

SPECIAL RELATIVITY

Historical timeline

(ish!)

Magnetic field from a current carrying wire



$$B = \frac{\mu_0 I}{2\pi r}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}$$



$$F = \frac{q_1 q_2}{4\pi \epsilon_0 r^2}$$

Force between two charges

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}$$

$$\pi^2 \rightarrow 2\gamma$$

1879-1955

Einstein

resolves the 'paradox' of the frame invariance of the speed of light (no matter how fast you move a body, all observers will measure the beam travelling at c) by allowing time and space to change as speeds $\rightarrow c$. This theory is called

SPECIAL RELATIVITY

1. Time dilation ("moving clocks run slow")

2. Length contraction

3. Loss of Simultaneity

\rightarrow incorporated into **LORENTZ TRANSFORMS**

• **Light** - the best understood physical phenomena

• Huygens, Fresnel, Young... **Wave model of light**

• Electricity & Magnetism \rightarrow ELECTROMAGNETISM

• Foucault & Fizeau use clockwork strobe effect to measure the speed of light. If light is a wave, in what medium does it propagate? The "Luminiferous Aether"

• Maxwell predicts Electromagnetic waves propagate at speed $c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$ independent of coordinate system
 $c = 2.998 \times 10^8 \text{ m/s}$

• Faraday, Helmholtz, Hertz, Lorentz confirm Maxwell's predictions experimentally

• Michelson & Morley show light can propagate in a vacuum i.e. no aether is required

• Experiments with pions show emitted γ rays travel at c regardless of the speed of the pion which emits them
 * Alväger 1964
 * Filippos & Ex 1963

• Muon mystery! Far too many are detected, given known 2.2 μs half life
 [Muons are created in upper atmosphere as a result of cosmic radiation]



