

Summary of Physics

Special relativity:

- Einstein did not invent it, but gave clearer arguments
- Deals only with observers with constant linear velocity
- “Cannot do an experiment to measure absolute velocity”
- Speed of light constant for everyone

Consequences of special relativity:

- Time dilation and length contraction (always for the other guy)
- Mass can be converted into energy and vice versa
- Cannot agree on simultaneity of events

Experimental evidence for special relativity:

- Michaelson-Morley experiment: failure to detect “ether”
- slowing of natural subatomic “clocks” (decay half-life) for high-speed particles

+ others

Quantum mechanics

The mechanics of very small objects

size of atom = 10^{-10} meters (= 1 Angstrom)

size of atomic nucleus = 10^{-15} m (= 1 fermi)

Basic results:

waves (like light) can act as particles

- photoelectric effect
- no “ultraviolet catastrophe” for blackbody radiation

particles (like electrons) can act as waves

- fixed (“quantized”) orbits for electrons around atoms
- Davisson-Germer showed electrons have diffraction (interference)

Objects (light, electrons) described by *wave function*

The wavefunction predicts the *probability* of any outcome, not the specific outcome itself

Copenhagen interpretation: the wavefunction “collapses” upon making a measurement

Many-worlds: at each quantum event the universe splits into separate universes

General relativity

General relativity goes beyond special relativity to include acceleration and gravity

"you cannot do an experiment to distinguish between gravity and acceleration"

General relativity includes Newton’s theory of gravity for small masses and velocities

General relativity also explains the observed perihelion shift of Mercury

General relativity predicts

- bending of light rays by gravity
- gravitational redshift
- gravity waves
- black holes (not unique to GR)