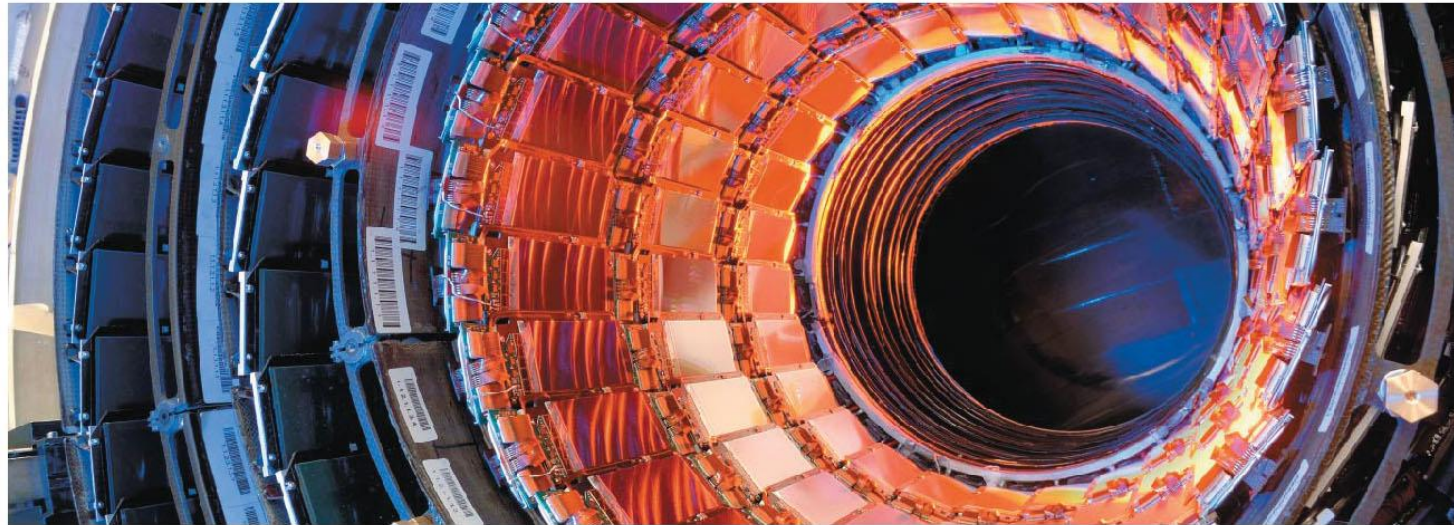# Chapter 36 – Relativity

- Reference frames, events, measurements, space-time diagrams

- Postulates of special relativity, impact on simultaneity

- Time dilation, space contraction, and Lorentz transformations

- Relativistic momentum and energy

What is an inertial reference frame?

Inertial reference frames are reference frames that move relative to each other with **constant velocity**.

- You'll learn to work with the **positions** and **times** of **events**.
- All the **clocks** in an inertial reference frame are **synchronized**.

Velocity of S′ relative to S
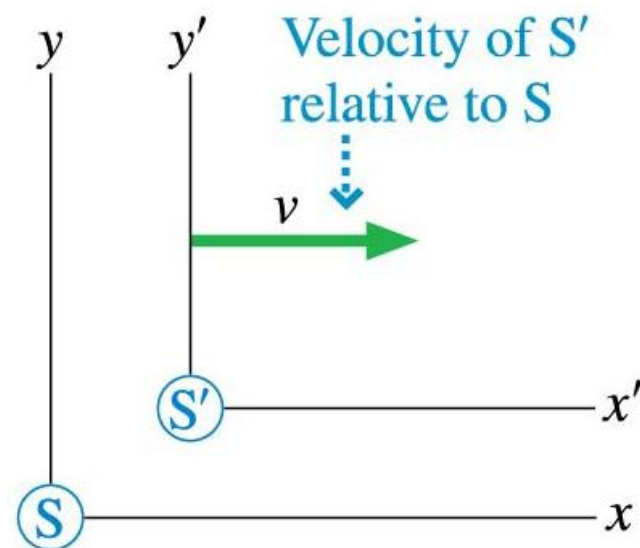
At time t, the origin of S′ has moved
distance vt to the right. Thus $x = x' + vt$.

y' Firecracker

$y = y'$

$z = z'$

$t = t'$

y

vt

x'

x

u

$x' = x - vt$

v $y' = y$

S x S′ x'
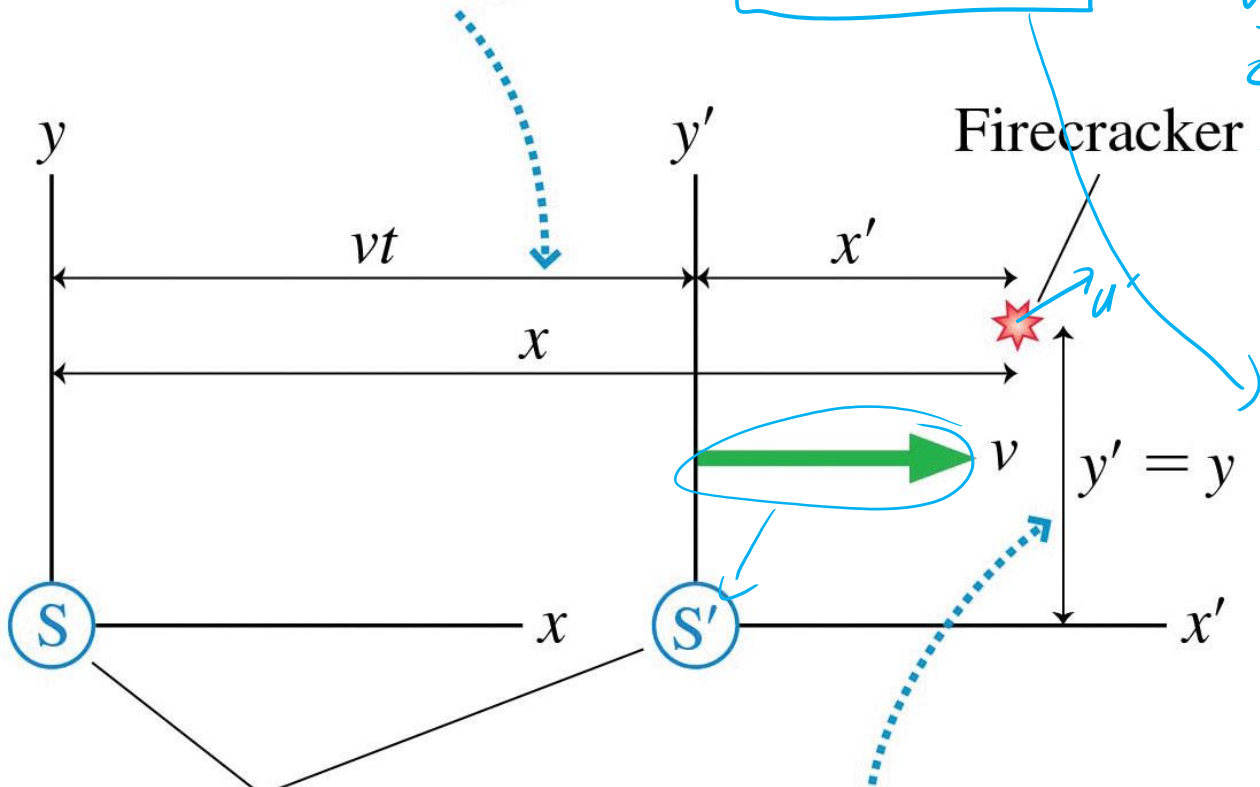
$\dfrac{dx'}{dt} = \dfrac{dx}{dt} - \dfrac{d}{dt}(vt)$

Origins coincide
at $t = 0$.

Distances perpendicular to
the motion are not affected.
Thus $y' = y$ and $z' = z$.

$u_f' = u_f - v_{s..s'}$

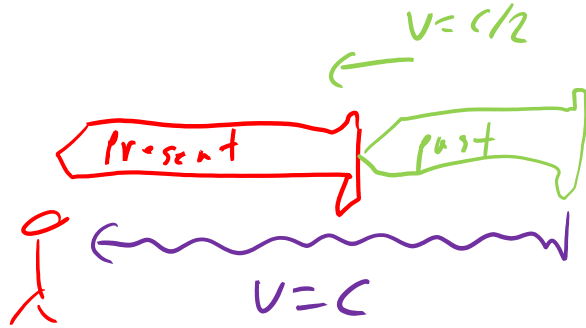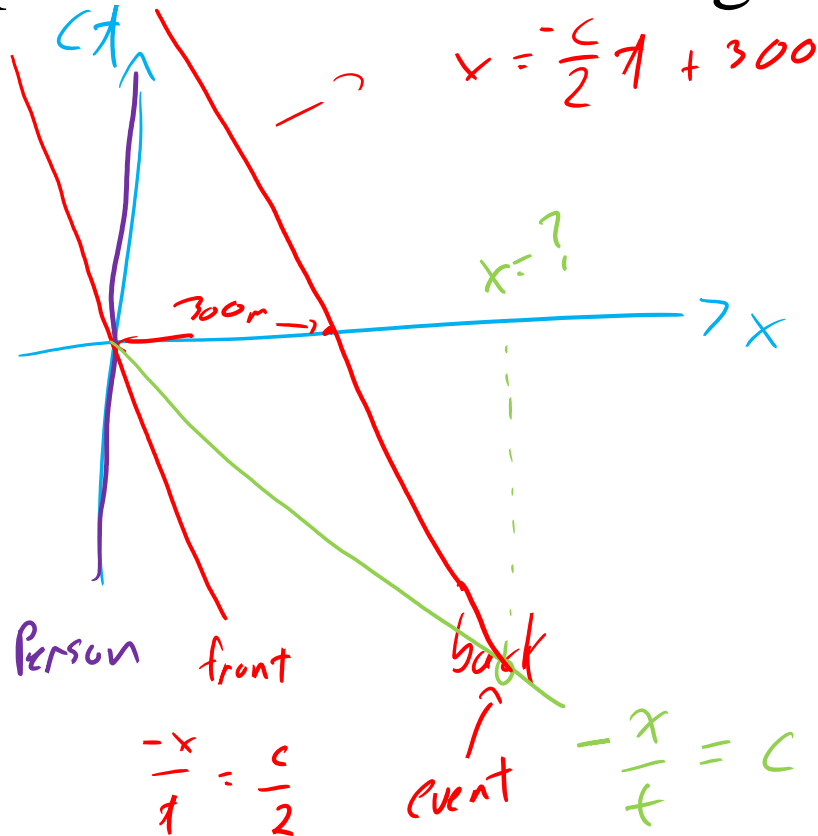$a_f' = a_f$

A rocket of length 300 m travels toward you at v=0.5c. You take a photo when the front just passes you. What does the photo show is the length of the rocket? Ignore relativity.

$300m$

$v = 0.5c$

$c = 3 \times 10^8 \, m/s$

$x = ?$

$v = c/2$

Present

past

$v = c$

A rocket of length 300 m travels toward you at v=0.5c. You take a photo when the front just passes you. What does the photo show is the length of the rocket? Ignore relativity.

ct

$x = \frac{-c}{2}t + 300$

$c = 300 \frac{m}{\mu s}$

$x = \frac{-c}{2}\left(\frac{-x}{c}\right) + 300$

$x - \frac{x}{2} = 300 \rightarrow \frac{x}{2} = 300$

$x = 600m$

$x = ?$

$300r \rightarrow$

$\rightarrow x$

Person   front   back

event

$\frac{-x}{t} = \frac{c}{2}$

$\frac{-x}{t} = c$

Team Up questions
(+300 m, -1 us) and (+600 m, -2 us)