanity needs in this day and age are not material; they are of a higher nature. They are spiritual and relate to the human spirit. Only people can recognize Truth and its inherent beauty.

I am nearing the latter part of my life. It has been a good life having met and worked with incredible and wonderful people. Over the years I have seen that most people are good and follow a path of integrity. Sooner or later we all come to a point of decision, Adlerian [42] I guess, where we can choose to suffer the consequences of integrity, or get away with lying. It may not even be that big a deal. We can lie and no one will really know, no one of consequence anyway. Or we can tell the truth and even though it is no great deal, suffer for it. We have all had to come to that point of decision at some time in our lives. However we decide, determines the rest of our lives. Falsehood multiplies. Decisions come again and again and the point of falsehood that may have set us on that path must be justified, rationalized and covered up. People who live a lie go mad. Of course, the opposite is true too. If a decision is made to maintain integrity, even though one may suffer for it, that decision just seems to keep coming back in different forms. And the honest cannot get ahead and the dishonest always appear to succeed. And our society is built for the successful. So it seems that on the whole, if one chooses a life of integrity, one has chosen a life of poverty and hardship. This is not always the case, but it is more often than not.

So there you go. Truth is and so are you. You can follow it or not according to your desire. And no one says you have to play the fool. You can live a lie or you can acknowledge that the best things in life are free and live in service to others rather than to yourself. However, you cannot rationalise your decision. Whatever it is – you wear it.

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