# How Einstein's Mindless Mathematical Laws Fail to Lead to a Rational Explanation of the Pound-Rebka Experiment

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**Abstract**

***When Einstein first used his equations to predict the transverse gravitational red shift of photons and the gravitational slowing of clocks, the effect was so small that it seemed impossible to measure. It was not until four years after his death that the effect was finally accurately measured in the laboratory. In 1959, Robert Pound and Glen Rebka made very accurate measurements of both red and blue transverse Doppler effects in the momentum of gamma ray photons produced by vertical differences in gravitational escape/surface velocity $_{es}V$ between the top and bottom of Harvard's Jefferson Tower. The measured values of this experiment do not support Einstein's downward pointing theory of gravity.***

Once Pound and Rebka had measured the gravitational transverse Doppler shift exactly as Einstein had predicted it, his followers immediately proclaimed this measurement validated his theory of the equivalence of gravity and inertia. The problem is that even though Einstein believed gravity and inertia to be equivalent, relative, and unmeasurable, Pound and Rebka measured inertia and gravity to be equal, absolute, and measurable. Einstein's calculations for the effect were correct, but his assumptions of equivalent downward force and motion was not validated by the measurements.

## Gravitational Time

Experimental physicists measure two distinct and units of time. Measurements of photon time intervals are usually separate from measurements of gravitational time intervals. Because these two time flows move in opposite directions and are many orders of magnitude apart, all measurements of time intervals record either intervals of photon time (seconds) or intervals of gravitational time (years). Photon time is based on the speed of light and gravitational time is based on the speed of gravitational force. The Pound-Rebka experiment was probably the first measurement of time to combine and compare the opposite flows of photon time and gravitational time into equal measurements.

## Doppler Shifts

In the process by which an atom emits or absorbs a photon, the photon undergoes two separate Doppler shifts depending on the quantity and direction of the atom's absolute motion. First, the photon has a transverse Doppler shift based on the absolute quantity of the atom's momentum vector relative to the zero momentum frame of the universe. This transverse shift has the same value in all directions and is always a red shift for emitted photons and a blue shift for absorbed photons. A body's transverse shift causes emitted photons to be red shifted because as the atom's clocks slow, it takes longer to emit photons. Absorbed photons are blue shifted because slower clocks absorb photons in smaller intervals of time.

The photon also has a separate external direct Doppler shift that is either a red or blue shift de-

pending on the atom's vector of absolute motion relative to the universal position of photon rest. These two shifts are combined by the observers to measure their relative velocity with a source. Direct Doppler shifts are different for each direction. Only atoms at absolute zero momentum rest emit and absorb photons with no transverse or direct Doppler shifts.

## The Pound-Rebka Experiment

The mechanical details of Pound-Rebka are quite simple. Fe-57 crystals were used as very high momentum gamma photon emitters and absorbers to measure both red and blue Doppler shifts. Shifts in photon momentum are separately measured as both transverse and direct Doppler effects. These Fe-57 crystals are like atomic clocks that precisely measure the speed of both photons and the velocity of gravity.

The experiment uses accelerometers and linear actuators to measure and compare changes in the linear momentum of both photons and the upward gravitational transverse momentum at Earth's surface. The measurements clearly show that the motion and force of photon time is both opposite and complementary to the velocity and force of gravitational time.

## The Lorentz Transformations of Mass and Time

$m' = M/\sqrt{1-v^2/c^2}$ & $t' = T/\sqrt{1-v^2/c^2}$ *The mass m' and intervals t' of a moving clock are equal to rest mass M and interval T divided by the square root of one minus its velocity squared divided by the speed of light squared.*

When a body is accelerated relative it its intrinsic position of rest, its mass is increased and the internal clocks of its atoms are slowed down. These increase in mass and length in clock intervals are proportional to the body's absolute momentum.

Transverse Doppler shifts result from a body's change in momentum. To conserve angular momentum, the atom's clock slows as its momentum is increased. A clock at rest has no momentum and has its shortest possible recorded intervals of T = 1 sec. At 1/2c, a clock's mass increases to m' = 1.15 and its recorded intervals increase to T = 1.15 sec. By using the Mossbaurer effect, Pound and Rebka were able to measure changes in photon momentum and intervals of time as small as .0000000000000025 sec.

The transverse Doppler shifts that Pound and Rebka measured at the top of the tower resulted from the differences in the Lorentz transformation of momentum between the slower escape/surface velocity $_{es}V$ at the top and the faster velocity at the bottom. The difference in the Lorentz momentum transformation between escape/surface velocities at the top and bottom produces a transverse Doppler shift of $2.5 \times 10^{-15}$ in photons and clocks.

## Pound-Rebka Theories

Ever since the Pound-Rebka experiment was first performed in 1959, a number of gravitational theorists have tried to use their own downward pointing theories of gravity to explain the measurements in terms of gravitational fields, potential energies and other unmeasured metaphysical entities like aethers and spacetime dimensions.

Relativity theorists claimed Einstein's equivalence principle had been validated along with the rest of his general theory of relativity. The problem was that there were opposing camps within general relativity proponents that calculated the same values for the measured shifts but

offered different equations and completely different metaphysical mechanisms to explain them.

These theorists ignore upward gravity measurements and claim that as photons move through varying gravitational potentials, they either gain or lose momentum to the field and thus change their wavelengths while in flight. Some general relativists even claim that all photons throughout the universe are constantly being red-shifted as they pass through expanding and curving gravitational spacetime potentials. Cosmologists use this assumption of a curving and expanding gravitational medium to explain the red-shifted Hubble photons from distant galaxies as peculiar non-motion induced Doppler effects in which photon momentum and energy are not conserved.

They also use this assumption of curving and expanding space to explain their proposed cooling theory of the universe in which the temperature of the Cosmic Blackbody Radiation is believed to have cooled from an initial temperature of 3000°K to its present 2.7°K. The enormous amount of momentum and energy lost in this cooling process is claimed to have just vanished into the "fabric" of this expanding spacetime. The cosmologists primary justification of this expanding spacetime assumption is meant to be the ultimate solution to Olbers' dark sky paradox. Surely, if the CBR photons had not cooled from 3000°Kelvin by expanding spacetime, we would today all be vaporized.

One major problem with general relativity enthusiasts is that they are unable to make up their minds. Either gravity's expanding spacetime shifts a photon's momentum in flight or it does not. Quantum electrodynamics has established that Doppler shifts only occur at the emission and absorption of photons yet there is a substantial group of general relativists who claim photons are Doppler shifted when they travel through spacetime continuum fields. Other theorists imagine waves of gravitons interacting with the photons to change their momentum and even their velocity at c, but there is no direct evidence for any of these metaphysical assumptions.

While some of the Pound-Rebka experiment's details are technically complex, the measured results are simple and straightforward direct and transverse Doppler shifts of photons and atomic clocks. The downward pointing gravity theories of Newton and Einstein are not validated in any way verified by these measurements. Photons are measured to interact with gravity's upward motion. The downward force of gravity exists only in Einstein's wildest imagination. To justify this, he once said that "Imagination is more important than knowledge".

Gravity has long been considered as a magical, forceless, and equivalent downward acceleration but Pound-Rebka clearly demonstrates it to be an equal combination of upward acceleration and downward deceleration. The upward force of gravitational acceleration is balanced by the deceleration of gravitational time. Falling bodies do not change their momentum until they encounter the upward momentum of Earth's surface. Photons do not change their momentum or wavelength until they are reflected or absorbed by atoms. The experiment measures the gravitational expansion of Earth's mass, space, and time and its interaction with the motions of photons.

All of Pound-Rebka's physical measurements of motion and force are purely mechanical calculations of momentum. There are only three *mindless mathematical laws* used in this explanation. One for the momentum of matter ($F = ma*d$), one for the momentum of photons ($p = mc$) and one for the relationship between matter and photons ($h = m\lambda c$).

*Force is equal to mass times a combination of acceleration and deceleration relative to Earth's surface and photon momentum is equal to their mass times the speed of light relative to zero momentum photon rest. Planck's constant h is the mass of any photon times its wavelength times the speed of light. The value of Planck's constant h = 6.6260755 x* $10^{-34}$ *is the mass in kilograms of a photon with a wavelength of one meter or the wavelength in meters of a photon with a mass of one kilogram.*

## The Nature of Photon Momentum

This explanation of Pound-Rebka is not in any way meant to be a theory of photons. The photon model used in this description is strictly a generic photon derived from simple photon measurements. Regardless of what your theory of the photon might be, you must use these same measured values of momentum and wavelength to quantify your version of the photon. It makes no difference whether you believe the photon to be a massless wave of "pure momentum and energy" or a mass particle with the kinetic energies of its motions. Whether or not the photon has mass is irrelevant to this experiment. Any body's rest mass is a calculated quantity that is only implied through the measurement of its momentum vector. Momentum is a relative quantity and we can never measure a photon's exact mass or energy because we cannot separate the Doppler effects of its absolute momentum of (mc) from its relative momentum of (mv).

The only photon parameters measured in the Pound-Rebka experiment is its calculated intrinsic momentum p = mc relative to its measured momentum p = mv. All theories of the photon use momentum as its primary parameter of measurement, as do all theories of matter consider momentum as the primary parameter in the measurement of mass.

## The Mossbauer Effect

Atoms emit photons that travel an unlimited distance at c until other atoms either absorb or reflect them. Atoms reflect most photons and can only absorb a limited number of wavelengths. In the shorter wavelengths like X-rays and gamma photons only a very limited number of wavelengths can be emitted and absorbed by a particular atom. As the momentum and energy of photons increase, atoms can absorb fewer and fewer photons until finally they can get down to the point where they can only emit and absorb a single photon of a very precise wavelength.

In the case of the Pound-Rebka measurement, the atom used is a radioactive isotope of Iron (Fe-57) and the photon is a green gamma photon that has a momentum of p = 1, energy $e = p^2$, and wavelength of $\lambda = 1/mc$. A Fe-57 atom at rest can only emit or absorb this single photon. When one of these green photons travels from the bottom of the tower to the top, it maintains its momentum of p = 1. When it gets to the top of the tower with its lower escape/surface velocity and faster Fe-57 clock, it cannot be absorbed because the faster Fe-57 atom can only absorb and emit blue photons.

When two of the Fe-57 crystals used in the Pound-Rebka experiment are placed apart horizontally on level ground, they are each able to readily absorb the p = 1 "green" photons emitted by the other. However, if either crystal is put into even a slight amount linear motion, all absorption of p = 1 photons stops. When Pound and Rebka placed two Fe-57 crystals apart vertically in the Jefferson Tower, there was no photon absorption at either the top or bottom crystal even though they appeared to be at rest and maintained an exact vertical distance of 22.5 meters.

## Linear Actuator Measurements

The cause of the shift in photon momentum is the differences in transverse momentum of the Fe-57 clocks at top and bottom. In order to make the transverse blue shifted Fe-57 atoms at the top of the tower absorb the green photons from the bottom, it was necessary to put the bottom emitter on a very slow linear actuator that can move upward at a precisely set velocity of V = 1. This is the velocity that gravity accelerates to in the time it takes for a photon to move from the bottom to the top. As the actuator speeds up to this velocity, it creates a direct blue Doppler shift in the emitted photon that matches the transverse blue shift at the top receiver.

In the case of photons moving from the top emitter to the bottom receiver, the linear actuator was set to move the Fe = 57 atoms downward at V = 1. This relative velocity red shifts the top blue photons to green so they can be absorbed by the bottom receiver. These measurements show that direct Doppler shifts are caused by relative motion and transverse Doppler effects are caused by absolute motion.

## Gravitational Expansion of Mass, Space, and Time

When we measure and calculate the physical mechanics of gravitational motion and force with Newtonian accelerometers and Fe-57 clocks we logically and philosophically arrive at the gravitational expansion of mass, space and time. This is not a theory of gravity because it makes no assumptions other than the accuracy of measuring instruments. Any "theory" of gravity must present metaphysical assumptions to show the physical measurements of upward gravitational motion and force to be false. Gravitational expansion is a principle of measurement that details how we feel the force of gravity with our bodies and what gravity does and looks like when we measure it.

## Field and Particle Theories of Gravity

There are several basic theories of gravity and each uses different mindless mathematical laws to explain how the Pound-Rebka device actually works. All of these gravity theories can be divided into two basic ideas: particle theories and field theories.

While some theories use just one of these imaginary concepts, general relativity theorists use calculations that allows the momentum of particles, waves and fields to be equivalent so they can be used interchangeably in its descriptions of the dynamics of gravitational force and motion.

In some field theories of gravitational force, it is assumed that a universal gravitational spacetime continuum field causes clocks to run faster at the top of the tower than at the bottom and that photons remain unchanged as they move between them. In other field theories, clocks remain stable and photons are red and blue-shifted as they move in different directions through gravitational fields. In particle theories, numerous tiny particles called gravitons interact with the gamma photons to change their intrinsic momentum and wavelength. In other theories, the particles take the form of tiny waves within the gravitational field that causes it to "curve" and produce unmeasured downward force and motion that is equivalent to the upward motion and force of gravity that we all feel and measure. In some theories, each graviton either adds or subtracts momentum from each photon it encounters.

The Harvard theoretical physicists from where the Pound-Rebka experiment was preformed, believe that as long as their mathematical equations accurately quantify the measurements, it is

not necessary to propose an actual physical mechanism to explain how it all works. What they say is, "Shut up and calculate". Motion is relative and gravity is equivalent and no other physical explanations are required to explain their correct calculations.

The crucial philosophical problem with all gravitational field and particle theories is that no fields or gravitational particles have ever been detected and measured and the physical problem with all these theories is that they completely ignore the actual experimental measurements of the upward pointing gravitational motion and force that are made with accelerometers and felt with our sense of balance.

Since both direct and transverse Doppler shifts occur at emission and absorption of photons, it is generally impossible to completely separate the individual components of a measured Doppler shift. The Pound–Rebka experiment is the one case where it is possible to precisely separate red and blue direct Doppler shifts from red and blue transverse Doppler shifts.

## The Deceleration of Gravity

The force we measure with an accelerometer usually produces an unknown combination of absolute acceleration and deceleration. F = ma*d. With the Pound-Rebka experiment, we are able use Doppler shifts in gamma photons to precisely measure the difference between the acceleration and deceleration of gravity.

General relativity is a metaphysical theory because it completely ignores the actual physical measurements of gravitational motion and force. It is based on equivalent force and acceleration that produce none of the changes in motion that we measure with accelerometers. What Newton and Einstein failed to understand was that there is no way for an accelerometer to distinguish between absolute acceleration and deceleration and that their equivalent acceleration of gravity was actually measured to be a combination of deceleration and acceleration. Gravity is an acceleration/deceleration dichotomy that is equal and opposite but not equivalent. The problem with both special and general relativity is that they never embraced deceleration as being the real and distinct equal to acceleration. If motion is assumed to be relative, there can be is no physical distinction between acceleration and deceleration. One of the measured distinctions that relativity has acknowledged but not explained is that acceleration causes an increase in mass and clocks to slow while deceleration causes mass to decrease and clocks to speed up.

## The Fantasy of Equivalent and Relative Motion

Physicists often tout the Pound-Rebka result as an actual measurement of the hidden gravitational potential produced by the curvature of gravitational space that is calculated and predicted by general relativity's equivalence principle.

The only space that is measured to curve is not the metaphysical four-dimensional external spacetime continuum space surrounding atoms but rather the three-dimensional internal gravitational space defining the shape and intrinsic inertial expansion of atoms.

The gravitational expansion of mass, space and time is the true local measure of gravitational motion and force and it extends only to the surface of each atom or to the edge of each body of mass. No measurement has ever been made of a downward occult gravitational force field or attraction existing far beyond the locality of matter.

All such fanciful ideas about a downward pull of gravity may be philosophically, psychologi-

cally and emotionally pleasing fantasies to the relativity theorists but, in reality, a downward pull of gravity is nothing more than the purest of metaphysical speculation. The simple true nature and cause of gravity revealed by the Pound-Rebka experiment is that Earth falls up with a constant upward velocity that is accelerating and decelerating at the same time.

## Einstein was Right even Though He was Wrong!

The principle of the gravitational expansion of mass, space, and time does not dispute any of Einstein's 100% correct calculations and measurements of natural phenomena. The problem is in the upside down, backwards, and inside out assumptions he used to make the calculations.

The most important principle of the scientific method of physical measurement is the temporal direction of cause and effect. Momentum's direction in time is always measured from cause to effect. In the equivalence principle, the direction in time of cause and effect is turned upside down. Equivalent gravitational force becomes the cause and equivalent gravitational motion becomes its effect.

For the cause of a falling body's unmeasured downward gravitational acceleration, Einstein calculated an unmeasured downward force appearing from his assumption of a gravitational field. His only measurement was non-directional relative motion between the falling body and Earth's surface. The principle of gravitational expansion uses measured upward gravitational force to calculate the upward motion that accelerates Earth's surface toward the stationary "falling" body. While both calculations yield correct results, the gravitational expansion calculations are based on directional accelerometer measurements and Einstein's predictions are based on metaphysical ideas of motion that ignore the direction of physical measurement. Einstein effectively tried to reverse the direction of time for the scientific method's principle of cause and effect.

The proper form of Newton's equation F = ma for cause and effect is F = md. *Force is equal to mass times deceleration*. The difference is that F = ma is a physical principle of measurement and F = md is the philosophical principle for the direction of cause and effect. Force can only be produced when the momentum of one body is decelerated to increase the momentum of a second body. Force is a momentary effect of the cause of momentum transfer.

These equations represent the cause and effect relationship between momentum and force. Force is never the primary cause of acceleration of mass. It is the transfer of momentum between bodies of mass that causes the effect of force. Momentum exists as a timeless unmeasurable conserved quantity but force only exists as a fleeting measure of time in the transfer and conservation of momentum between moving bodies of mass. Force is the momentary interaction when the momentum of one mass is decelerated to increase the momentum of a second mass. The deceleration of a body of mass is the cause of force and the accompanying acceleration of another mass is the effect of force.

## Conclusion

The principle for the gravitational expansion of mass, space, and time is validated by the Pound-Rebka experiment and Einstein's theory of the equivalence of gravity and inertia is not.

Observer #1 measures green photons absorbed and emitted from his Fe-57 clock to have a momentum and wavelength of p = 1 and λ = 1.

At the top of the tower, observer #2 measures these green photons at p = 1 and λ = 1. However, he thinks of them as red-shifted because they are not absorbed by his top Fe-57 crystal clock that only absorbs and emits blue photons with a momentum of p = 1.0000000000000025. When the linear actuator at the bottom is turned on and set to move upward at a velocity of V = 1, these green photons are direct Doppler shifted to blue and are then absorbed by the faster running Fe-57 clock at the top.

Top observer #3 measures blue photons emitted and absorbed by the faster top clock to have a momentum of p = 1.0000000000000025.

Bottom Observer #4 measures transverse blue shifted photons from the faster top Fe-57 clock to have a momentum of p = 1.0000000000000025. These blue photons are unable to be absorbed by the bottom Fe-57 crystal that can only absorb p = 1 green photons. When the red shift linear actuator is turned on and set to move downward at V =1, these blue gamma photons are red shifted to green and can then be absorbed by the slower bottom Fe-57 crystal clock.

This measurement process involves both transverse Doppler shifts and direct Doppler shifts. Transverse shifts prevent the photons from being absorbed and the blue and red direct Doppler shifts of the linear actuators allow the photons to be absorbed by the Fe-57 atoms.