ON THE ORIGIN OF EVERYTHING

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The Physical Model of Light, Matter, and Gravity

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Disclaimer

This book presents an independent physical model of light, matter, and gravity. It is written for general discussion and exploration. It is not a textbook, professional scientific advice, or a replacement for established scientific references. Standard theories and historical figures are discussed for context, and readers are encouraged to compare the ideas in this book with accepted research, experiment, and observation.

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INTRODUCTION

"Although I am fully convinced of the truth of the views given in this volume ... I by no means expect to convince experienced naturalists whose minds are stocked with a multitude of facts all viewed, during a long course of years, from a point of view directly opposite to mine. ... But I look with confidence to the future, to young and rising naturalists, who will be able to view both sides of the question with impartiality." Charles Darwin, On the Origin of Species (1859)

Physics works. That is the strangest thing about it.

We can predict the motion of planets, calculate the behavior of atoms, and track particles that exist for only a fraction of a second. We build technologies that would have seemed impossible just a few decades ago. Modern physics is the most successful predictive system ever developed.

If you ask what gravity does, physics has an answer. If you ask how to calculate it, physics has an answer. If you ask how atoms behave, physics has answers for that too. But if you ask what is physically happening beneath the math, the answers become less certain.

What is light? What is a photon? What is matter, and how does it remain stable? What causes particles to behave as they do? And my favorite question: How does gravity work?

Mathematics predicts what we will observe. It does not always tell us what physically happens to produce it.

This concern is nothing new. Newton was troubled by the idea of gravity acting across empty space without a physical cause. Faraday searched for the physical mechanisms behind the forces he observed. Einstein spent decades looking for a deeper understanding of quantum theory and never accepted probability as the final answer. Schrödinger questioned what his own wave equation said about physical reality. These were not critics standing outside of physics. They helped build it, and they knew that prediction was not the same as understanding.

That same gap between prediction and physical understanding still exists today. For centuries, books and papers have pointed to unanswered questions, challenged old assumptions, and identified places where our theories remain incomplete. But far fewer have taken the next step: trying to build a physical model of what might actually be happening beneath the mathematics.

This book begins with one premise: The universe is a physical place filled with physical events, and those events must have physical causes. If a photon strikes an electron, something happens between them. If atoms remain stable for billions of years, something maintains that stability. If gravity acts across space, some process must carry that influence.

This book does not reject mathematics. The equations work. The question is what those equations are calculating. What physical events produce the patterns we observe?

The search begins with the question that runs through every chapter of this book:

What is physically happening?

The Black Box

Imagine a small black box sitting on a table. It is completely sealed, with one hole on top and a narrow slot across the bottom. Drop red marbles into the hole one at a time, and they roll out through the slot at different points, gradually forming a pattern.

Now drop green marbles through the same hole. A different pattern appears, shifted and stretched from the first. Try blue marbles, and another pattern emerges. Each color produces its own result, as though something inside the box responds differently to each marble.

No one can open the box. Years pass, experiments are repeated, and measurements become more precise. Eventually, people learn to predict exactly which pattern every color will produce. The equations work, and the predictions keep coming out right.

After a while, it becomes known as the most successful theory ever developed.

But every now and then someone raises their hand and says:

“Wait a minute. Something real and physical is happening inside that box.”

Maybe there are gears, levers, or channels guiding the marbles. Maybe there is a mechanism no one has imagined. Whatever the answer may be, the patterns cannot be creating themselves. Don't you want to know what's happening?

The usual response is: Why worry about what happens inside the box? We already know what comes out.

But knowing the result says nothing about the mechanism that produced it. Common sense tells us that something inside the box must be sorting the marbles and directing their paths. The equations may calculate the results perfectly, but they should lead us toward the process, not stand in its place.

Physics has grown comfortable with sealed boxes. When order appears in the results, there must be order in the events that produced them. Predicting the pattern is a great achievement. Discovering what creates it is the next step.

Opening the box is not a distraction from physics. It is physics.

The Search for Unity

Science has always moved forward by finding connections that were hidden before. Again and again, things that once seemed completely separate turned out to be different parts of the same physical process.

Newton showed that a falling apple and the orbiting Moon obeyed the same law. Faraday and Maxwell brought electricity, magnetism, and light into one unified theory. Einstein connected space and time and described gravity as the geometry of spacetime.

Each advance moved science toward greater unity. Nature can look complicated when its parts are studied separately. As knowledge grows, those separate parts sometimes turn out to be different expressions of the same process.

Some of the biggest questions in physics are still unanswered. Light, matter, charge, and gravity are still treated as separate problems, each with its own theories and mathematics. And with each generation, science passes on assumptions from the one before it.

Through the centuries, some of those assumptions become so familiar that we stop questioning them at all.

One of those assumptions is that light, matter, charge, and gravity are all fundamentally different things. But what if they are not? What if they are different results of the same physical process working at different scales?

If a mechanism like that exists, it should appear throughout nature, and one of the first clues is a pattern found almost everywhere we look.

A Common Signature

The inverse-square law shows up everywhere in physics. Gravity gets weaker with the square of the distance. Electric forces do the same. Radiation spreading outward from a point source thins according to the same geometric rule.

That should make you think.

Newton found the inverse-square relationship in gravity. Coulomb found the same mathematical relationship in electric force. Radiant energy spreading through space follows the same geometry. Across different centuries and different areas of physics, the same pattern kept showing up.

The similarities don't stop there. Light and gravitational disturbances both travel at the same measured speed even though physics treats them as completely different things. So why do these same patterns keep showing up? Are they coincidences, or are they signs of one physical process working in different ways?

That question is at the heart of this book. If a common process exists, it should be physically real. It should be happening everywhere, crossing the room around you right now and filling the space between galaxies.

This book argues that such a process exists.

We will start with the physical questions. What is happening? What is moving? What interacts? What produces the forces, structures, and patterns we observe?

The book is divided into three main parts: LIGHT, MATTER, and GRAVITY. Light comes first because it gives us a good place to start. Deciding whether MATTER or GRAVITY should come next was harder, because the two are closely connected. I chose MATTER first, followed by GRAVITY.

From there, the book keeps asking the same basic question: Can one physical process account for what we see from the smallest particles to the largest structures in the universe?

The answer has to be built one step at a time, and this search begins with light.

PART I: LIGHT

Every cubic centimeter of the universe is filled with light. Photons cross the space between stars and galaxies, pass through the world around us, and carry information across distances so great that some have been traveling for billions of years before reaching us.

We know how to measure light, predict its behavior, and use it with incredible precision. But beneath all of that, one basic question remains:

What is light physically?

Part I begins with that question and follows the photon through the familiar behavior of light, asking whether all of it can be understood as the motion and interaction of one real physical particle.

CHAPTER 1: THE NATURE OF LIGHT

"Are not the rays of light very small bodies emitted from shining substances?"

—Isaac Newton, *Opticks* (1704)

Few questions have caused more confusion, disagreement, and fascination than this one:

What is light?

For more than three centuries, some of the greatest minds in science have taken a swing at it. Newton believed light was made of tiny particles. Huygens argued that it was a wave. Maxwell connected light with electricity and magnetism. Einstein later brought particles back into the picture. Quantum mechanics kept both answers, treating light as a particle in some situations and a wave in others.

With each discovery, some things fell into place while others stopped making sense. Even now, the question remains difficult to answer in physical terms.

What is moving from a distant star to your eye?

Over centuries of experiments and debate, one thing kept showing up. No matter how successful the wave model became, light still behaved like something small and localized. It carried energy from one place to another, arrived at specific locations, and interacted with matter one event at a time. Again and again, the evidence seemed to point to something physical actually traveling through space.

The wave theory dominated physics through the nineteenth century and well into the twentieth, and for good reason. It accounted for things Newton's particle model could not and made predictions that matched experiments with great accuracy. But even with all that success, it still told us more about how light behaves than what light actually is.

At the beginning of the twentieth century, Einstein reopened the question. While studying the photoelectric effect, he proposed that light transfers energy in localized packets, later called photons. Experiments confirmed that light carries energy and momentum in discrete amounts and is detected at definite locations.

That is where our story begins. Not by returning to Newton's corpuscles, but by asking whether the photon can give us the physical picture that has remained out of reach.

Before building that picture, we need to follow the path that brought us here.

Newton's Corpuscles

In 1665, the Great Plague forced Cambridge University to close, sending a young Isaac Newton back to his family home in Woolsthorpe. Removed from lectures and academic routine, he spent much of his time conducting experiments and thinking about the natural world. During that period, he began investigating a question that had puzzled philosophers for centuries:

What exactly is light?

In one of his most famous experiments, Newton darkened a room, cut a small hole in a window shutter, and allowed a narrow beam of sunlight to enter. He then placed a glass prism in the beam.

The white light spread into a band of colors across the wall: red, orange, yellow, green, blue, and violet. Today, the result is familiar to anyone who has seen a rainbow. At the time, it raised an important question. Did the prism create the colors, or had they been present in the sunlight all along?

Newton answered with another prism. After separating the colors, he passed them through a second prism arranged to bring them back together. The spectrum returned to white light. The glass had not created the colors. It had separated something already present within the sunlight.

To Newton, light consisted of tiny bodies traveling through space. Different colors represented different kinds of light particles, each responding differently as it passed through glass. Reflection and refraction were physical interactions governed by direction, momentum, and geometry. Light was matter in motion: small, fast, and mechanical.

Figure 1.1. *Newton's prism experiment showing white light separated into its factor colors.*

The idea fit much of the evidence available at the time. For nearly a century, few scientists saw any reason to abandon it.

The Rise of the Wave Theory

Not everyone agreed with Newton. One of his strongest critics was the Dutch scientist Christiaan Huygens. Instead of seeing light as a stream of tiny particles, Huygens believed it traveled through space as a disturbance, much like ripples spreading across a pond.

There was an immediate problem. Ripples need water. Sound needs air. Every wave known at the time needed some medium to travel through. If light was a wave, what was it traveling through?

Huygens proposed that space was filled with an invisible substance that later became known as the luminiferous aether. The aether could not be seen or touched, but it gave light waves something to travel through.

No one knew what the aether was made of, and no one could detect it directly, but the wave model matched many observations, giving scientists good reason to take it seriously.

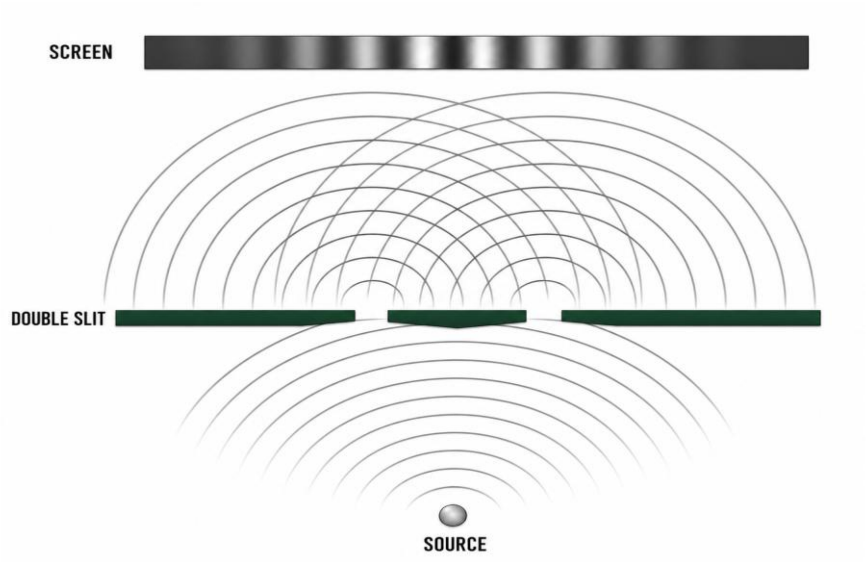

Figure 1.2. *Classic wave-interference illustration showing the bright and dark bands produced by Young's double-slit experiment.*

Then, in the early 1800s, Thomas Young performed experiments that would become some of the most famous in science. His original setup was somewhat different from the double-slit experiment we know today, but the basic result was the same: light traveling along two paths produced alternating bright and dark bands. The familiar double-slit version, shown in Figure 1.2, was difficult to account for with Newton's particles and became strong evidence for the wave theory. As the results were repeated and confirmed, Newton's particle theory gradually fell out of favor, and for much of the nineteenth century, the debate appeared settled.

The final push came from James Clerk Maxwell. During the 1860s, Maxwell brought electricity and magnetism together in one mathematical theory. His equations showed that changing electric and magnetic fields could travel through space. When he calculated how fast they would travel, the answer matched the measured speed of light.

The conclusion seemed hard to avoid. Light appeared to be an electromagnetic wave.

By the end of the nineteenth century, the evidence for the wave theory looked overwhelming. Newton's particle model seemed destined to become part of history, an early idea that had served its purpose and then been replaced.

But nature was not finished with particles.

The Light Bulb

No one was trying to overturn physics. They were trying to build a better light.

By the late nineteenth century, electricity was moving out of laboratories and into everyday life. Cities were beginning to glow after dark, and much of the excitement centered on the electric light bulb. It promised longer days, safer nights, and a new way of living.

Engineers were trying to make light bulbs last longer, shine brighter, and waste less energy as heat. But solving those practical problems led directly to a much bigger question:

How do hot objects release energy?

Everyone knew that hot objects glow. Heat a piece of metal and it begins to glow red, then orange, and finally white as its temperature rises. The changing color reveals how the outgoing energy shifts across the spectrum.

The practical question was easy to ask: How much energy is released at each frequency, and how does that distribution change with temperature?

Answer that correctly, and engineers could design a bulb that directed more energy into visible light instead of losing most of it as invisible heat.

Classical physics ran into a serious problem.

According to the theory, as an object got hot, it should release energy across a wide range of frequencies. But the calculations said that the higher the frequency went, the more energy should be released. Keep going to higher and higher frequencies and the predicted energy just kept increasing, with no limit, but that was not happening.

The problem came from a basic assumption. Classical physics treated energy as something continuous that could be divided into smaller and smaller amounts. It also assumed that a hot object could distribute energy among every possible frequency. The higher the frequency, the more possible ways there were for that energy to be distributed. Since there was no upper limit to frequency, the mathematics eventually predicted an unlimited amount of energy.

This became known as the ultraviolet catastrophe.

The name sounds complicated, but the problem was actually pretty simple. The theory said an ordinary hot object should pour out enormous amounts of energy at very high frequencies, especially beyond visible light into the ultraviolet and above. Real objects did not do that. A hot stove, a cup of coffee, or a glowing light bulb released a limited amount of energy in a measurable range of frequencies.

Nature had a limit that the theory could not account for.

Something about energy was still missing.

The Return

In 1900, Max Planck took on the ultraviolet catastrophe and found a mathematical solution that even he was not completely comfortable with.

Planck found that energy could not be exchanged in just any amount. The amount involved in each exchange depended on frequency. Lower frequencies involved smaller amounts of energy, while higher frequencies required larger amounts at once.

This changed the prediction completely. Instead of energy continuing to increase without limit at higher and higher frequencies, Planck's calculation produced what experiments actually showed. The radiation increased, reached a peak, and then fell off at higher frequencies.

Planck had solved the ultraviolet catastrophe mathematically, but an important physical question remained: Why did energy behave this way?

There is only so much energy available in excited matter. Higher-frequency radiation requires a larger amount of energy in each exchange than lower-frequency radiation. As the required amount increases, fewer exchanges can meet that requirement. At sufficiently high frequencies, the available energy is increasingly unlikely to support those larger exchanges.

Seen this way, the drop at higher frequencies begins to make physical sense. The energy available to matter is finite, and larger energy exchanges become progressively harder to support.

Planck had found a mathematical rule that worked, but he had not shown what was physically happening. That question would soon become even more important.

Figure 1.3 shows how the measured distribution rises to a peak and then falls away at higher frequencies.

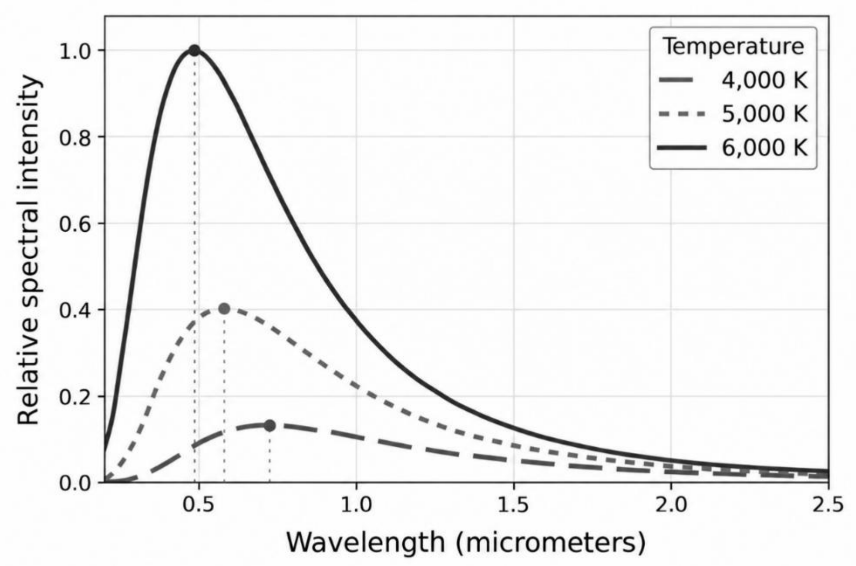

Figure 1.3. *Blackbody radiation curves showing how the peak shifts toward shorter wavelengths and higher frequencies as temperature increases.*

Planck had quantified the energy exchanged within matter. He had not claimed that light itself traveled through space as separate particles. At the time, the wave theory of light still stood.

Five years later, Albert Einstein took the next step.

When light strikes certain metals, it can knock electrons from the surface. This is known as the photoelectric effect. What mattered was not simply how bright the light was. Its frequency mattered.

Below a certain frequency, shining more light on the metal would not release an electron. Above the threshold frequency, electrons could be released even with relatively faint light. Increasing the brightness caused more electrons to be released, while increasing the frequency increased the energy of the released electrons.

Figure 1.4 shows that interaction as an individual photon transferring energy to an electron at the surface.

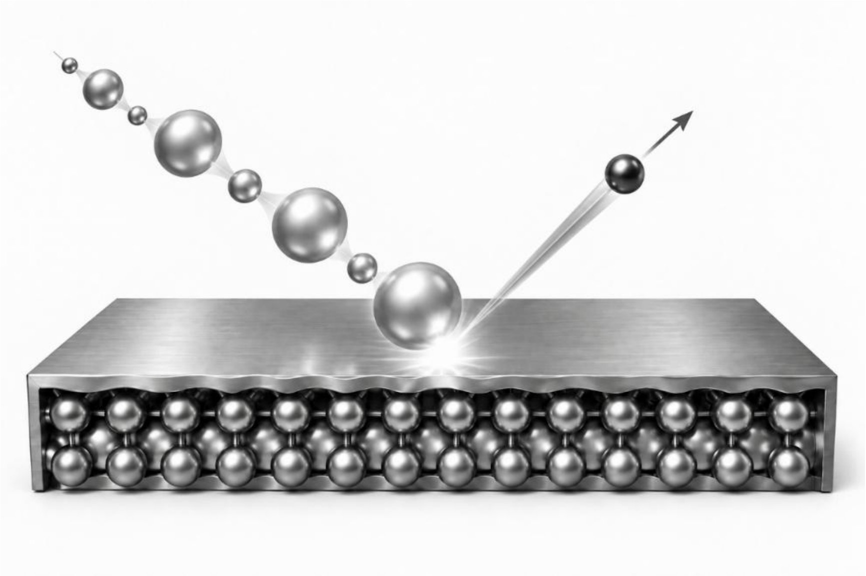

Figure 1.4. *The photoelectric effect, showing a photon transferring energy to an electron at a material surface.*

This was difficult to understand if light delivered its energy continuously across the surface. The metal behaved as though the energy arrived in separate amounts, with each amount depending on the frequency of the light.

Einstein took that idea seriously. He proposed that light itself came in individual packets of energy. Below the threshold frequency, a single packet did not carry enough energy to free an electron, no matter how many arrived. Above the threshold, a single packet could carry enough energy to do it. Brightness changed the number of packets arriving. Frequency changed the energy carried by each one.

Planck had found that energy was exchanged in discrete amounts. Einstein went further and proposed that light itself carried energy in those individual amounts.

More than two centuries after Newton proposed that light consisted of particles, the particle was back. Not because the wave theory had stopped working, but because experiments were showing a side of light that the wave picture alone could not account for.

The question had come full circle.

Physics was now faced with two answers that seemed to contradict each other, even though experiments supported both.

Light produced interference patterns that appeared to require waves. At the same time, it transferred energy in individual events, knocking electrons from a surface one at a time. Both behaviors were real, repeatable, and measured with great accuracy. Neither could be ignored.

Physics came to call this wave-particle duality. Quantum mechanics could predict both kinds of results with great accuracy, but giving the conflict a name did not tell us what was physically happening. It did not tell us what light actually was or how the same thing could produce both kinds of behavior.

The equations worked, but that was not the same as understanding what was actually happening.

Experiments had shown two very different sides of light. In some experiments, light spread into patterns that seemed to require waves. In others, it arrived and exchanged energy in individual events. Both were real. Somehow, the same light produced both.

Newton asked whether light was made of small bodies. More than three centuries later, physics can predict the behavior of light with incredible accuracy. We can detect individual photons, measure their energy, and calculate where they are likely to arrive. But the basic physical question is still there: What is a photon, and what is it actually doing as it travels from one place to another?

Over time, physics became very good at predicting what light would do without having to answer that question. For most practical purposes, that was enough. For this book, it is not. We are going back to the physical question and following it wherever it leads.

That means starting with something simple: a single photon traveling through space. What is it physically? What does it carry with it? Does anything about it change as it travels? What happens when it passes close to matter? And how can individual photons, arriving one at a time, eventually build the patterns we see in experiments?

Those questions will take us much further than light alone. But first, we need to understand the photon itself.

So that is where we’ll look. One photon, moving through real space from one place to another. We know where it starts. We know where it ends.

The question is what happens in between.

CHAPTER 2: THE PHOTON

"All the energy of a light ray is not distributed continuously over larger and larger spaces but consists of a finite number of energy quanta localized in points in space." Albert Einstein, 1905

The Photon Storm

Wherever you happen to be, day or night, indoors or outdoors, deep underground or drifting through open space, you are immersed in a storm you cannot feel. A relentless flood of photons surrounds you from every direction. They stream through the air, pass through the walls and floor around you, and move through the atoms of your body at the speed of light, without pause and without any awareness of you at all.

You never consciously sense a single photon. But photons reveal the stars and galaxies, warm your skin, and carry the world into your eyes. They make radio, television, and cellular communication possible. They pass through walls as Wi-Fi signals, scan bones as X-rays, heat food in microwave ovens, and allow scientists to probe matter down to the atomic scale. Most of what we know about the distant universe reaches us through photons.

It is difficult to appreciate how crowded so-called empty space really is. If you could freeze a cubic centimeter of ordinary space and examine it, you would not find a void. You would find photons arriving from every direction across an enormous range of frequencies. Among them would be the faint cosmic microwave background left from the early universe.

That ancient background contributes roughly 411 photons per cubic centimeter. But those photons are not sitting still. Every one moves at the speed of light, so what matters is not only how many occupy a region at one moment, but how many continually pass through it. On the order of ten trillion cosmic microwave background photons pass through a cubic-centimeter region every second.

That is only one small portion of the electromagnetic spectrum. Add infrared radiation, visible starlight, radio signals, ultraviolet light, X-rays, gamma rays, and countless nearby sources, and the total photon traffic passing through that cubic centimeter of space becomes impossible to imagine. The number is staggering.

In just a few seconds, more photons can pass through an area the size of your fingertip than there are estimated grains of sand on all the beaches of Earth. Most pass through one another without interaction, but together they carry much of the energy and information reaching us from across the universe.

Throughout this book, photons will be treated as real physical objects. Nothing proposed here challenges the mathematical success of quantum mechanics or relativity. Their equations remain exactly as they are. What follows is a physical picture of what those equations may be calculating.

The starting premise is this: A photon is a real particle with real properties, traveling along a real path through space from one interaction to the next. Everything that follows grows from that premise.

A Single Traveler

Imagine a photon leaving the surface of Betelgeuse hundreds of years ago, long before the first telescope was pointed toward the sky. Once its journey begins, it travels across hundreds of light-years without stopping or slowing down. Century after century, it remains one individual traveler moving steadily toward its destination.

As it travels, the photon carries more than forward motion. It carries an internal rhythm. Its frequency is not merely a number in an equation or a label assigned by an observer. It is a physical property that travels with the photon. Along with direction and orientation, frequency remains part of the photon's physical state from the time it leaves its source until it interacts with something along its path.

Frequency is central because it determines the energy the photon carries. It determines whether the photon can eject an electron from a metal surface, excite an atom, trigger a chemical reaction, or produce the sensation of color when it reaches the eye.

One way to picture the difference between forward motion and internal rhythm is to imagine striking a tuning fork tuned to the note

A and then carrying it across a room. The tuning fork moves across the room at one speed while its arms continue vibrating 440 times every second. Carry it faster or slower and its forward speed changes, but its internal vibration remains separate from that motion.

In the model developed throughout this book, a photon behaves in much the same way. It carries linear momentum in its direction of travel while possessing an internal oscillation. That oscillation determines the photon's energy and plays a major role in its interactions with matter. **Figure 2.1 shows the basic picture used throughout this book.**

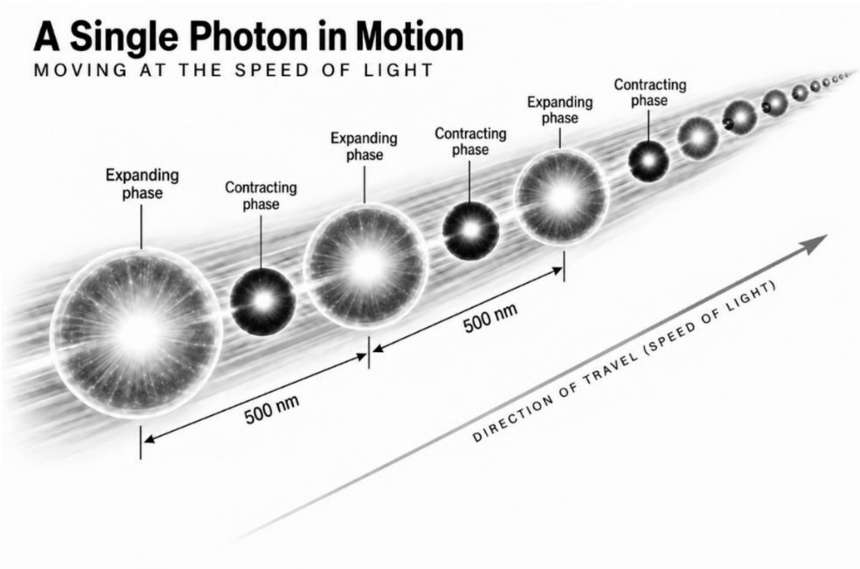

Figure 2.1. *A greenish-blue photon with a wavelength of 500 nanometers, oscillating approximately 600 trillion times per second while traveling forward at the speed of light. The alternating larger and smaller forms represent successive stages of expansion and contraction.*

A photon in flight therefore has several physical properties: direction of travel, a constant forward speed in vacuum, an internal oscillation, and a spin orientation in space that we call polarization. There is also phase, which identifies where the photon is within its oscillation cycle at any particular point along its path.

The oscillation should not be pictured as two equal halves, with the photon spending half of each cycle expanded and half contracted.