A Brief History of Light

Galileo was one of the first people to hypothesize that light had a finite speed. Prior to this, light was widely believed to travel instantaneously. His experiment was not sensitive enough to determine the speed.

Newton (1643-1727) postulated that light was a particle (or corpuscle). Having developed the laws of motion and the law of gravity. He could explain reflection, refraction and diffraction with this model - all behaviours of light that were readily observable. He assumed that light travelled so fast that it travelled in straight lines and the particles were so small that they would never collide.

Christiaan Huygens (1629-1695) was a contemporary of Newton's who postulated that light was a wave. He was largely ridiculed at the time, but the wave theory of light also explained observable behaviours. Interference of light, however, was *not* observed, which was a failing of the wave theory.

Ole Roemer (1644-1710) made the first calculations of the speed of light by observing eclipse of Io, one of the four Galilean moons of Jupiter. He concluded that it took about 22 minutes for light to travel the diameter of the Earth's orbit, making the speed of light about 220,000 km/s. This was later confirmed by both Huygens and Newton.

Thomas Young (1773-1829) using the double slit experiment showed that light *does* interfere with itself. By shining light first through a single pinhole and then a pair of slits (or pinholes) he obtained the same type of interference pattern that is obtained from two waves. This was in strong support of the wave model - as the particle model of light could not explain interference.

Leon Foucault (1819-1868) measured the speed of light in water in 1949. It was found to be slower than the speed of light in air, which contradicted Newton's particle theory. Newton's model predicted that as the light got close to the water, the gravitational attraction of the water would speed up the particles, instead of slowing them down. This measurement was seen to be the final nail in Newton's particle theory.

James Clerk Maxwell (1831-1879) demonstrated that electric and magnetic fields travel through space in the form of waves and at the speed of light. He proposed that light was an electromagnetic wave made up of oscillations of these fields.

Albert Michelson (1852-1931) measured the speed of light in air to be $299,864 \pm 51$ km/s and estimated the speed of light in a vacuum to be 299,940 km/s. He received the Nobel prize for his work in the speed of light. The modern value is 299,792,458 km/s. We will use 3.00×10^8 m/s.

Albert Einstein (1879-1955) in 1905 (the same year as his theory of relativity) postulated that light came in packets of energy, which are now called photons. This was a result of the photoelectric effect, in which light of a high enough frequency could cause electrons to be emitted from a piece of metal. This was in contradiction with a wave theory (which would suggest that light just needed to be brighter). The photon, which was more of a particle, still maintained wave properties. This was the introduction to the "wave-particle duality" of light. Light behaves as both a wave and a particle.