Special Relativity

principle of relativity: physical laws are the same in all inertial reference frames

inertial reference frame: moving at constant velocity

no inertial reference frame is special or than the others

how can you tell if you're in an inertial frame?
- no pseudoforces
- Newton's 1st law is true
  - objects maintain constant $\vec{v}$ unless acted on by outside force

Galileo came up with this

It worked great! — until electromagnetism

EM waves have speed $v = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} = c = 3 \times 10^8 \text{ m/s}$

but compared to what?

Light travel in a medium?

19th century physicists — yes! it must!

ether

but ether must be
- extremely rigid
- undetectable

Michelson-Morley experiment
- light has same speed in all directions
- ∴ ether doesn't exist

Einstein:

suppose light has same speed in every reference frame

Event : point in spacetime

(x, y, z, t) ← spacetime coordinates

Motion: a series of events