Relativity VS QUANTUM MECHANICS

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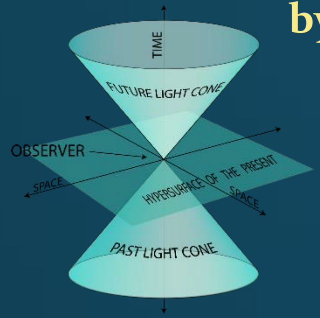
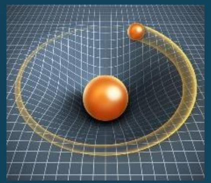
Special Relativity

Special Relativity was introduced in 1905, by Albert Einstein and describes only the special case where motion is uniform; there is no acceleration and objects travel at a constant speed.



Special Relativity created a fundamental link between space and time. The universe can be viewed as having three space dimensions, up/down, left/right, forward/backward — and one time dimension. This 4-dimensional space is referred to as the space-time continuum.

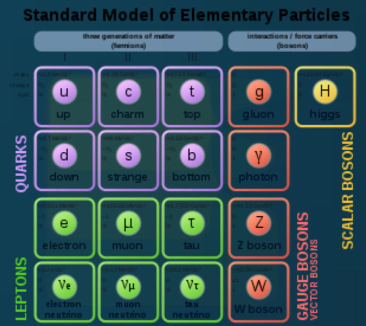


General Relativity

General relativity expands upon special relativity and reforms Newton's laws of gravitation, providing a unified description of gravity as a geometric property of space and time (space-time). Unlike special relativity, general relativity accounts for changes in motion such as acceleration and curved motion. Through this explanation, Einstein could accurately describe the orbits of large celestial bodies such as the planets and stars. He suggested that space and time were like an interconnected fabric in which a large mass would leave an indentation, causing neighbouring bodies to be gravitationally attracted to it. Physical matter had finally been described through space and time; space-time moves matter, whilst matter curves space-time.

Time Dilation

Einstein discovered that the closer you travel to the speed of light, the slower time travels in your reference frame. A clock that is moving relative to an observer will be measured to tick slower than a clock that is at rest in the observer's own frame of reference! This was a huge as it opposed the previous ideas proposed by Sir Isaac Newton suggesting that time was an absolute quantity.

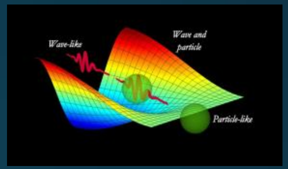


What is Quantum Mechanics?

Quantum Mechanics is the study of the interactions of subatomic particles at the fundamental level. In general relativity, events are continuous and deterministic, meaning that every event agrees with theory and prediction. However, in quantum mechanics, events produced by the interaction of subatomic particles lead to ambiguous probabilistic answers rather than definite outcomes. Quantum rules allow certain interactions between matter that are forbidden by classical physics.

Wave Particle Duality

Wave–particle duality is the concept that physical matter at the subatomic level acts both like particles and as waves depending on how they are observed. For example, the double slit experiment produces an interference pattern that is wave like on a screen, but one may propose that as particles are defined as known fixed points in space, they should not be able to interfere with one another and produce a wave like pattern. In addition to this, interacting with the particle by measuring its speed/motion, changes its wave function and it can sometimes behave as a wave of unpredictability or a particle with definite parameters. This opposes general relativity completely as things that apply on the large scale do not apply at the subatomic level; a new theory is required to unify the two ideas into one complete theory namely, String Theory.



The Way Forward

Quantum Mechanics is our latest development in a modern theory to describe everything we see at the atomic level. This, along with developments in string theory will allow us to understand the very nature of the universe and uncover dark matter and dark energy. We have built the LHC to test these theories and have discovered great things such as the discovery of the Higgs Boson and the Higgs Field. Nonetheless, Relativity and Quantum Mechanics have led us to great advancements in science and are the elementary theories of our universe.