

Quantum Physics 101 - 1

Most of us with any semblance of a high school education remember the tale of Sir Isaac Newton, and the apple that brained him on the noggin. But many of us probably aren't aware of how this peculiar incident evolved into the classical branch of science that explains the movement of stars, planets, the solar system, as well as deal with the concepts of Force and matter. You know, Physics. Let's examine Newton for a moment. Mr. Newton was born in 1642 in England. He attended Cambridge University in 1661 where he became a noted student of mathematics. He performed many experiments that were innovative as well as creative, and was responsible for defining a whole new understanding of the science of mechanics. What many do not know, is he also studied chemistry (in the form of "Alchemy, a study that would eventually kill him), the history of western civilization, and theology.

He was also a genius.

While he is remembered primarily as the target for the apple, he is considered by most as the founding father of *modern* physics. As the tale is told, he sat in his orchard and was struck on the head with an apple. He surmised that the force that caused the apple to fall was the same force that governed the control of the moon and planets. This got him to ciphering. He started by calculating the amount of force required to keep the moon in orbit compared to the force pulling an object to the ground. Of course these calculations, begot more calculations which begot more calculations until he had an entire book of calculations, titled Principia Mathematica: Mathematical Principles of Natural Philosophy.

Only it was really three books in one.

Part one was the foundation for the science of mechanics, part two was fluids and fluid motion, and three was the law of gravitation as applied to the universe and planetary bodies. He also addressed the ebb and flow of the tides and computed the equinoxes based on the exertion of solar and lunar forces. This of course became what is now called classical Newtonian physics, and it became the greatest scientific achievement in history, or at least until the end of the 19th century when a new revolution took place.

Few of my fellow paranormal researchers know this, and they should.

But what was the act that supplanted Newton's work?

Simple.

While the history of quantum mechanics essentially began with the 1838 discovery of cathode rays by Michael Faraday, the cornerstones were laid toward the end of the 19th century with the experiments performed in 1862 by Gustav Kirchhoff in his attempt to prove his theorem about black body radiation. He had proposed that the energy emitted by a black body depends on the temperature and frequency of the emitting energy. However, he had some missing pieces. It wasn't until 1900 that German physicist Max Planck kicked it up a notch and discovered a positive I.D. on the missing part of Kirchhoff's theory. Planck figured out the "magic" between the energy and frequency of radiation. He discovered that the energy emitted by a resonator could only take on discreet values, or "quanta". Ahhhhh.....quanta.....

Planck also determined that a quantum has a constant amount of activity. This is known as Planck's Constant, and along with the speed of light, it is still one of the two surviving

constants in physics. This event that upstaged Newton's work was of course the birth of Quantum physics. But what did it all mean exactly?

What it means is that waves can be measured in small packets of quanta. This created the Holy Hand Grenade of Antioch, which exploded into a cloud shrapnel in the form of new theories in the atomic and subatomic world. But it came about as a companion to Newton's laws. Where Newtonian Physics governed the electromagnetic and gravitational forces on large objects, quantum physics explained how an electron orbited the nucleus of an atom.

Einstein would throw a bone in the pile by showing that an electromagnetic wave, such as light, could be described by a newly named particle, the Photon. This little brain poof became the theory of unity between subatomic particles and electromagnetic waves, also known as Wave-Particle Duality a fundamental principle in modern Quantum Physics. This is actually akin to voodoo in many conventional scientists' eyes, as it states that a particle and a wave are neither one nor the other, yet, mysteriously they can be both at the same time. The major significance of the wave particle duality is that all behavior of light and matter can be explained through the use of a differential equation which represents a wave function, generally in the form of the Schrodinger equation. This ability to describe reality in the form of waves is at the heart of quantum mechanics.

As hinted at above, the most common interpretation is that the wave function represents the probability of finding a given particle at a given point. These probability equations can diffract, interfere, and exhibit other wave-like properties, resulting in a final probabilistic wave function that exhibits these properties as well. Particles end up distributed according to the probability laws, and therefore exhibit the wave properties. In other words, the probability of a particle being in any location is a wave, but the actual physical appearance of that particle isn't. The waveform collapses under observation. Remind you of anything spooky?

Further experiments demonstrated that an electron for example, would exhibit particle-like behavior under one condition, and then become wave-like under a different condition.

Wave Particle Duality really began back in the 1600's when Newton and a fellow by the name of Christiaan Huygens argued over each other's theory. Newton believed light was particulate, and Huygens believed it was wave-like. Turns out they were both right...and wrong at the same time...

Have a headache yet? You will.

Quantum mechanics is all about migraines.

Everything and nothing is the rule.

Thomas Young later reinforced the idea that light was a wave with his experiments in 1802. Young is remembered for performing the "Double Slit" experiments. By beaming a light through a narrow slit of a board, then through two more narrow slits, he discovered that light beams spread apart and overlapped, creating bands of light and bands of darkness. This led him to develop his theory of light interference, establishing the wave nature of light. He went on to propose that light waves were transverse rather than longitudinal as previously believed.

Now for an interesting footnote. Young was key in deciphering the Rosetta Stone, opening the understanding and translation of Egyptian Hieroglyphics. Is that cool or what? I digress...

Einstein would later prove, as would others, that atoms have both particle and wave natures about them. Light would be included eventually in this concept, and Wave-Particle Duality would define the behavior of quantum objects based on when and how you observed them. And, they could also exhibit behavior inconsistent with being a wave or a particle, defying reason, and causing a migraine. Welcome to quantum mechanics or "How I learned to think abstractly outside of the box"...

A footnote on particles...

Particles are everywhere in physics, as well as in the bread box and on my carpet. And except for the photon and the graviton (and they may also have this in common with all particles) all particles have antiparticles associated with them. Most also have multiple spin states, color configurations (bindings) and they have their own branch of study, called particle physics.

Let's look at the dust for a second. And this list is general. Fermilab, the largest particle accelerator in the U.S., and the LHC, the largest particle accelerator in the world, have both added to the many thousands of particles now known to science. But this gives you an idea.

Lepton: a particle consisting of Muons

Muon: Heavier Flavored Lepton

Taus: Heaviest known Lepton

Neutrino: Uncharged massless lepton

Quark: a particle with six flavors, charm, strange, top, bottom, up, and down.

(Remember when Jimmy Neutron went to college? He had to recite the types of Quarks. That show has great writers.)

Electron: Negatively charged particle making up the outer shell of an atom

Positron: An anti-electron positively charged

Hadron: particles made up of quarks, including baryons and mesons

Pion: Lightest of the mesons

B-meson: One of the heaviest mesons

Protons: Positively charged particle made up of two up and one down quark, making up an atomic nucleus.

Neutron: Jimmy's last name. Neutral particle consisting of two down and one up quarks making up an atomic nucleus

Boson: Particles associated with forces, such as photons for electromagnetism, gluons for interactions of the strong force, W and Z for weak force interactions.

Graviton: Associated with gravitational force

Fermion: A matter particle

Spooky Particle: Quantum entangled photons

and finally the much encountered but never hailed

Moron: Really dense, stupid particles that exist only on the human level. Also known as a Troll. These can be easily identified by their basement address, their colorful boxer shorts with slogans such as "I'm the Bomb" or "Kiss me I'm a Geek" and hover around PC keyboards existing vicariously in the virtual reality of the web....