

The Physics of Motion a Simplified Approach

By

Morris G. Anderson

General Relativity & Quantum Mechanics Are Incompatible

“It does not appear possible to introduce in a natural way the hypothesis of wave-particle duality into the framework of general relativity”

(Bahram Mashhoon, Physics Letters A Volume 122, number 6,7; *Wave Propagation in a Gravitational Field*, 22 June 1986. Department of physics and Astronomy, University of Missouri, Columbia, MO 65211, USA).

This presentation documents an alternative approach.

- The equations are simple.
- The results agree with data.

Overview

In this lecture, we will investigate the nature of **time, matter, and gravity**. This will include a discussion about **standard units** and **the influence of motion and gravity on the natural frequency of clocks**.

We will also review a simple method for calculating the **curvature of motion in a gravitational field** based on the wave characteristics of matter. A comparison of this method with published data demonstrates that it provides an accurate model for the following examples:

- 1) Simple trajectory motion.
- 2) The orbital precession of planets in our solar system.
- 3) The bending of light as it passes near the Sun.
- 4) The gravitational red shift of light.

Upon completion of this lecture, you should have a better understand of time, matter, and gravity and a new appreciation for the importance of establishing fundamental definitions and postulates in deriving equations to model the physics of nature.

Source of Presentation Material

Time, Matter, and Gravity © 2004 By Morris G. Anderson.

This book can be downloaded from the following internet site:

<http://anderson.morris.home.att.net>

Wave Propagation In A Gravitational Field

as presented at the

APS Four Corners Section Fall Meeting on October 15th, 2004 at the University of
New Mexico, Albuquerque, NM

Outline

- Introduction
 - Trajectory motion and the wave nature of matter
- Establish definitions of:
 - Time
 - Length
 - Matter
 - Velocity
 - Momentum
 - Force
 - Energy
- Derive equations for calculating:
 - The influence of motion on the characteristics of matter.
 - Motion in a gravitational field based on wave propagation.
 - Compare results with data.

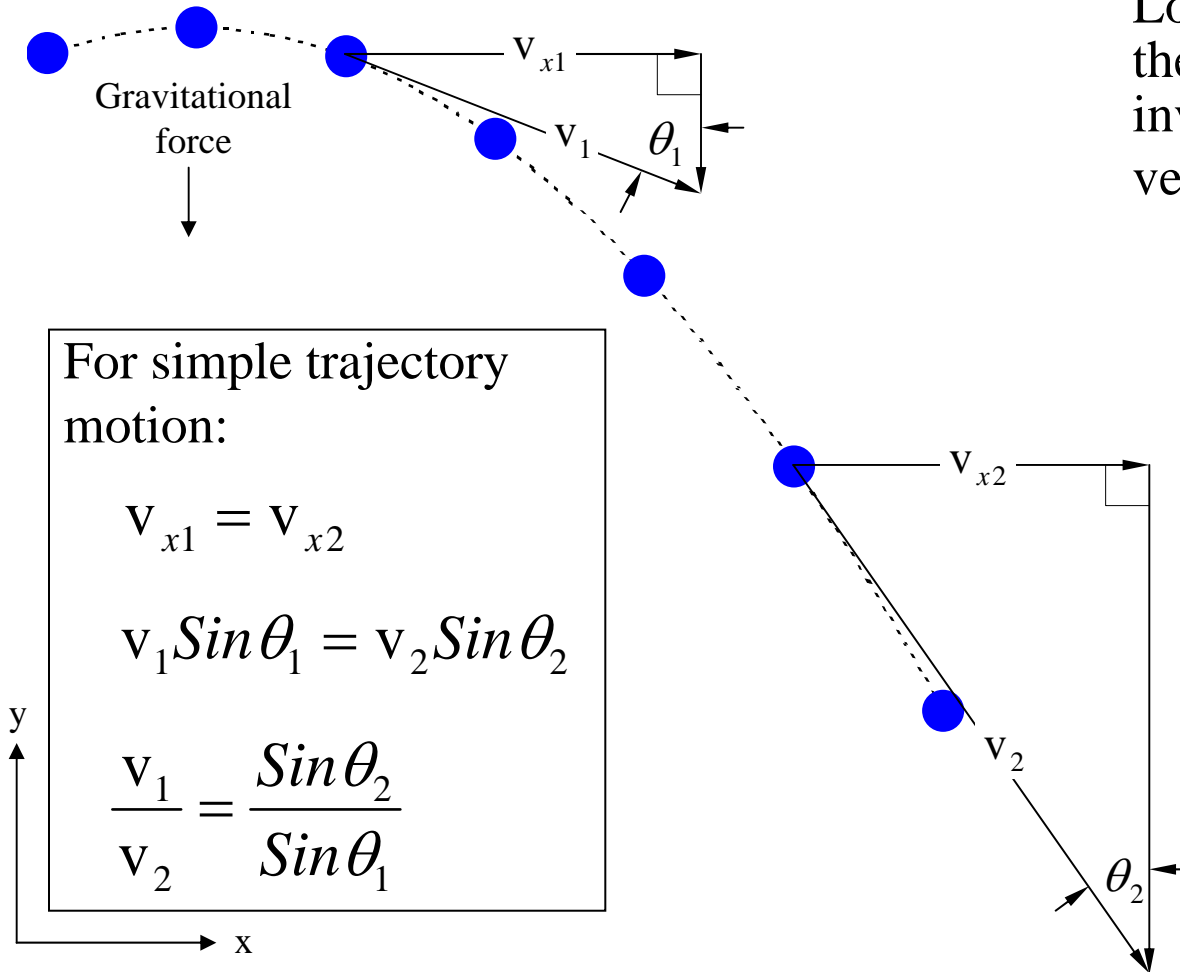
Introduction

Louis de Broglie postulated that the wavelength of any object is inversely proportional to its velocity. Therefore:

$$\frac{v_1}{v_2} = \frac{\lambda_2}{\lambda_1}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{\sin \theta_2}{\sin \theta_1}$$

This equation is Snell's Law, which is used to calculate the path of wave propagation such as light passing through the atmosphere.



For simple trajectory motion:

$$v_{x1} = v_{x2}$$

$$v_1 \sin \theta_1 = v_2 \sin \theta_2$$

$$\frac{v_1}{v_2} = \frac{\sin \theta_2}{\sin \theta_1}$$

This demonstrates that we can calculate the trajectory of an object based only on its wave characteristics. This is an important clue to the nature of gravity!

Louis de Broglie Postulated That Electrons Have Wave Characteristics Opening The Field Of Wave Mechanics

In 1923 Louis de Broglie proposed that an electron in motion has wave characteristics as defined by the following equation:

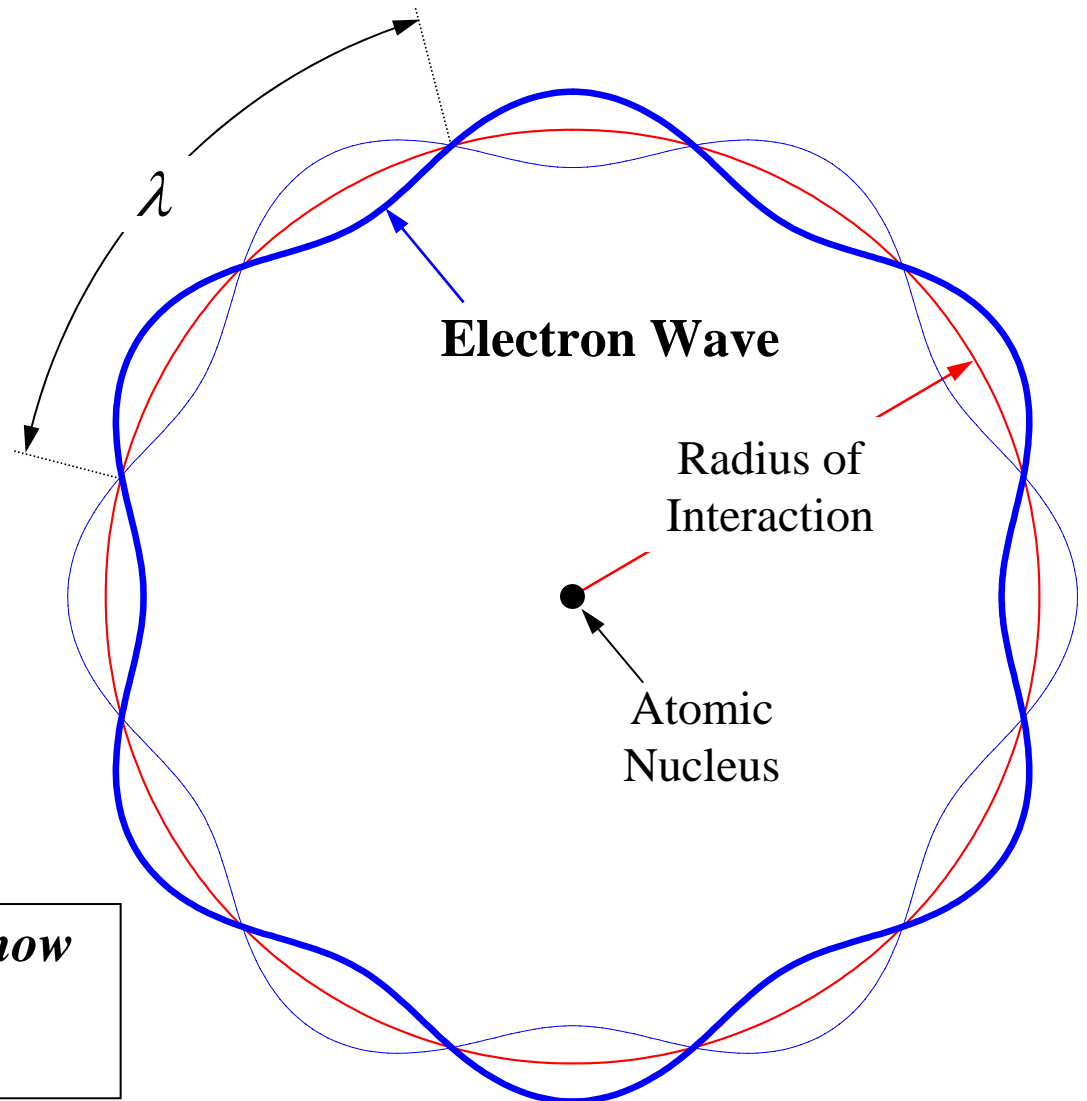
$$\lambda = \frac{h}{p}$$

This led to the concept that the orbital circumference of an electron could be described in terms of its wavelength as:

$$2\pi r = n\lambda$$

Thus, the Field of Wave Mechanics was born.

In this presentation, we will show how wave characteristics also govern motion in a gravitational field.



Definitions Make It Possible To Share Ideas and Concepts

What is a Definition?

From: <http://dictionary.com>

def·i·ni·tion

- A statement conveying fundamental character.
- A statement of the meaning of a word, phrase, or term, as in a dictionary entry.

When we create a definition we develop a statement that gives meaning to a word, concept, or process. We do not derive it and it is not a law of nature. We simply state it to be so.

Some concepts which we call laws are actually definitions. A good example is Newton's second law of motion. We use this relationship to give meaning to the word, force. Hence, we use it as a definition and not as a law!

What is Time?

When we say the word, time, we usually know exactly what we are trying to communicate. Example:

When a boy asks his mother, “What time is dinner?” and she responds with, “At 5 o’clock and we are having your favorite desert,” there is no confusion. He will make every effort to be at the table when dinner is served. Therefore, from this perspective we all know exactly what time is.

Therefore, it is remarkable that there has been so much confusion in establishing a meaningful definition. The following statements provide a few examples of how it has been done.

1. "Absolute, true, and mathematical time, of itself, and from its own nature flows equably and without regard to anything external, and by another name is called duration." (From Newton's statement in the first pages of *The Principia*)
2. The measured or measurable period during which an action, process, or condition exists or continues. (Webster's New Encyclopedic)
3. "Time is the essence of existence" (Loren R. Anderson)

Our Use of the Word TIME

We use the word "time" to express at least two primary ideas. Therefore, to avoid confusion we will use the following notation.

We will use all capital letters for concepts similar to the question of:

”What TIME is it?”

We will use lower case type or capitalize only the first letter for concepts similar to the question of :

”How much Time will it take?”

The Meaning We Apply to the Word “TIME”

As we ponder the basic meaning of TIME, we realize that we can think of it as:

- Our position with respect to the orientation of the hands on a clock.
Example:
 - We can plan to be at work when the hands on the clock indicate 8:00am.
- Our position with respect to the Sun, planets, and stars. Example:
 - We can plan to meet on the top floor of the Empire State Building when the position of the Earth, Sun, and stars indicate that it is Tuesday, February 14, 2012, at 5:00pm.
- On further examination, we find that we use TIME as a method to predict and confirm our position with respect to other things. We simplify this concept through recognizing that:

TIME is where you are.

The Definition of TIME

We use Time to predict and confirm our position with respect to other things. We can simplify this concept by recognizing that TIME is where you are. This concept, known as the "Position Definition of TIME," leads to the following definitions of our relationship with the past, present, and future.

TIME	TIME is equal to position, which corresponds to where something is.
TIME Past	TIME Past is where you have been and where, or the way, things were.
TIME Present	TIME Present is where you are and where, or the way, things are.
TIME Future	TIME Future is where you will be and where, or the way, things will be.
A separation in TIME	A separation in TIME (commonly referred to as length) is equal to or corresponds to a separation in position.
A change in TIME	A change in TIME (commonly referred to as time) is equal to or corresponds to a change in position.

Postulate: *For any Time (past, present, or future) the position of any object with respect to all matter is unique.*

A Standard of Time

In our attempt to confirm and predict our position with respect to other things, **it helps to know our position with respect to a standard.** This makes it possible for us to coordinate our activities such as working or meeting together at a specific location.

Let us consider using light as a standard of time. In doing so we first establish “the standard location” as presented below. We will use the subscript, s , to identify properties at this location.

The standard location is a place on the Earth, in a vacuum, where we define the units of time, length, and matter. The scientific community could define this to be the location of the current time standard for the United States and the Global Positioning System located at the U.S. Naval Observatory in Washington D.C.

A **Vacuum** is a volume of space where there are no particles or electromagnetic waves

Time

Time is equal to a change in TIME and corresponds to a change in position.

One second of Time is equal to a change in TIME corresponding to a change in position of light equivalent to the separation in position, in a vacuum, of the first and last waves of a continuous band of 9192631770 waves of the radiation corresponding to the transition between two hyperfine levels of the ground state of the cesium 133 atom at the standard location.

One meter of Time is equal to $\frac{1}{299\,792\,458}$ seconds of Time. In general, the second should be used as the standard unit of time.

This definition is consistent with the second as defined in 1967 by the 13th General Conference on Weights and Measures

Thus, we can define time in terms of light!

Length

Length is equal to a separation in TIME corresponding to a separation in position.

One second of length is equal to a separation in TIME equivalent to the separation in position, in a vacuum, of the first and last waves of a continuous band of 9 192 631 770 waves of the radiation corresponding to the transition between two hyperfine levels of the ground state of the cesium 133 atom at the standard location.

One meter of length is equal to $\frac{1}{299\,792\,458}$ seconds of length. In general, the meter should be used as the standard unit of length.

This definition is consistent with the second as defined in 1967 by the 13th General Conference on Weights and Measures

Thus, we can define length in terms of light!

Matter

Matter is the substance of existence.

We can think of matter as the stuff things are made of. In this sense it encompasses all that exists including:

- Space
- Energy
- Human thought
- Etc.

Matter is governed by the **The Law of Conservation** stated by the following postulate:

Postulate: *It is not possible to create or destroy matter.*

Velocity

The velocity, \vec{v} , of an object is equal to the change in position of the object in meters, divided by the corresponding magnitude of the change in position of light at the standard location in seconds.

We can express this mathematically as follows:

$$\vec{v} = \frac{d\vec{x}}{dt} = \lim_{t \rightarrow 0} \frac{\vec{x}}{t}$$

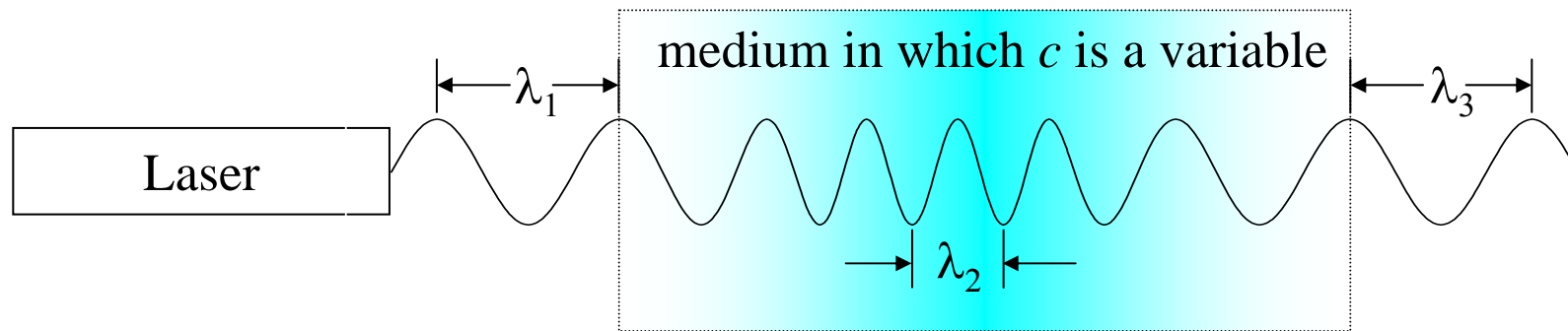
Where:

\vec{x} = the change in position of the object in units of meters (vector).

t = the magnitude of the change in the position of light at the standard location in units of seconds (scalar).

Therefore, velocity is a vector with units of m/s.

Definitions of Momentum and Energy Must Be Compatible With the Nature of Light



We assume, based on our understanding of light, that we can verify the following conclusions by experiment.

- The wavelength and speed of light at the locations of λ_1 and λ_3 are the same.
- The wavelength and speed of light at the location of λ_2 are less than the wavelength and speed of light at the locations of λ_1 and λ_3 .
- The frequency of the light does not change when it moves from the location of λ_1 to the location of λ_2 and on to the location of λ_3 .
- A photon at the location of λ_3 possesses the same amount of energy and momentum as it did at the location of λ_1 .
- Based on our definition of matter we conclude that photons at the location of λ_2 possess the same amount of matter as they do at the locations of λ_1 and λ_3 .

Momentum

The momentum, $\vec{\mathbf{p}}$, of an object is a vector that is equal to the product of its matter, m , the standard speed of light, c_s , and $\vec{\beta}$ (the ratio of velocity with the local speed of light). This is expressed mathematically as:

$$\vec{\mathbf{p}} = m\vec{\beta}c_s \quad \text{where} \quad \vec{\beta} = \frac{\vec{\mathbf{v}}}{c}$$

Therefore:
$$d\vec{\mathbf{p}} = \vec{\beta}c_s dm + mc_s d\vec{\beta}$$

For the special case where c is equal to c_s , the equation $\vec{\mathbf{p}} = m\vec{\beta}c_s$ is equivalent to the familiar form of $\vec{\mathbf{p}} = m\vec{\mathbf{v}}$

Force

Newton's 2nd Law of Motion is our definition of force.

“The summation of forces is equal to the rate of creation of momentum.”

$$\sum \vec{\mathbf{F}} = \frac{d\vec{\mathbf{p}}}{dt}$$

Therefore, force is defined as a vector!

Energy

The energy added to an object by a force, \vec{F} , is equal to the vector dot product of the force and the change in the object's position

vector, \vec{r} , multiplied by $\frac{c_s}{c}$ and stated mathematically as:

$$E = \int \vec{F} \bullet d\vec{r} \frac{c_s}{c}$$

For a simplified one dimensional problem we can write this as:

$$dE = Fdr \frac{c_s}{c}$$

For the special case where $c = c_s$ this equation is equivalent to the familiar form of:

$$dE = Fdr$$

$$E = mc_s^2$$

Postulate: *The speed of light, c , is a function of the properties of space as defined by Maxwell's equations, and therefore independent of any force acting upon it.*

Based on this postulate and our equations for energy and velocity we have:

$$dE = Fdr \frac{c_s}{c} = F \frac{c_s}{c} v dt = \frac{dp}{dt} \beta c_s dt$$

$$\bar{\mathbf{p}} = m\bar{\beta}c_s \quad \text{Therefore, } d\bar{\mathbf{p}} = \bar{\beta}c_s dm + mc_s d\bar{\beta}$$

$$dE = \beta c_s (\beta c_s dm + mc_s d\beta)$$

If we use this equation to calculate the result of a force applied to a photon of light, then, β is equal to a constant value of one, and $d\beta$ is equal to zero. Therefore, at this boundary condition, we obtain:

$$dE = c_s^2 dm$$

$$E = mc_s^2$$

Energy Is a Scalar Property of Matter

If $E = mc_s^2$ is true in general, then we can combine it with the definitions and equations we have developed to obtain:

$$\left(\frac{m_o}{m}\right)^2 + \beta^2 = 1$$

Therefore, the ratio of the total matter (m) to static matter (m_o) is a function of velocity. Energy is also a scalar property of Matter as required by our definition of Matter.

For the special case where c is equal to c_s , the equation $E = mc_s^2$ is identical to Einstein's famous expression for the equivalence of matter and energy.

Note: These equations have been verified by experiment.

A Standard Unit of Matter Defined in Terms of Light

Postulate: *The energy, E , of a single photon is inversely proportional to its wavelength, λ , according to Albert Einstein's photon concept as:*

$$E = hf = \frac{hc}{\lambda}$$

We can combine this postulate with the equations we have derived to define a unit of matter in terms of light as follows:

One kilogram (kg) of matter is equal to n_{kg} photons of light where:

$$n_{kg} = \frac{\lambda c_s^2}{ch}$$

λ = Photon wave length in meters

c_s = Standard velocity of light

c = The local velocity of light

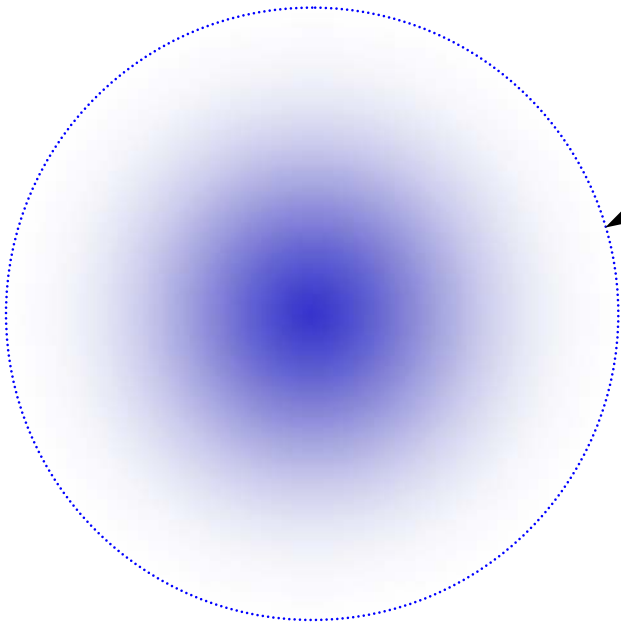
h = Plank's Constant

Matter and The Speed of Light

- Objective:
 - Determine the relationship between the speed of light and the characteristics of matter.
- Approach:
 - Combine Maxwell's equation with Wave Mechanics:

Where There Is Space There Is Matter

Postulate: *Space and matter are mutually dependent upon each other. Where there is space there is matter, and where there is matter there is space. One does not exist without the other*



The matter of an object occupying a given region of space in the form of a standing wave.

Historical Note:

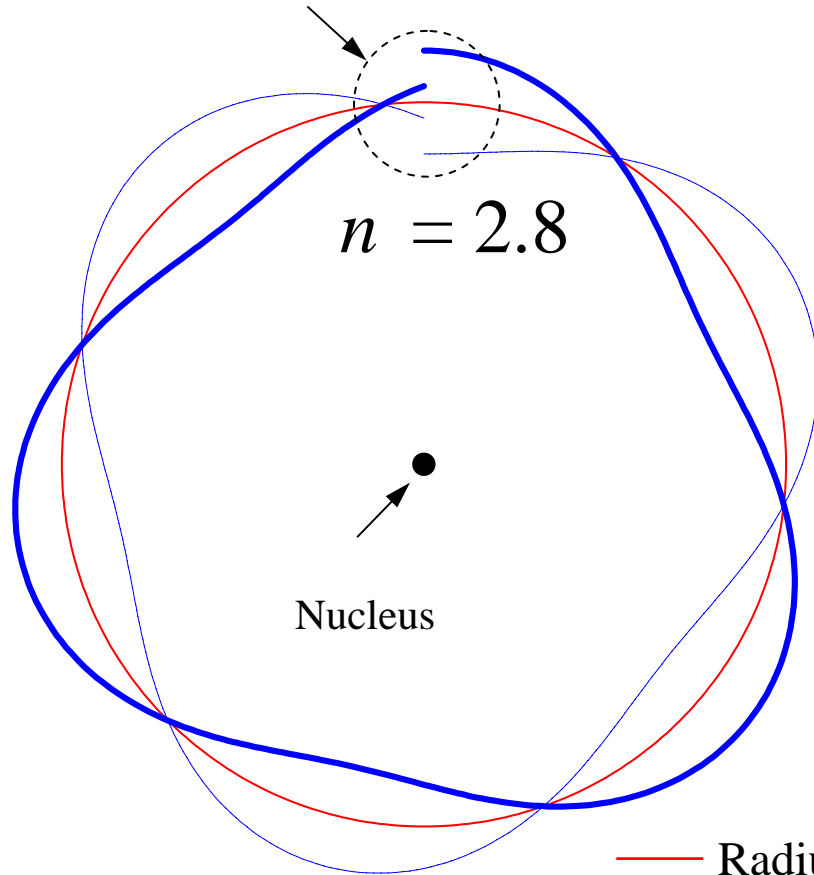
1638 - Rene Descartes theorizes that light is a pressure wave through the second of his three types of matter of which the universe is made. He invents properties of this fluid that make it possible to calculate the reflection and refraction of light. The "modern" notion of the aether is born. (from <http://maxwell.byu.edu/~spencerr/phys442/node4.html>)

An internet search on “aether” will uncover considerable debate. Einstein replaced it with his concept of “space-time” in the theory of General Relativity. This is commonly referred to as “the fabric of space.”

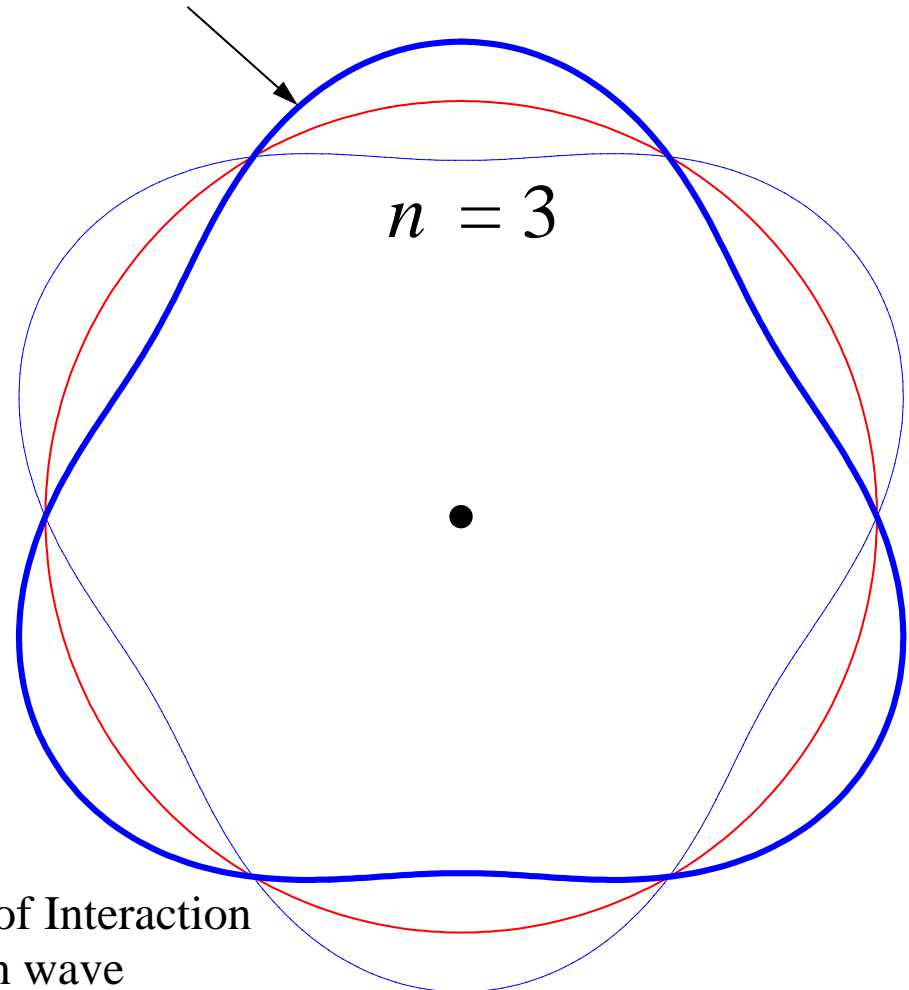
Here we simply state: *Space is filled with matter that obeys Maxwell’s equations.*

Integer Values Of Wavelength Are Required For A Stable Electron-Nucleus System

Non-integer value results in a discontinuity preventing a stable waveform



Integer value results in a stable waveform

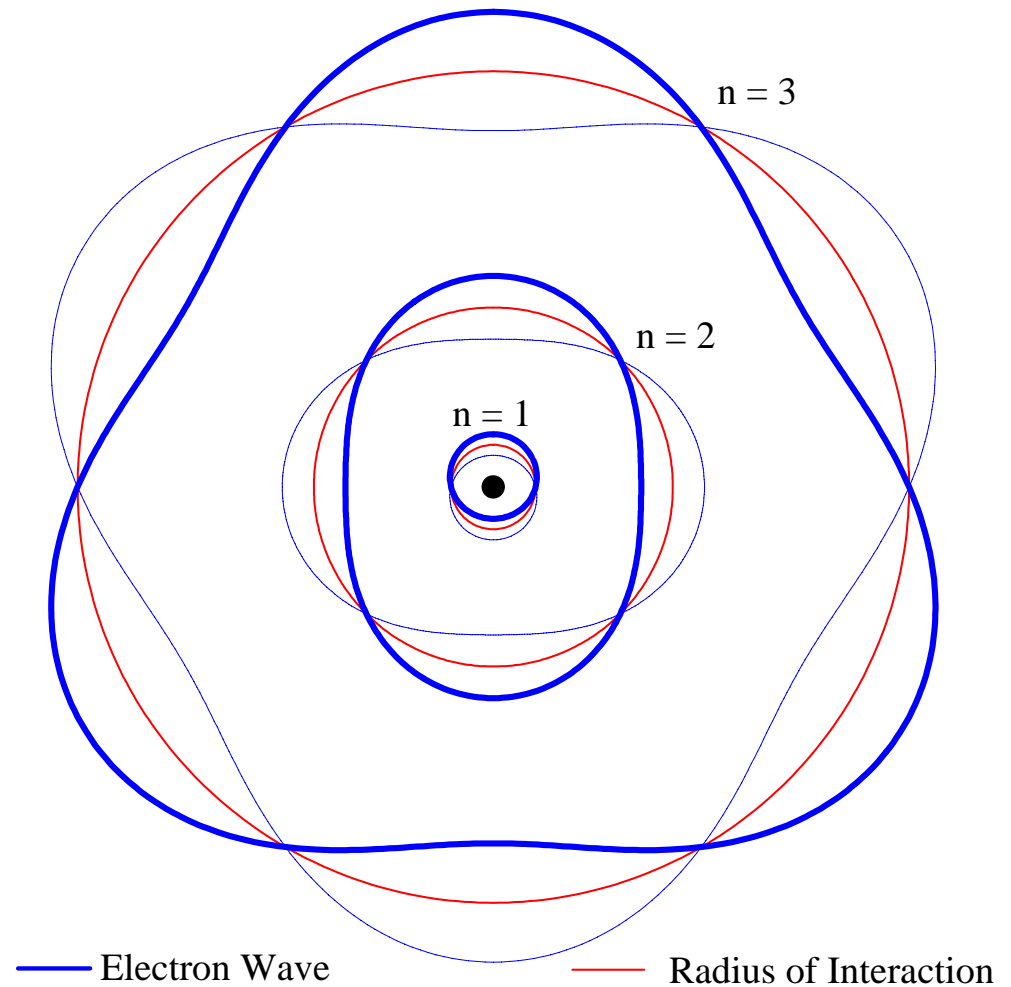


— Radius of Interaction
— Electron wave

An Atom Releases Energy As An Electron Transitions From One State To Another

When we derive the energy of transition from infinity to a stable waveform we obtain:

$$E_t = \frac{-Z^2 e^4 m (1 - \beta^2)}{8 \epsilon^2 n^2 h^2} \left(\frac{c_s}{c} \right)^4$$



Maxwell's Equation

Based on Maxwell's equations, the speed of light is a function of the permittivity, ϵ , and permeability, μ , of space as follows:.

$$c = \frac{1}{\sqrt{\mu\epsilon}}$$

Postulate: *The ratio of the permittivity of space to the permeability of space in a vacuum is constant and independent of position.*

Based on this postulate we can derive the following relationship between the permittivity of space, the permeability of space, and the speed of light.

$$\epsilon = \frac{\epsilon_s c_s}{c} \qquad \mu = \frac{\mu_s c_s}{c}$$

The Influence Of The Speed Of Light On The Rest Matter And Charge Of Particles

Postulate: *The ratio of the rest matter to charge of an electron is constant or independent of location. The ratio of rest matter to charge of a proton is also constant.*

Based on this postulate it is reasonable to assume that the charge and rest matter of an object are also functions of the speed of light, in a vacuum, as follows:

$$e = e_s \left(\frac{c_s}{c} \right)^x \quad m_o = m_{os} \left(\frac{c_s}{c} \right)^x$$

An atom can exist at rest with its electrons in various energy states. Therefore, the transition energy of an electron is also part of the rest matter of the atom. It follows that the transition energy of an atom must vary in the same manner as the rest matter of the atom. Therefore:

$$E_t = E_{ts} \left(\frac{c_s}{c} \right)^x$$

The Characteristics Of Matter As A Function Of The Speed Of Light

If we combine the following equations and solve for x :

$$\epsilon = \frac{\epsilon_s c_s}{c} \quad \mu = \frac{\mu_s c_s}{c} \quad e = e_s \left(\frac{c_s}{c} \right)^x \quad m_o = m_{os} \left(\frac{c_s}{c} \right)^x \quad E_t = E_{ts} \left(\frac{c_s}{c} \right)^x$$

$$E_t = \frac{-Z^2 e^4 m (1 - \beta^2)}{8 \epsilon^2 n^2 h^2} \left(\frac{c_s}{c} \right)^4$$

We obtain: $x = -\frac{1}{2}$

Therefore: $m_o = m_{os} \sqrt{\frac{c}{c_s}} \quad e = e_s \sqrt{\frac{c}{c_s}}$

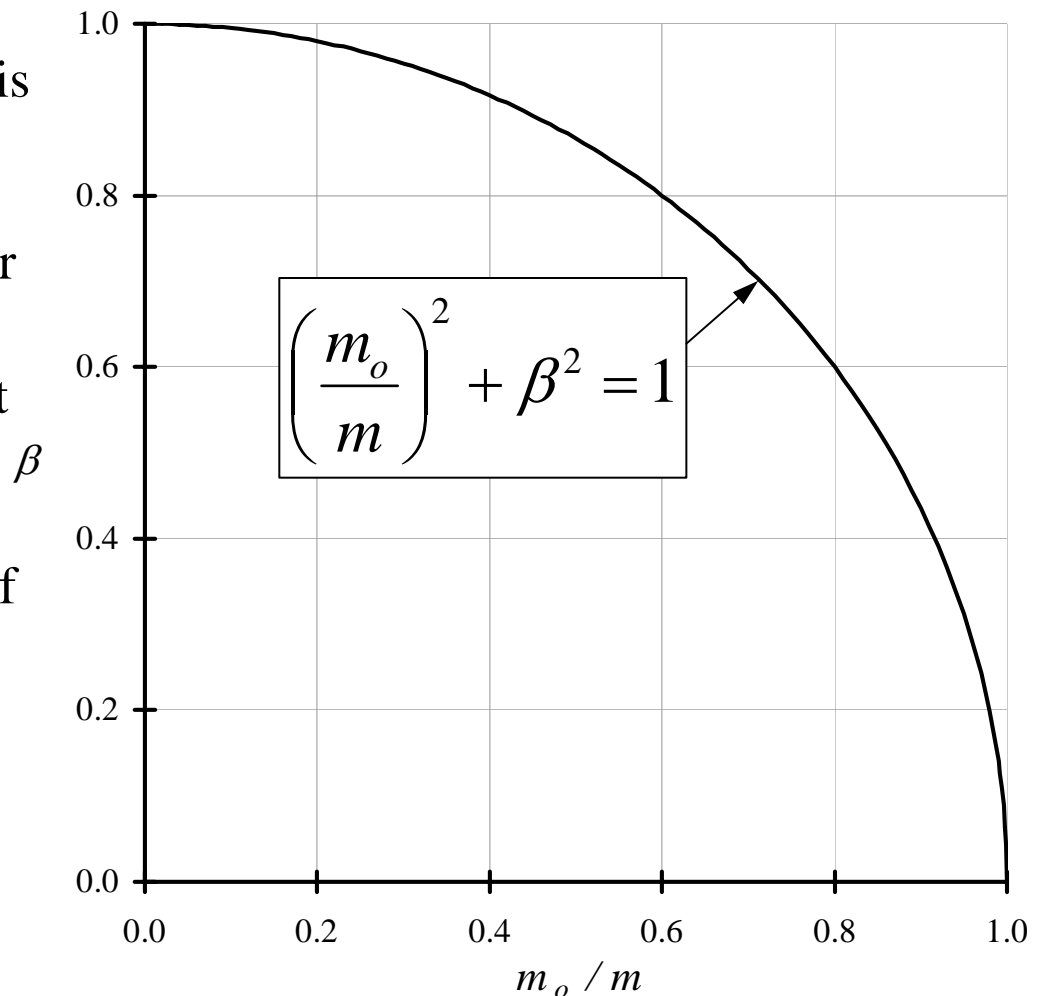
This illustrates that the rest matter and charge of a particle are a function of the square root of the speed of light in a vacuum.

The Velocity of an Object Can Be Modified by Changing the Ratio of Total to Static Matter

The velocity (βc) of an object can be changed by applying a force to it. In this case the total matter of the object is changed. Based on our definitions of momentum and energy we can also alter the velocity of an object by:

- Changing the rest matter of the object
- Changing the speed of light.

Imagine a space where the rest matter of an object is a function of position. In this space, an object would be accelerated in the direction of reduced rest matter. It is proposed that this is why an object accelerates in a gravitational field.



Gravitational Force And The Speed Of Light

Postulate: *A body of matter distorts the medium of space causing the speed of light to be a function of position. Gravity is the influence of this gradient on matter.*

Postulate: *The gravitational force of attraction between two objects under static conditions can be calculated as:*

$$F = \frac{c}{c_s} \frac{m_o MG}{r^2}$$

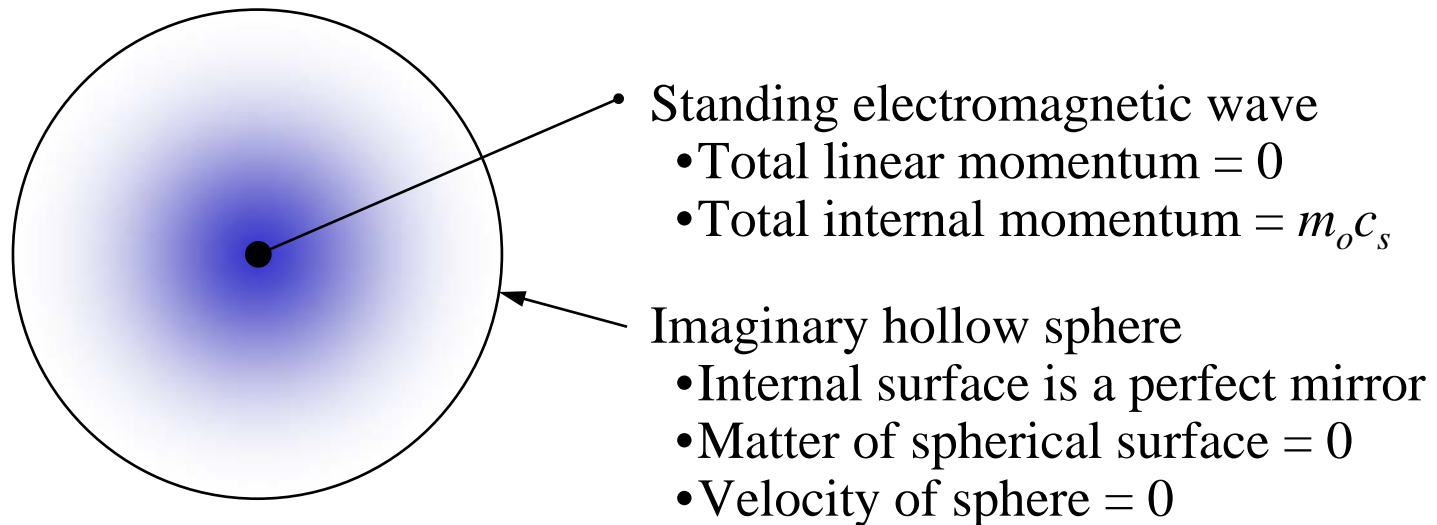
We will refer to this as corrected gravity to distinguish it from Newton's law of gravity.

It follows from these postulates and the equations we have derived that, for a single governing body, if we know the speed of light at one position we can calculate it another position with the following equation:

$$c_2 = c_1 e^{\frac{2MG}{c_s^2} \left(\frac{r_2 - r_1}{r_1 r_2} \right)}$$

A Particle Composed of Electromagnetic Waves

Postulate: *All fundamental particles are formed out of electromagnetic waves.*



It is possible to describe the properties of a particle in terms of a standing electromagnetic wave. Based on this approach a particle occupies a given region of space as required by the mutual dependency of space and matter.

If we use this concept to calculate the size of a neutron, the result is in very good agreement with high energy scattering data.

We Define the Following for A Particle Composed of Electromagnetic Waves

$$\bar{p}_\lambda = \hat{p}_\lambda m c_s = \text{Total Electromagnetic momentum}$$

$$\bar{p}_o = \hat{p}_o m_o c_s = \text{Internal momentum}$$

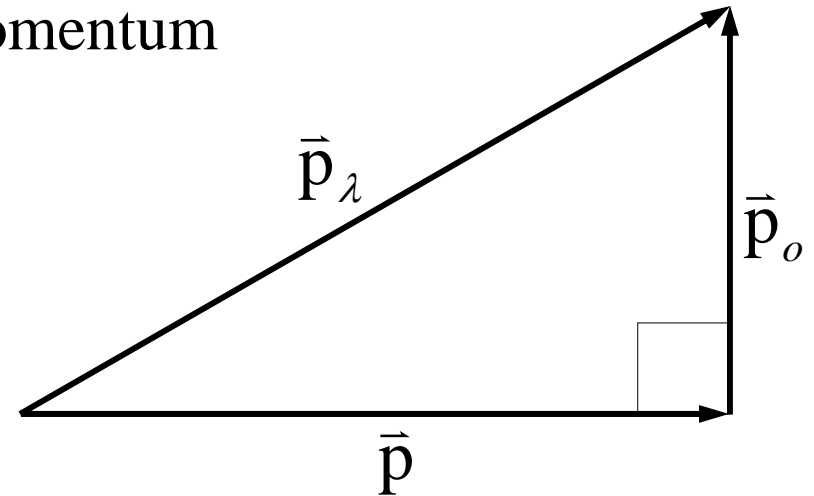
$$\bar{p} = m \beta c_s = \text{Linear momentum}$$

$$\bar{p}_o \bullet \bar{p} = 0$$

$$p_o = \sqrt{p_\lambda^2 - p^2}$$

$$m_o c_s = \sqrt{(m c_s)^2 - (m \beta c_s)^2}$$

$$m_o = m \sqrt{1 - \beta^2}$$



Postulate: *Total electromagnetic momentum is conserved. The change in the total electromagnetic momentum of a system is equal to the electromagnetic momentum in minus the electromagnetic momentum out.*

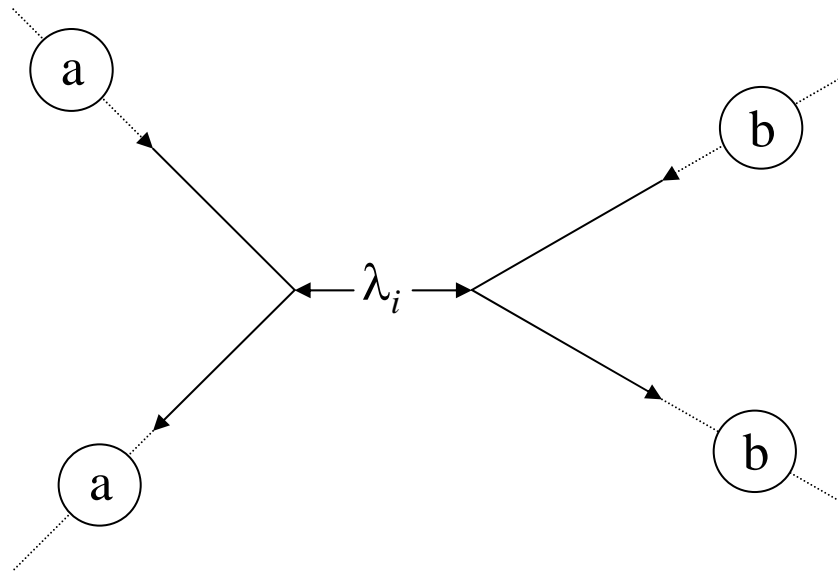
It follows that we can define the mass of an object to be equal to m_o as follows:

$$m_o = \frac{p_o}{c_s} = \text{Mass}$$

Wavelength of Interaction

Postulate: *Particles can interact by exchanging momentum through an electromagnetic wave.*

Therefore, based on this postulate, the wavelength of interaction between two particles is equal to the wavelength of interaction between the individual particles and the electromagnetic wave by which the momentum is transferred.



This figure represents the interaction between two particles through the influence of an electromagnetic wave. The basic concept is the same as a “Feynman diagram”.

Wavelength of Interaction

The wavelength of interaction is defined as:

The interaction Wavelength (λ_i) between an electromagnetic wave and an object is the distance the wave must move through the medium of space for two maximum or minimum wave values to interact with the object.

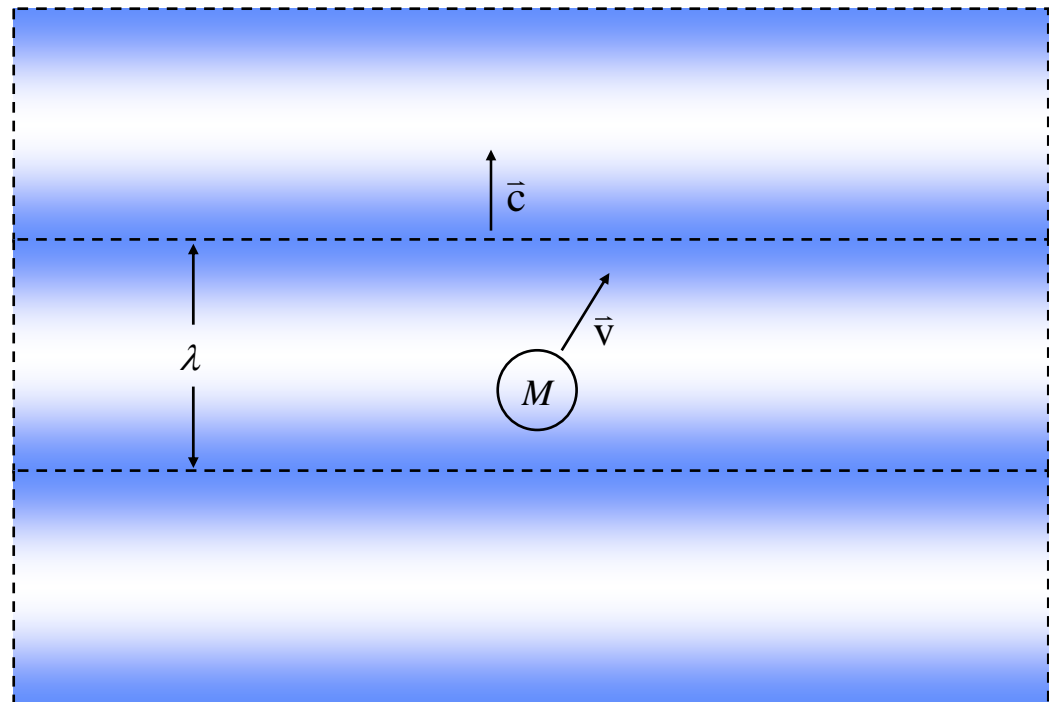
Based on this concept it can be shown that:
$$\lambda_i = \frac{ch}{(1 - \vec{\beta} \cdot \hat{c}) mc_s^2}$$

Therefore:
$$\lambda_i = \frac{ch}{p_i c_s}$$

For $c = c_s$ this reduces to de Broglie equation:

$$\lambda_i = \frac{h}{p_i}$$

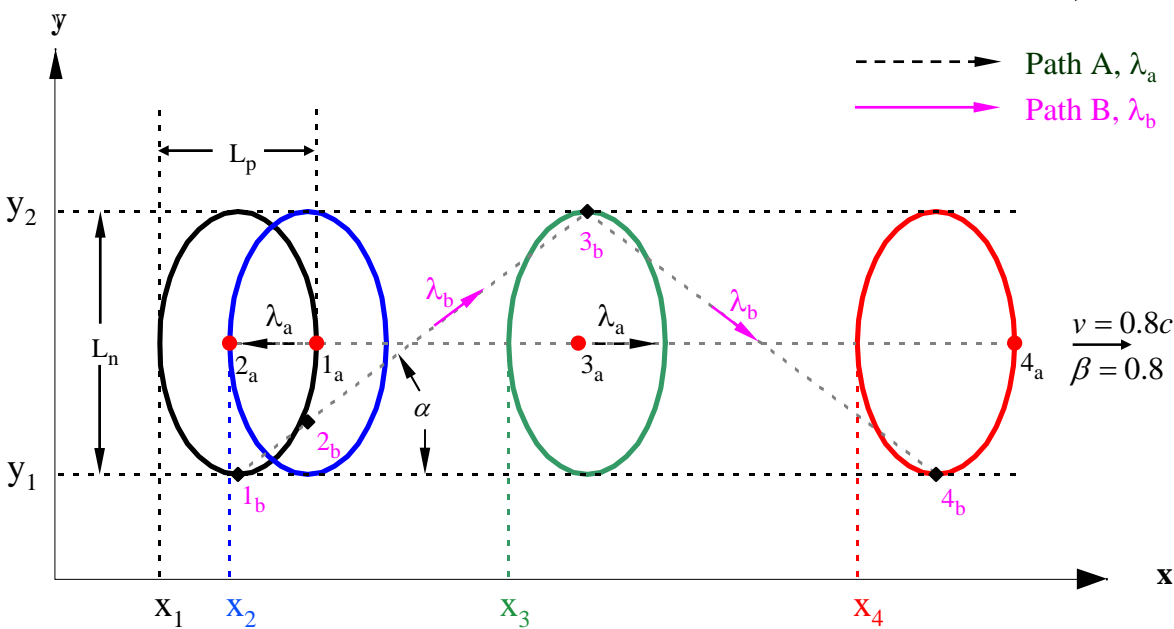
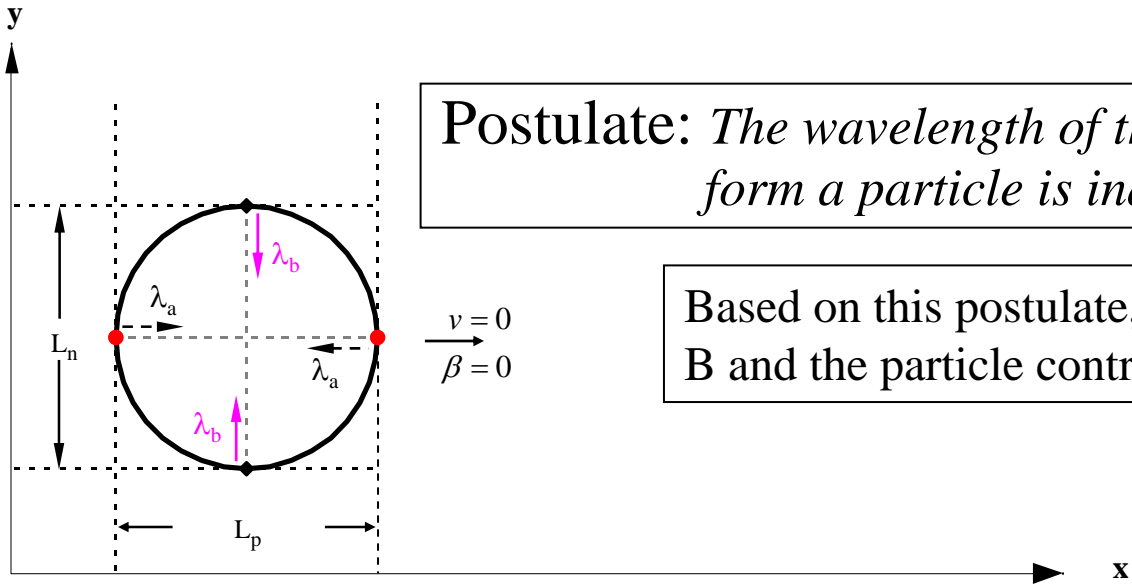
Where p_i is equal to the momentum of interaction



Length Contraction

Postulate: *The wavelength of the electromagnetic waves that form a particle is independent of orientation.*

Based on this postulate, Path A is the same length as Path B and the particle contracts when put into motion



Therefore, a particle contracts in the direction of motion by the amount.

$$L_p = \frac{L_n}{\sqrt{1 - \beta^2}}$$

This is the same equation derived by H.A. Lorentz. It is based on the concept that space is the medium through which light travels. And that all matter is composed of disturbances in the medium. Therefore, by design, the Michelson-Morely experiment gives a null results if this is true.

The Force Between Charges Is A Function Of The Distance Of Interaction

Postulate: *The charge of an object distorts the medium of space.
The interaction of these distortions causes the force of
charge attraction or repulsion.*

Postulate: *The force of interaction between and atomic nucleus
and a single electron can be calculated as:*

$$F = \frac{Ze^2}{4\pi\epsilon r_i^2}$$

Where:

$$r_i = \frac{r}{\sqrt{1 - \beta^2}}$$

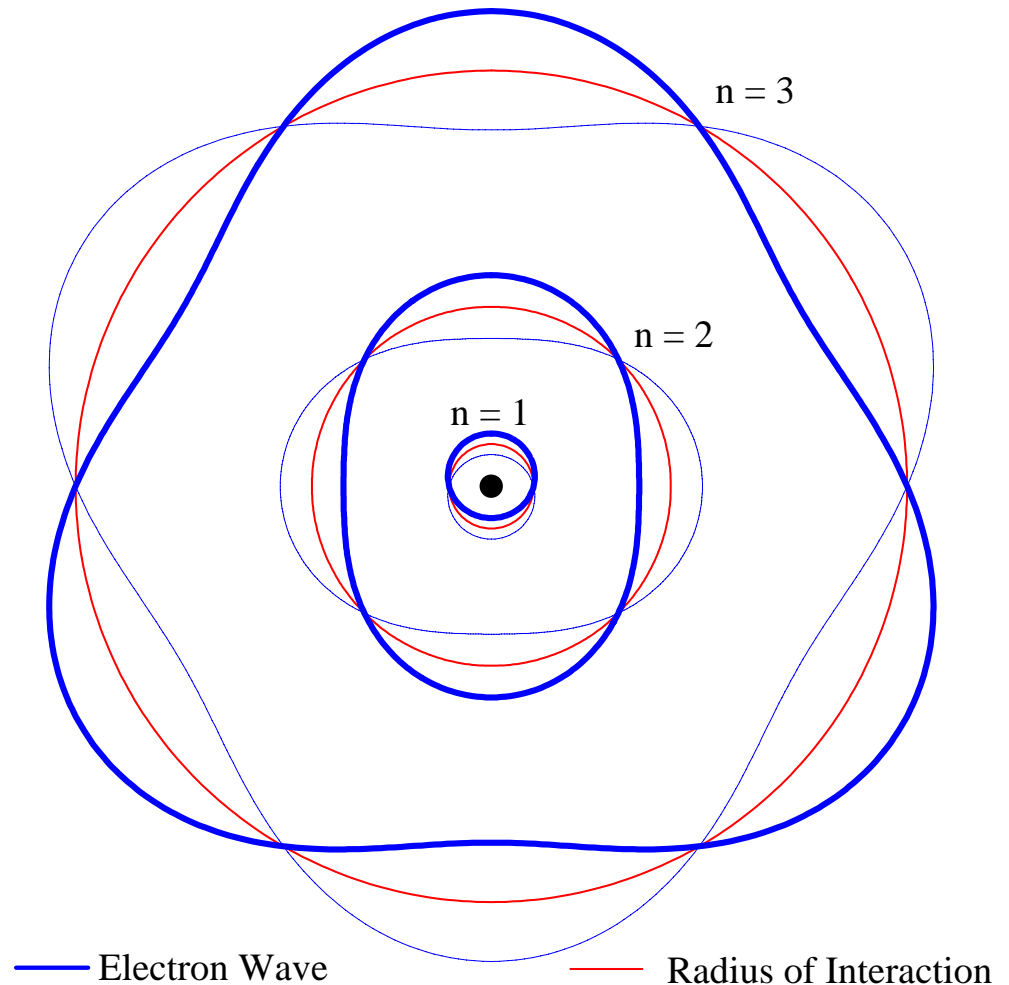
The Size And Density Of A Particle Is A Function Of The Properties Of Space

When we derive the radius of interaction for an atomic system we obtain:

$$\frac{r}{r_{os}} = \sqrt{\frac{c}{c_s(1-\beta^2)}}$$

This leads to an increase in the density of rest matter:

$$\frac{\rho_o}{\rho_{os}} = \frac{c_s}{c}$$



Postulate: *An electron-atomic nucleus system is stable when its structure corresponds to integer values of the wavelength of interaction.*

The Natural Frequency of Matter Decreases Near a Governing Body

If we apply the equations we have developed with the concept of wave mechanics in calculating the natural frequency of matter we obtain the following:

$$f = f_{os} \sqrt{\frac{c(1 - \beta^2)}{c_s}}$$

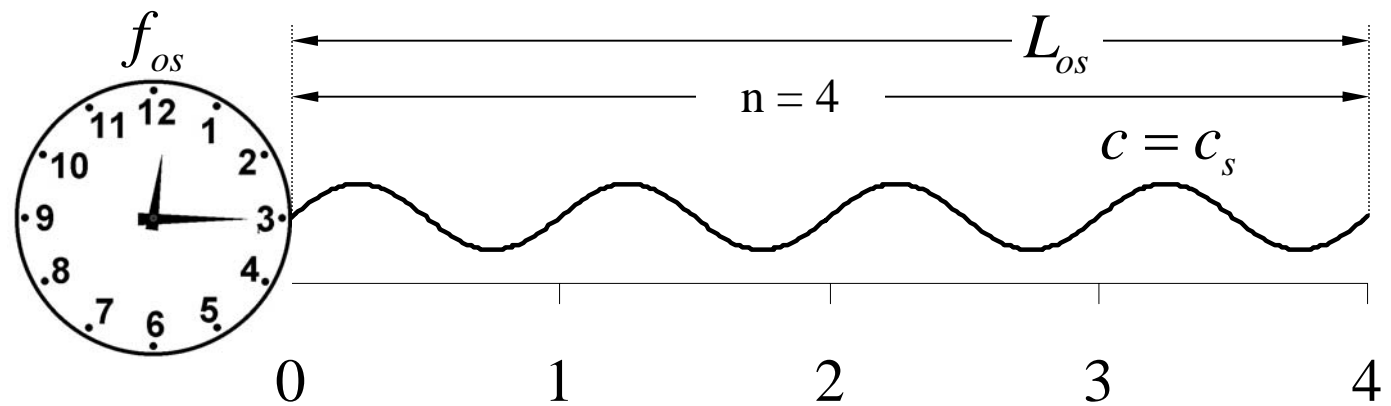
If we combine this with our equation for the variation of the speed of light near a governing body we can calculate the change in natural frequency as:

$$\frac{f_1 - f_2}{f_1} = 1 - \sqrt{e^{\left(\frac{2MG}{c_s^2}\right)\left(\frac{r_2 - r_1}{r_2 r_1}\right)}}$$

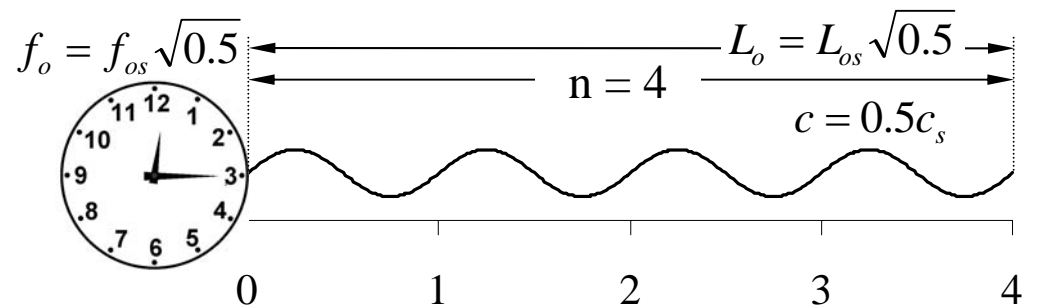
Rulers And Clocks In A Gravitational Field

If we combine the following equations: $r_o = r_{os} \sqrt{\frac{c}{c_s}}$ $f_o = f_{os} \sqrt{\frac{c}{c_s}}$

We obtain: $\frac{r_o}{f_o} = \frac{r_{os}}{f_{os}}$



Therefore, the ratio of the size of a ruler to the frequency of a clock in a gravitational field is constant! This has been confirmed by experiment.

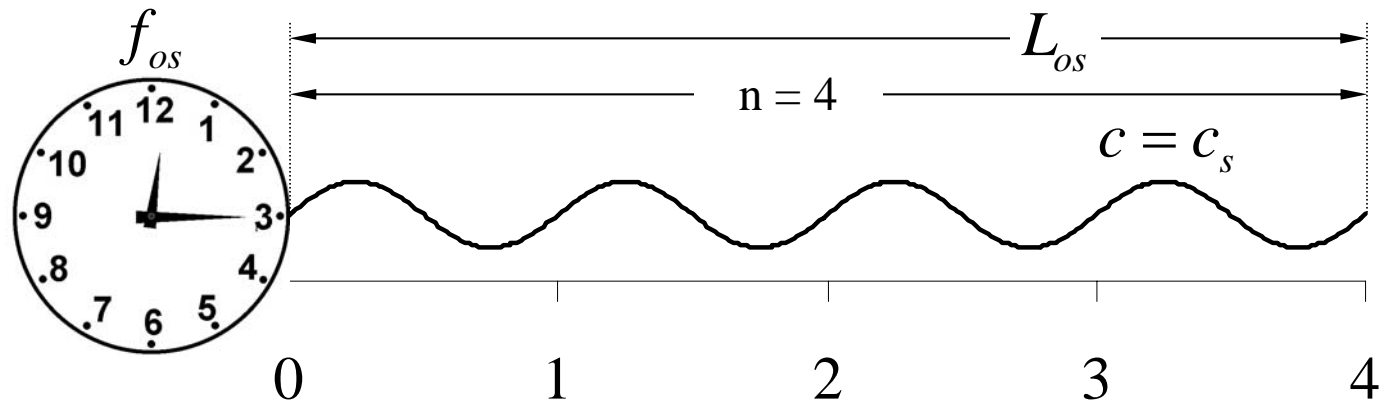


If A Clock Is Moved Closer To A Gravitational Body It Will Shrink And Tick Slower

At the standard location we can calculate the time, t , required for light to change position by L_{os} as:

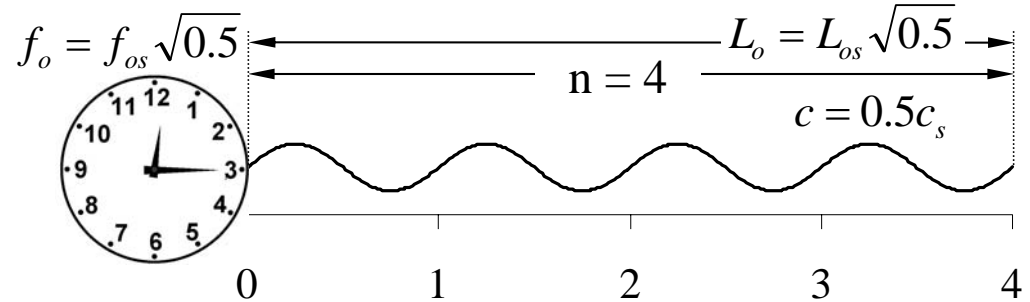
$$t = \frac{L_{os}}{c_s}$$

And the clock indicates that it takes four ticks or cycles for this to happen.



If we move the above clock to a location where the speed of light is equal to $0.5c_s$, then we can calculate:

$$t = \frac{L_{os} \sqrt{0.5}}{0.5c_s} = \sqrt{2} \frac{L_{os}}{c_s}$$



The clock runs slower and still indicates that it takes four cycles for light to change position by the length of the ruler.

Example Clock In A Laboratory

Problem: How much will the size and frequency of a clock change if we remove it from a table and place it one meter lower on the floor.

Solution: We can show that:

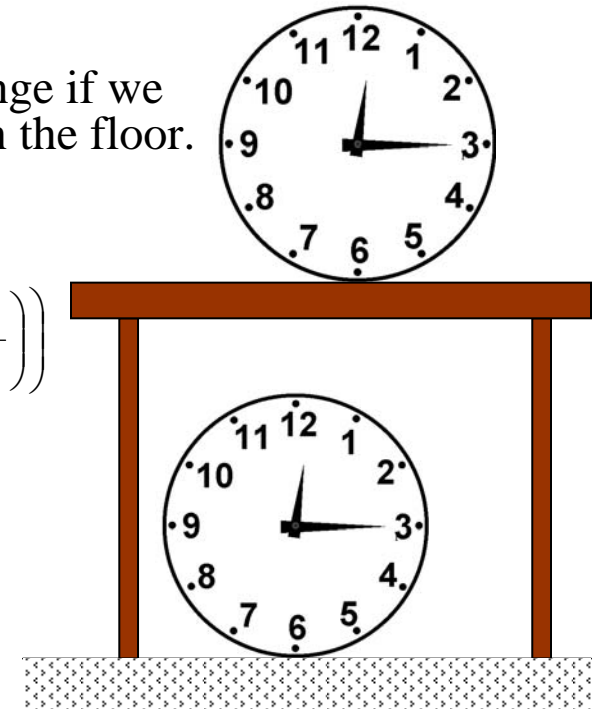
$$\frac{L_1 - L_2}{L_1} = \frac{f_1 - f_2}{f_1} = 1 - \sqrt{e^{\left(\frac{2MG}{c_s^2} \left(\frac{r_2 - r_1}{r_2 r_1}\right)\right)}} = 1 - e^{\left(\frac{MG}{c_s^2} \left(\frac{r_2 - r_1}{r_2 r_1}\right)\right)}$$

To eliminate numerical errors we use the series expansion:

$$1 - e^x = \left(-\frac{x}{1!} - \frac{x^2}{2!} - \frac{x^3}{3!} - \dots\right)$$

Plugging in the numbers we obtain:

$$\frac{L_1 - L_2}{L_1} = \frac{f_1 - f_2}{f_1} = 1.1\text{E} - 16$$



Give: $M = 5.9723\text{E} + 24\text{kg}$
 $G = 6.6742\text{E} - 11\text{ m}^3/(\text{kg s}^2)$
 $r_{\text{table}} = 6.3675\text{E} + 6\text{ m}$

This is within the grasp of current technology: “NIST-F1, the nation's primary time and frequency standard, ... as of the summer of 2005, the uncertainty has been reduced to about 5×10^{-16} ” (<http://tf.nist.gov/cesium/fountain.htm>)

The Influence Of Gravity On The Frequency of Matter Provides An Explanation For High Redshift Quasars

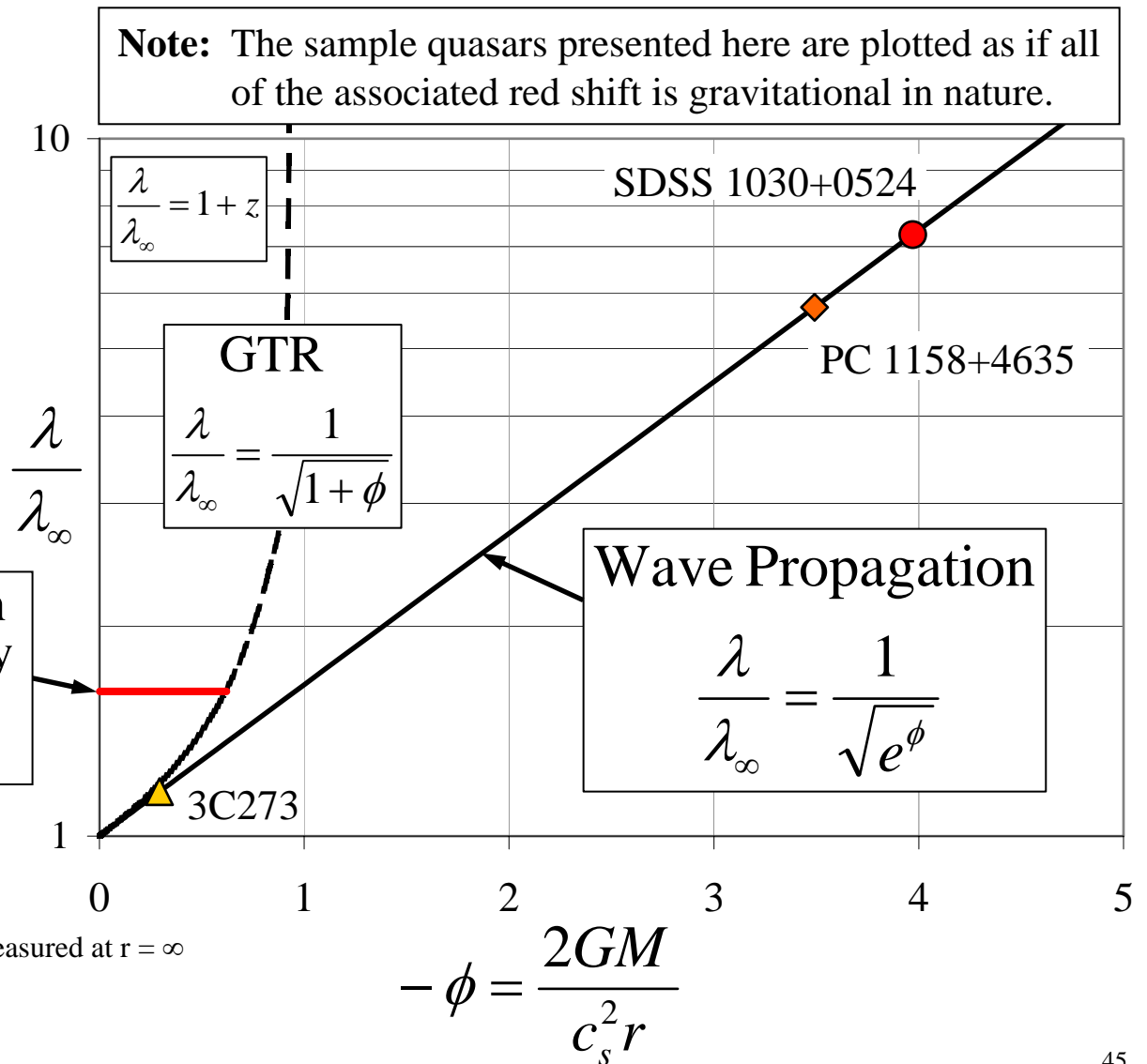
According to the following equation, the red shift of light is a logarithmic function of the matter of a governing body.

$$\frac{f_1 - f_2}{f_1} = 1 - \sqrt{e^{\left(\frac{2MG}{c_s^2}\right)\left(\frac{r_2 - r_1}{r_2 r_1}\right)}}$$

Limit calculated by Hermann Bondi for the General Theory of Relativity beyond which a black hole is predicted.

λ_∞ = Wavelength of photon emitted by M as measured at $r = \infty$

λ = Wavelength of photon created at $r = \infty$



Motion Is Governed by Wave Propagation

Postulate: *If the wavelength of an object is a function of position, and there is no other influence, the motion of the object is a pure function of wave propagation.*

We can use this postulate and the equations we have derived to calculate the path of an object based on its wave characteristics. The wavelength can be expressed as a function of the radius of curvature as:

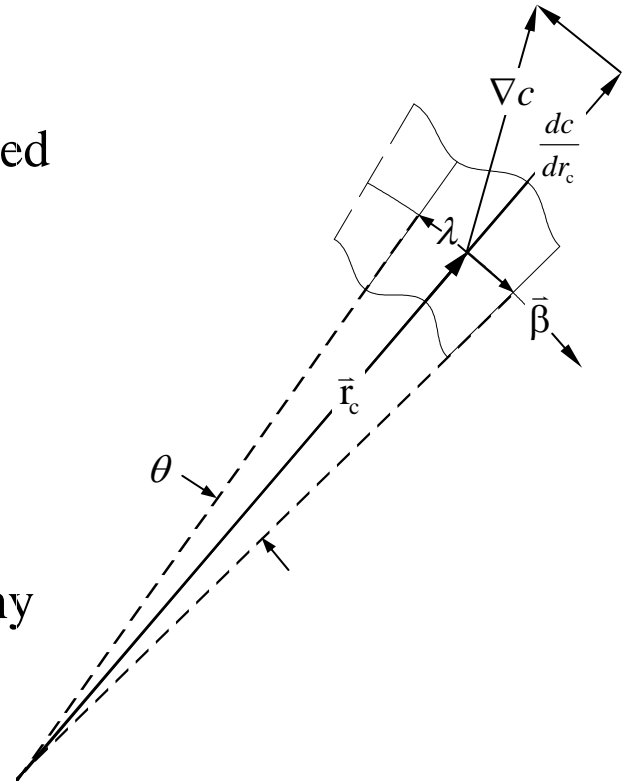
$$\lambda = r_c \theta$$

Therefore:

$$r_c = \lambda \frac{dr_c}{d\lambda}$$

It can also be shown that the curvature of motion at any point can be calculated as:

$$r_c = \frac{2c}{\left(1 + \frac{1}{\beta^2}\right) \frac{dc}{dr_c}}$$



This equation works for light, particles, and planets.

Wave Propagation In A Gravitational Field

By: Morris G. Anderson

APS Four Corners Section Fall Meeting

October 15-16, 2004

University of New Mexico, Albuquerque, NM

Wave Propagation In A Gravitational Field

“Louis Victor de Broglie postulated that *because photons have wave and particle characteristics, perhaps all forms of matter have wave as well as particle properties*” (Raymond A. Serway, *Physics For Scientists & Engineers*, page 1218 ©1996).

Hypothesis:

If the wavelength of an object is a function of position, and there is no other influence, the motion of the object is a pure function of wave propagation.

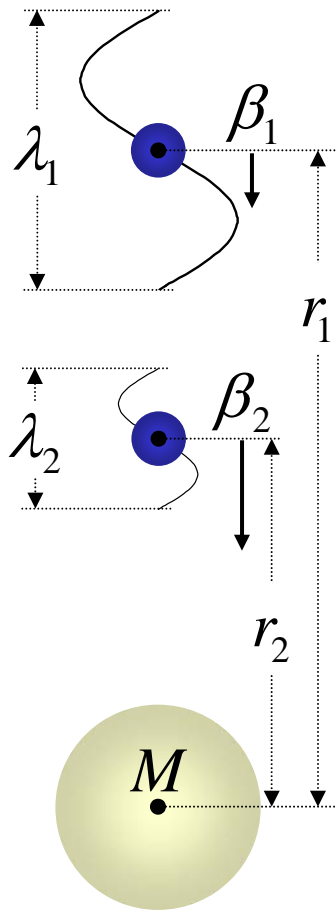
Purpose:

Develop a simple method to describe motion in a gravitational field in terms of wave propagation.

Note: A full derivation of this approach is provided in the book
Time, Matter, and Gravity © 2004 By Morris G. Anderson.

The Wavelength of Matter Decreases As It Moves Closer to a Governing Body

The decrease in wavelength of matter moving through a gravitational field can be calculated as:



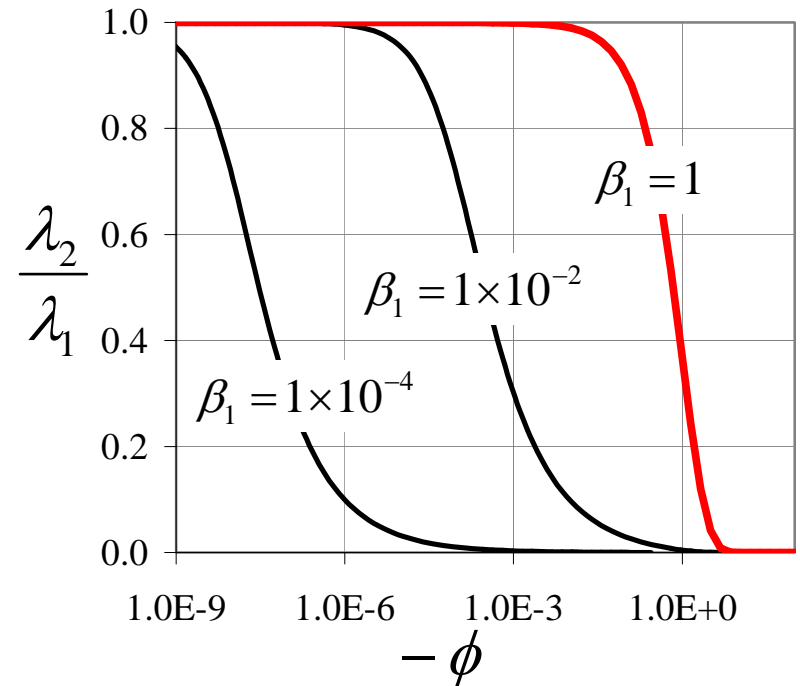
$$\frac{\lambda_2}{\lambda_1} = \frac{\beta_1}{\beta_2} e^{\phi}$$

Where:

$$\bar{\beta} = \frac{\bar{v}}{c}$$

$$\beta_2 = \sqrt{1 - e^{\phi}(1 - \beta_1^2)}$$

$$\phi = \frac{2MG}{c_s^2} \left(\frac{1}{r_1} - \frac{1}{r_2} \right)$$



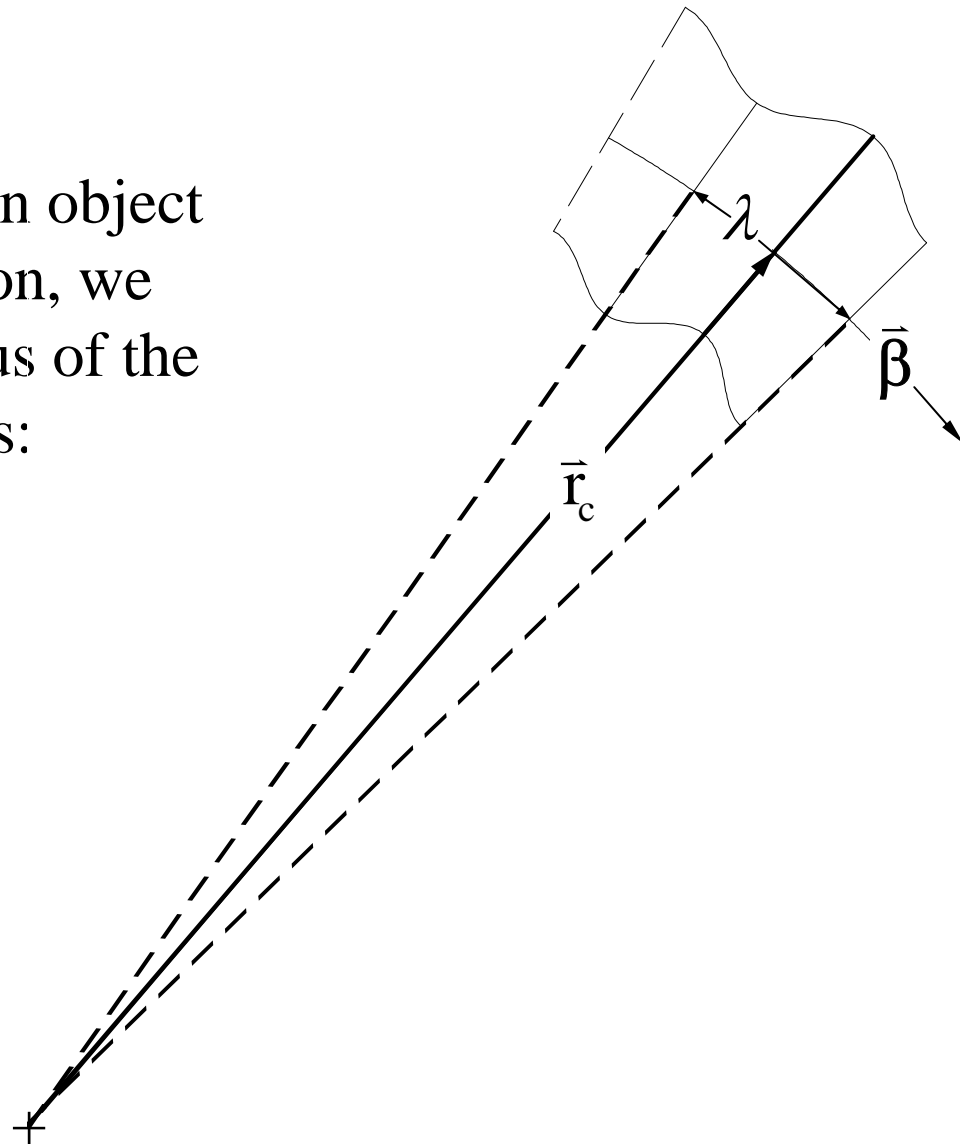
Assumptions

- Gravitational influence only
- The matter associated with λ is insignificant to M

The Propagation of a Wave Can Be Described in Terms of Its Curvature of Motion

If the wavelength of an object is a function of position, we can calculate the radius of the curvature of motion as:

$$r_c = \lambda \frac{dr_c}{d\lambda}$$



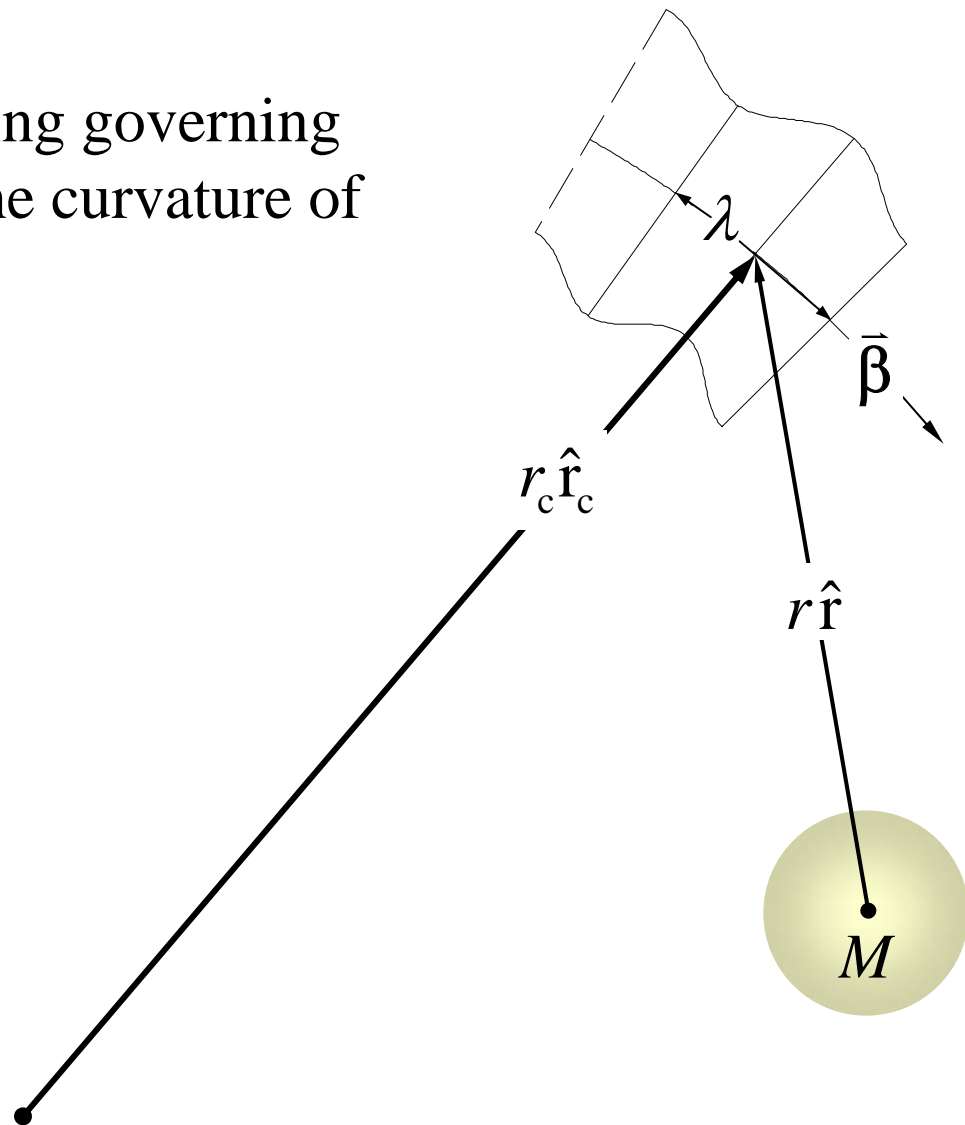
The Wave Properties of Matter Can Be Used to Describe Motion in a Gravitational Field

Near a single non-spinning governing body we can calculate the curvature of wave motion as:

$$r_c = \lambda \frac{dr_c}{d\lambda}$$

$$r_c = \frac{c_s^2 r^2}{\left(1 + \frac{1}{\beta^2}\right) MG(\hat{r} \cdot \hat{r}_c)}$$

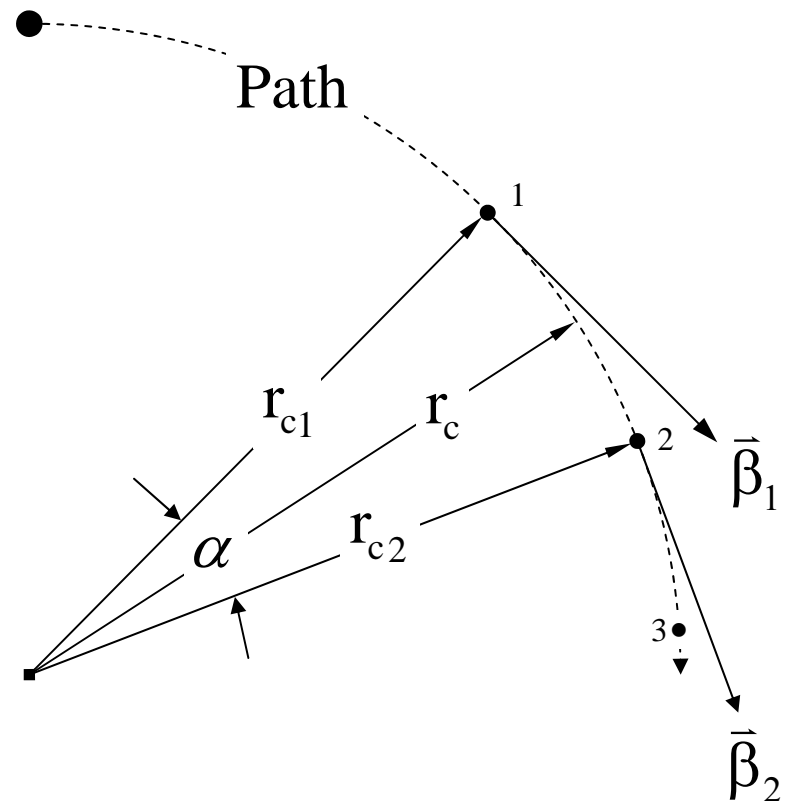
Note: This equation is only valid if the matter associated with the wave is much less than M .



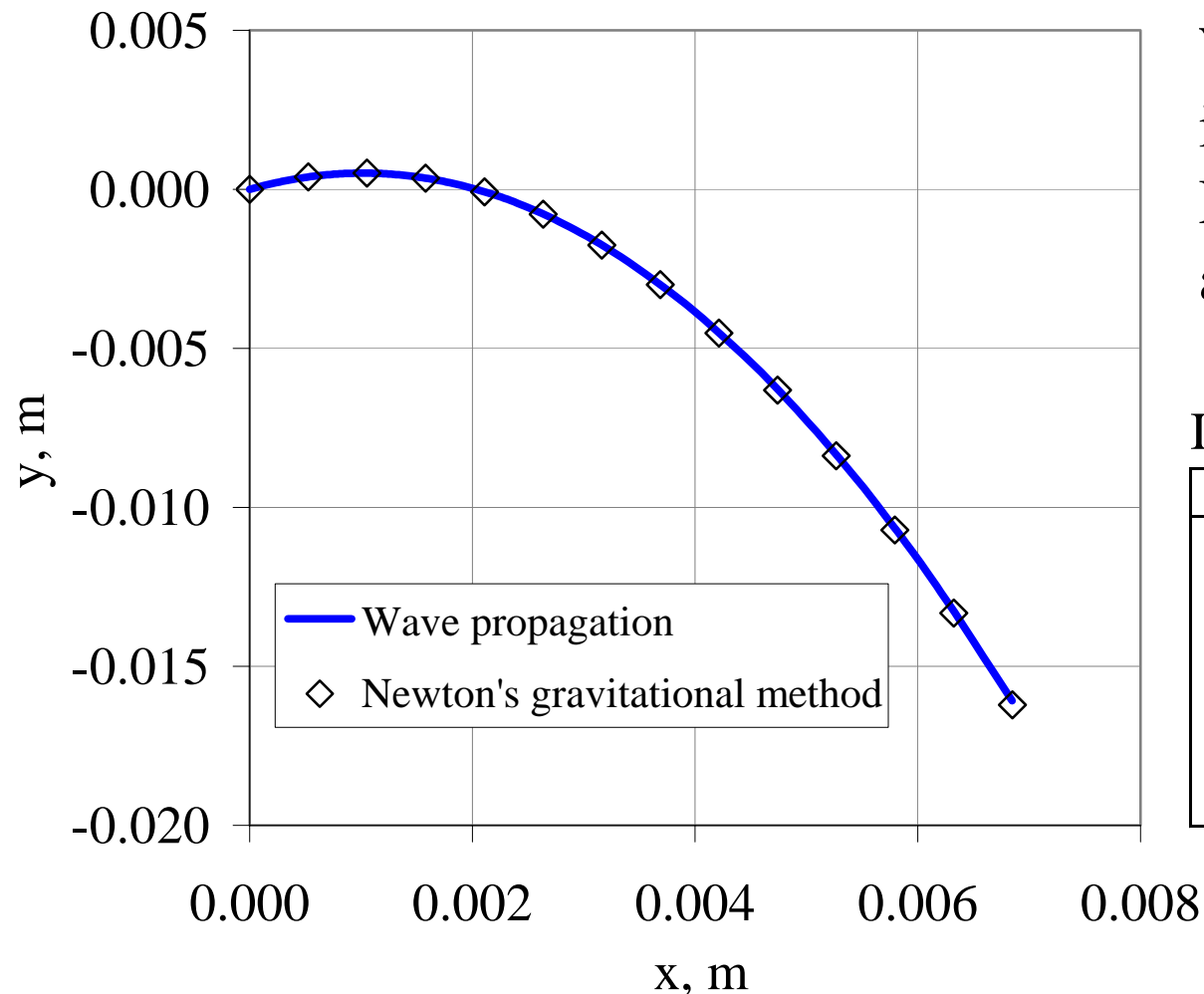
Numerical Methods Can Be Used to Calculate the Path of Wave Propagation

Given : Conditions at point 1

- Calculate \mathbf{r}_{c1}
- Set $\mathbf{r}_c = \mathbf{r}_{c1}$
- Estimate direction of motion at point 2 by rotating \mathbf{r}_c through α
- Calculate \mathbf{r}_{c2}
- If $\left[\mathbf{r}_c - \frac{\mathbf{r}_{c1} + \mathbf{r}_{c2}}{2} \right] < \text{tolerance}$
Proceed to point 3
- Else $\mathbf{r}_c = \frac{\mathbf{r}_{c1} + \mathbf{r}_{c2}}{2}$



The Wave Properties of an Object Can Be Used to Calculate Its Trajectory of Motion



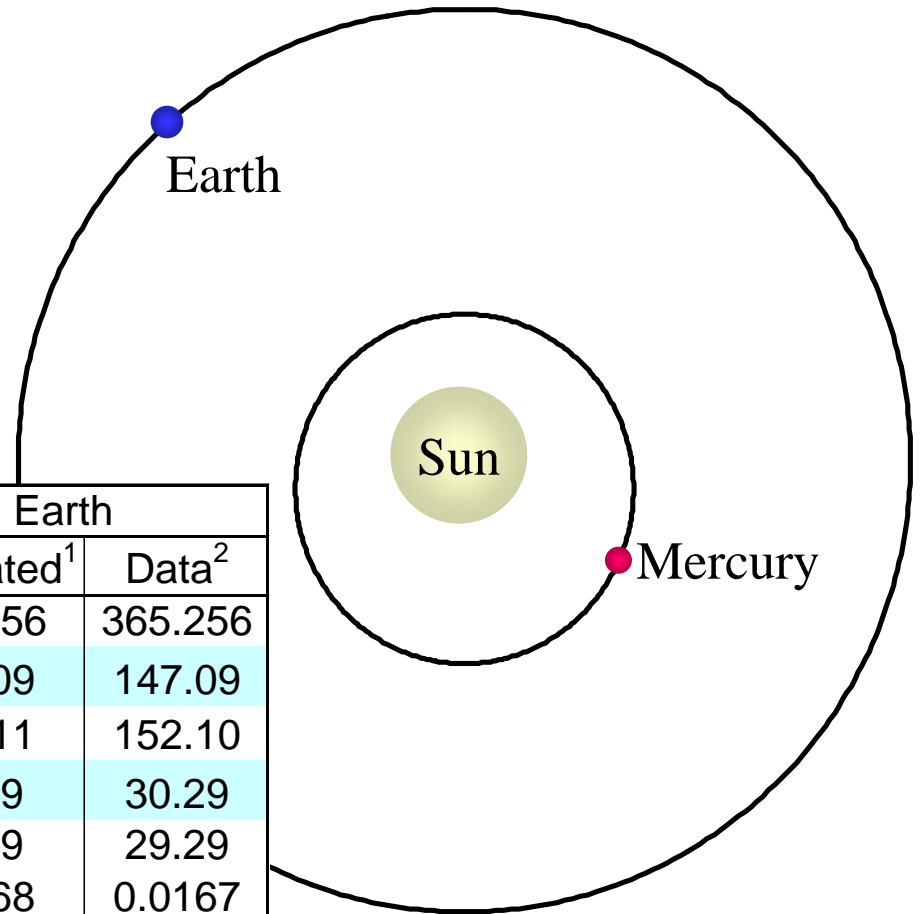
Wave propagation is indistinguishable from Newtonian Mechanics at low velocities.

Initial conditions:

Property	Value	Units
M	5.9723E+24	kg
G	6.6742E-11	m ³ /(kg s ²)
R	6.3675E+06	m
g	-9.83	m/s ²
v _x	0.10	m/s
v _y	0.10	m/s

We Can Use the Wave Properties of a Planet to Predict Its Orbital Motion

Wave propagation provides an accurate model of orbital mechanics.



Orbital parameters	Mercury		Earth	
	Calculated ¹	Data ²	Calculated ¹	Data ²
Sidereal period (days)	87.963	87.969	365.256	365.256
³ Perihelion (10 ⁶ km)	46.00	46.00	147.09	147.09
Aphelion (10 ⁶ km)	69.82	69.82	152.11	152.10
³ Max velocity (km/s)	58.98	58.98	30.29	30.29
Min velocity (km/s)	38.86	38.86	29.29	29.29
Eccentricity	0.2056	0.2056	0.0168	0.0167

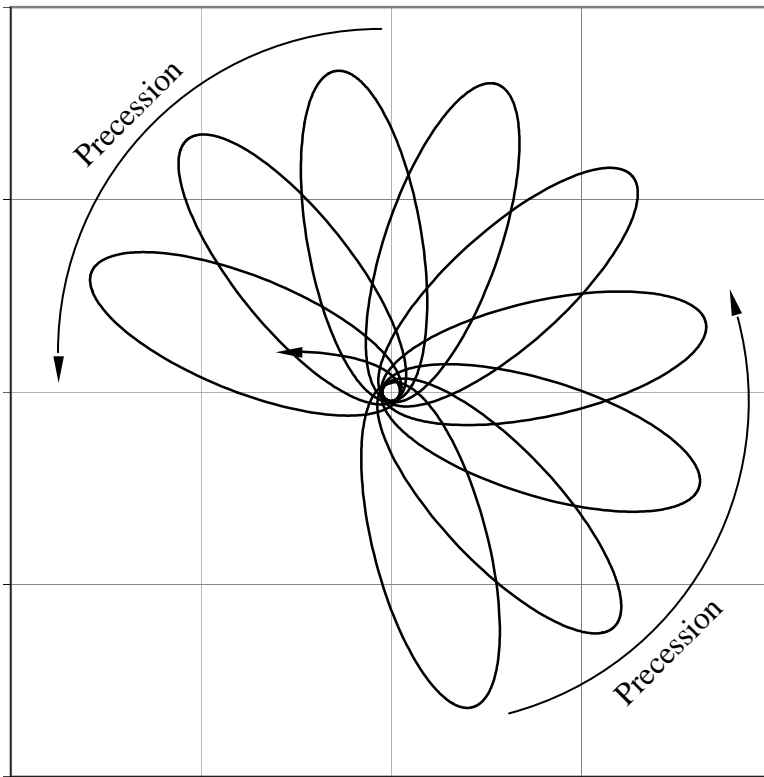
¹Calculated with the PATH program for a velocity rotation of 360°

²<http://nssdc.gsfc.nasa.gov/planetary/planetfact.html>

³Initial condition for the PATH program calculation

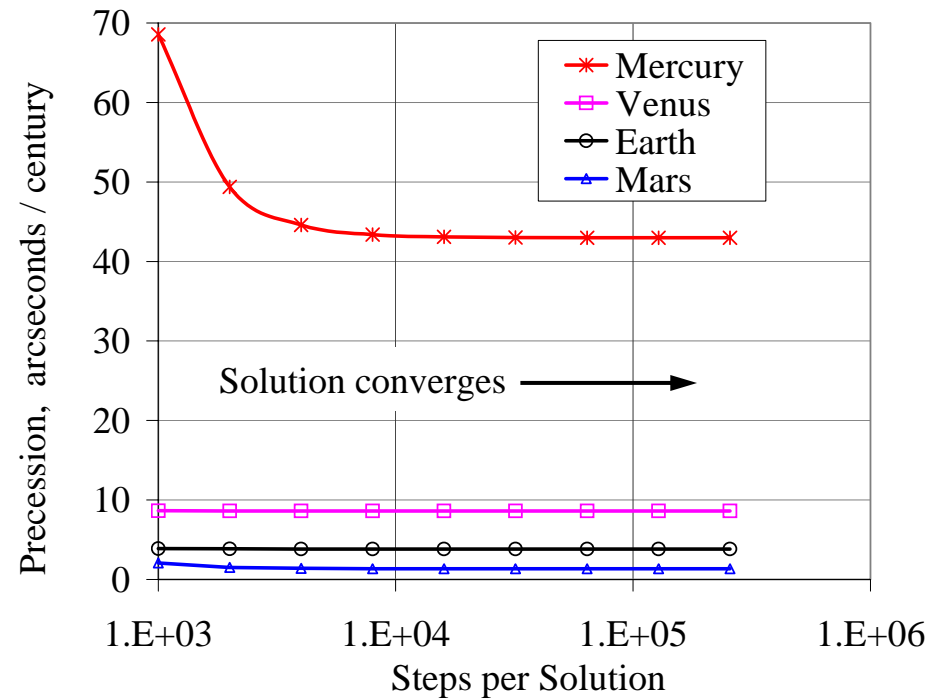
We Can Use Wave Propagation to Predict the Orbital Precession of Planets

Orbital precession is a fundamental characteristic of wave propagation.



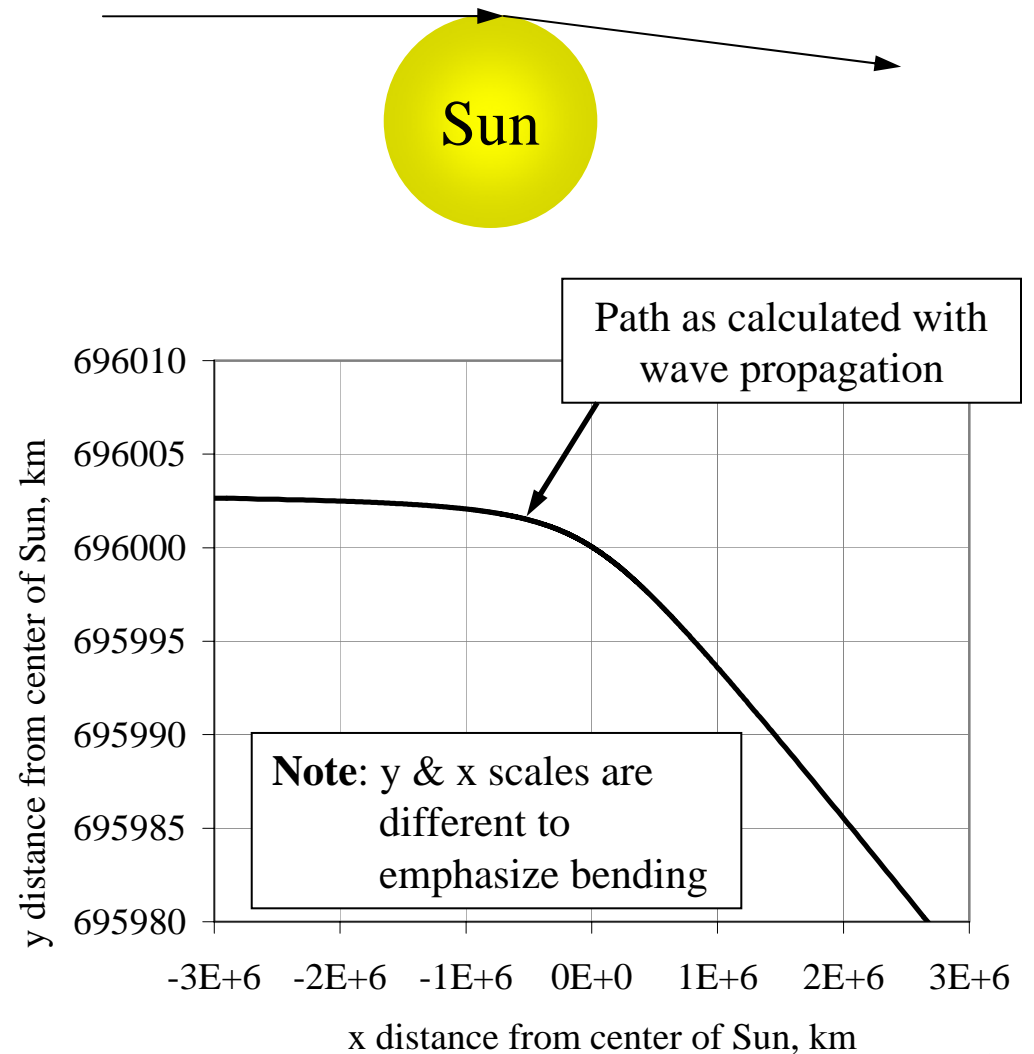
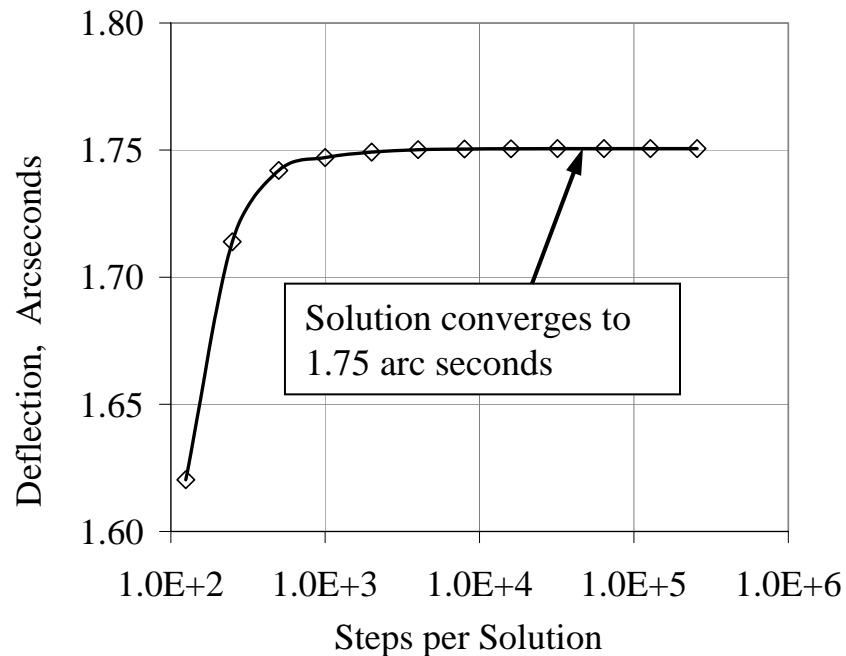
Orbital Precession, arcseconds / century		
Planet	Calculated ¹	Observed ²
Mercury	42.987	42.56 ± 0.94
Venus	8.625	8.4 ± 4.8
Earth	3.839	4.6 ± 2.7
Mars	1.351	1.5 ± 0.04

¹ Calculated with the PATH program using 256000 steps
² V.M. Blanco and S. W. McCuskey (1961) *Basic Physics of the Solar System*



Wave Propagation Accurately Predicts the Bending of Light by a Governing Body

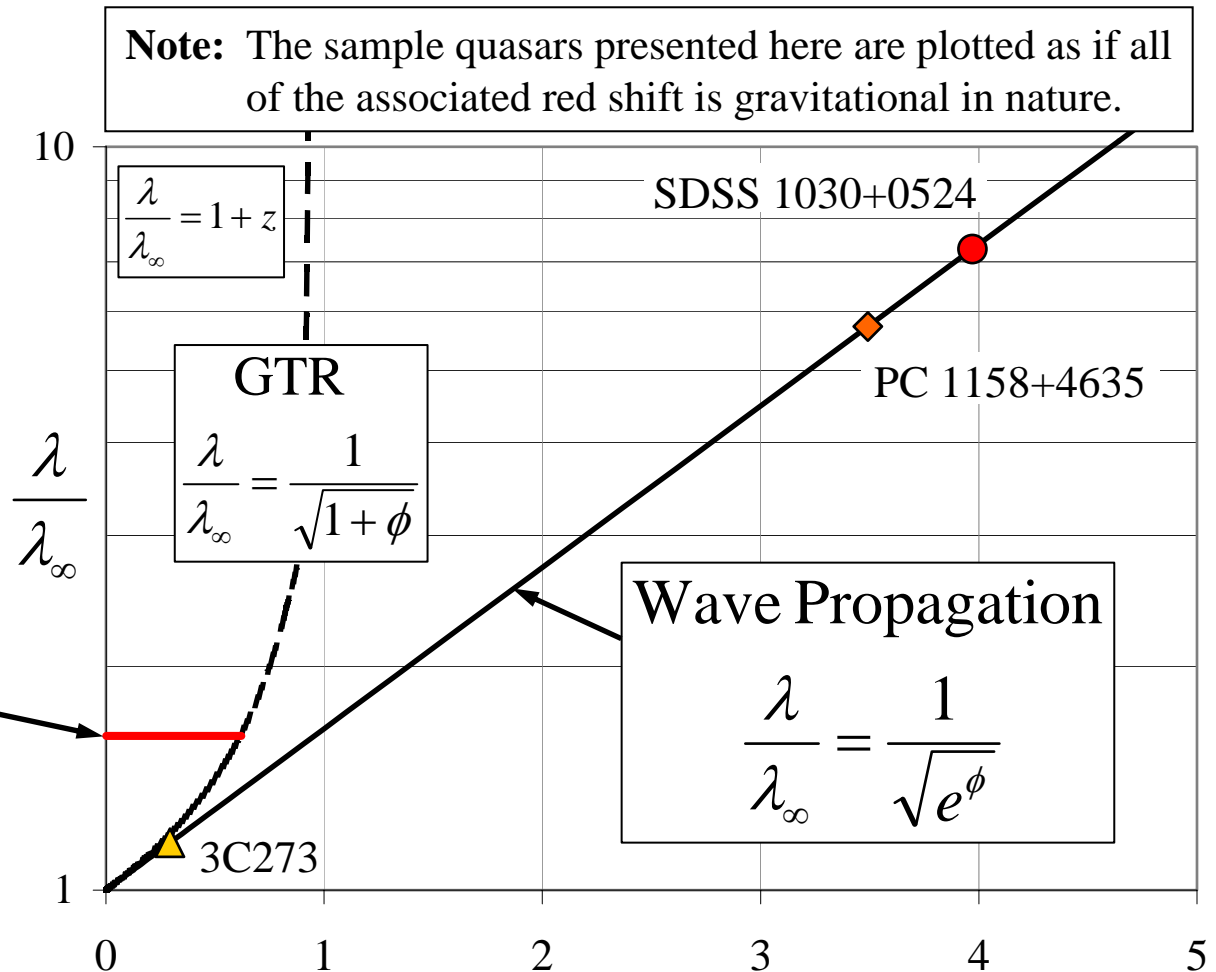
Wave propagation predicts that light will bend in the Sun's gravitational field by up to 1.75 arc seconds.



Wave Propagation Provides a Gravitation Explanation for the Red Shift of Quasars

Based on wave propagation some or most of the red shift associated with quasars can be explained in terms of the influence of gravity.

Limit calculated by Hermann Bondi for the General Theory of Relativity beyond which a black hole is predicted.



λ_{∞} = Wavelength of photon emitted by M as measured at $r = \infty$

λ = Wavelength of photon created at $r = \infty$

$$-\phi = \frac{2GM}{c_s^2 r}$$

Conclusions

- Gravity can be described as the influence of a governing body on the wave propagation of matter through space.
- The wave propagation method:
 - Satisfies the correspondence principle by providing an accurate model of the motion and natural frequency of matter.
 - Provides a simple description of gravity that is compatible with wave mechanics as illustrated in the book Time, Matter, and Gravity.
 - Predicts the Lorentz-Fitzgerald contraction and the null result of the Michelson-Morely experiment.
 - Predictions are similar to general relativity in weak gravitational environments.
 - Provides a gravitational explanation for the red shift of quasars. As explained by Hermann Bondi, this cannot be done with general relativity.

The full derivation of this approach along with an EXCEL spread sheet of the numerical method is available - email request to morris.anderson@honeywell.com

Summary

- We have accomplished our first two objectives by defining the meaning and characteristics of time and by defining a standard unit of matter in terms of light.
- We have achieved our third objective by explaining why motion and gravity influence the natural frequency of matter. We have also shown that this explanation is in agreement with experimental evidence.
- Finally we have achieved our fourth objective by explaining what gravity is and developing a method for predicting the motion of matter.
- We have presented a concept of time, matter, and gravity that is useful in understanding how things work. Specifically we have demonstrated that:
 - The foundation of definitions and postulates presented in this work provides an effective framework for explaining the laws of nature.
 - The Position Definition of Time provides a sound basis for understanding the behavior of matter.

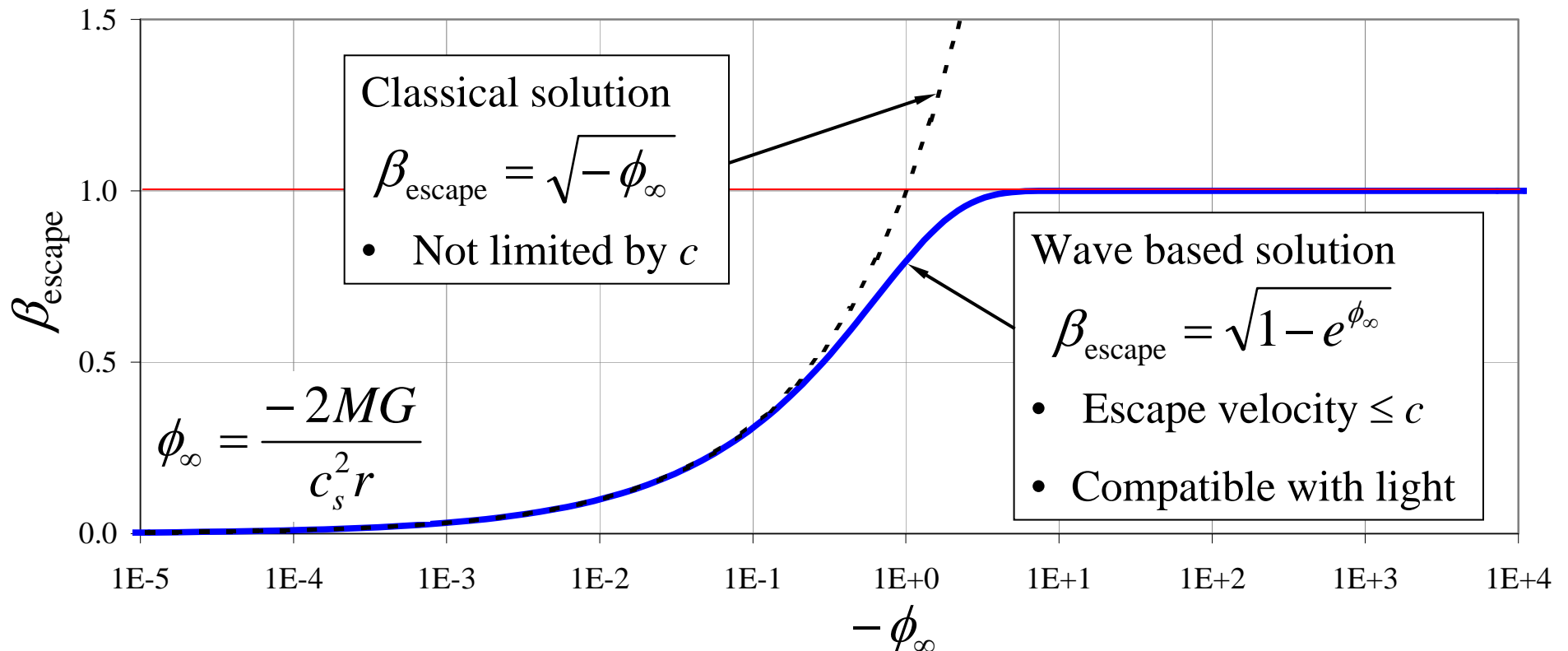
Summary - Continued

- The units of time, length, and matter can be defined in terms of light.
- We can model the influence of a governing body on its surroundings as a distortion in space that causes the speed of light to be a function of position.
- Mass, charge, and natural frequency are proportional to the square root of the speed of light.
- We can model the wavelength of interaction as a function of the momentum of interaction.
- A particle can be modeled as a standing electromagnetic wave.
- The force of gravity and the motion of matter in the form of photons, baseballs, and planets can be described in terms of wave propagation.
- An EXCEL spreadsheet has been created with these equations for predicting motion in a gravitational field. You can download it at: <http://anderson.morris.home.att.net/>

Backup Charts

The Laws of Motion and Gravity Must Be Compatible With Light

We can calculate the escape velocity for any wave of matter from a governing body if we modify the classical laws of motion and gravity to be compatible with the nature of light as outlined in the book *Time, Matter, and Gravity*.



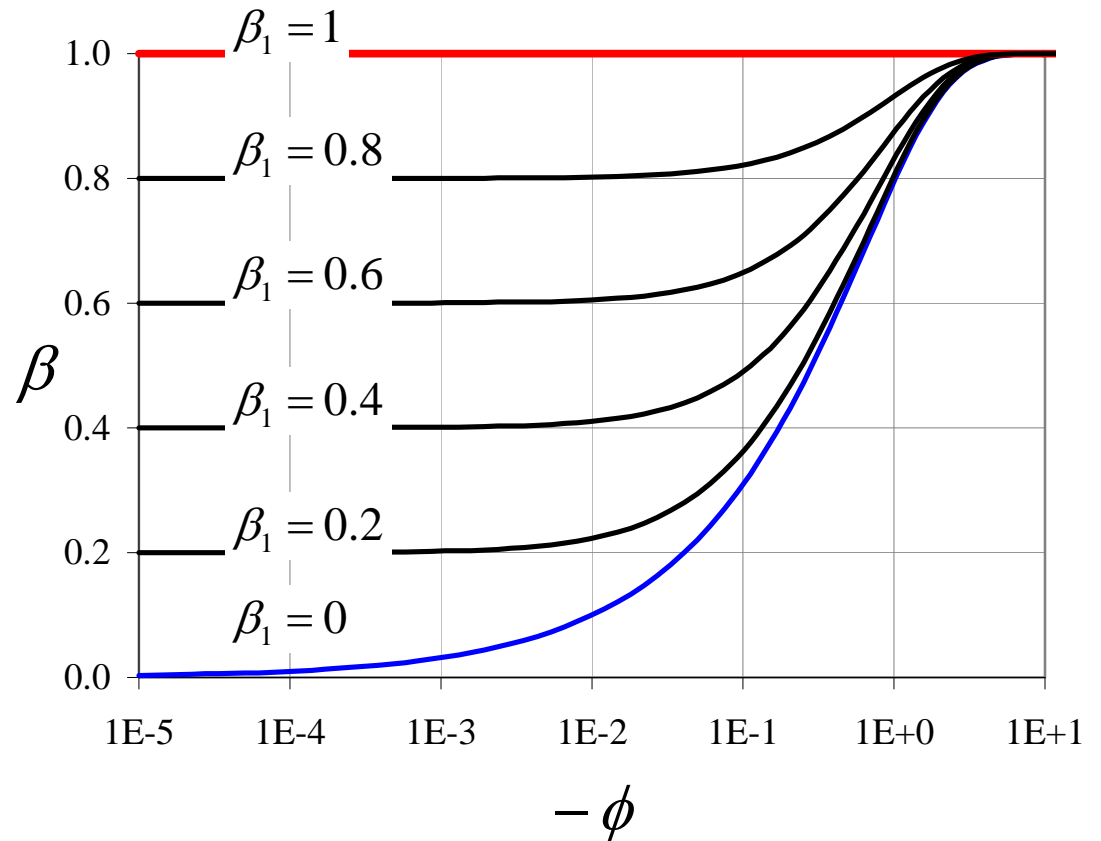
The Velocity of Matter Moving Through a Gravitational Field Is a Function of Position

We can show that the ratio of the velocity of matter to the speed of light changes as it passes through the gravitational field of a single governing body as follows:

$$\beta = \sqrt{1 - e^{\phi} (1 - \beta_1^2)}$$

Where:

$$\phi = \frac{2MG}{c_s^2} \left(\frac{r - r_1}{rr_1} \right)$$



The Wave Propagation Method Leads to a Natural Logarithmic Based Red Shift

