Lecture 2

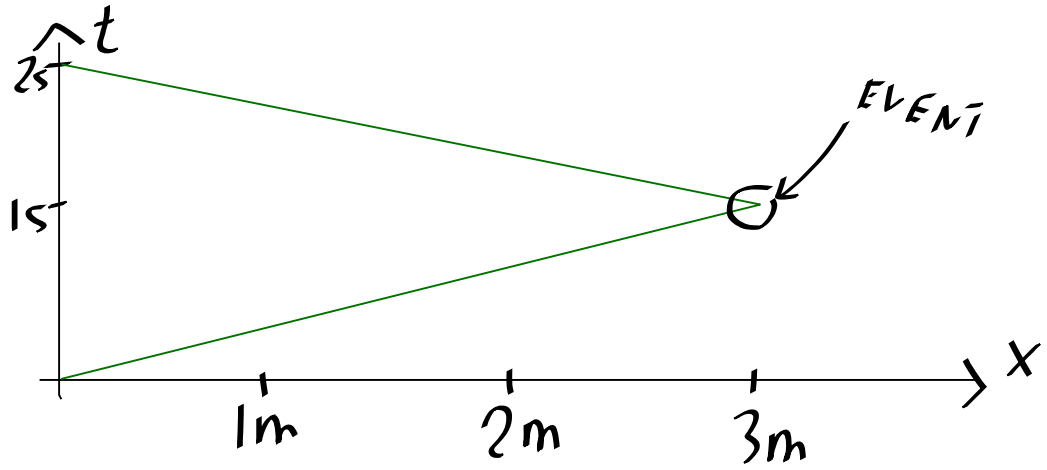
Start with an example: playing ping-pong on a moving airplane is just like playing on the ground, unless there is turbulance or the plane is accelerating or turning or etc...

DEF: A frame of reference is a coordinate system allowing to determine position and time of events

Made up of tics and clocks

Events have well defined position and time,
an event is a point in spacetime,
eg: collision

A spacetime diagram example: a rolling ball hits a wall at x=3m and t=1s and bounces back



-> Clicker Question

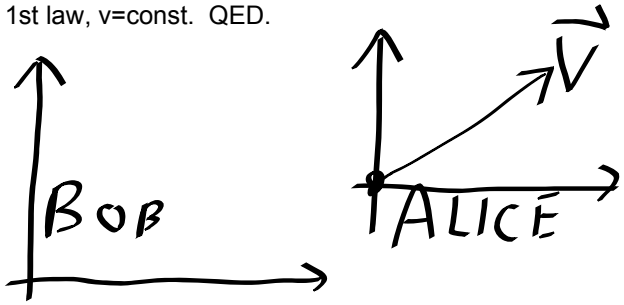
Observers at rest relative to each other use the same frame of reference to make measurements. A frame of reference is not the same as an observer.

$\sim$

DEF: An inertial frame of reference (IRF) is one in which Newton's 1st law of motion holds

Claim: all IRFs move with constant velocity with respect to each other.

Proof: Consider an object at rest w.r.t. frame A. No forces are acting on it, by Newton's first law. If frame A is moving with velocity v w.r.t. frame B, then this object is moving with velocity v in frame B. Since no forces are acting on it, by the above definition of IRF Newton's 1st law, v=const. QED.



-> Clicker Question

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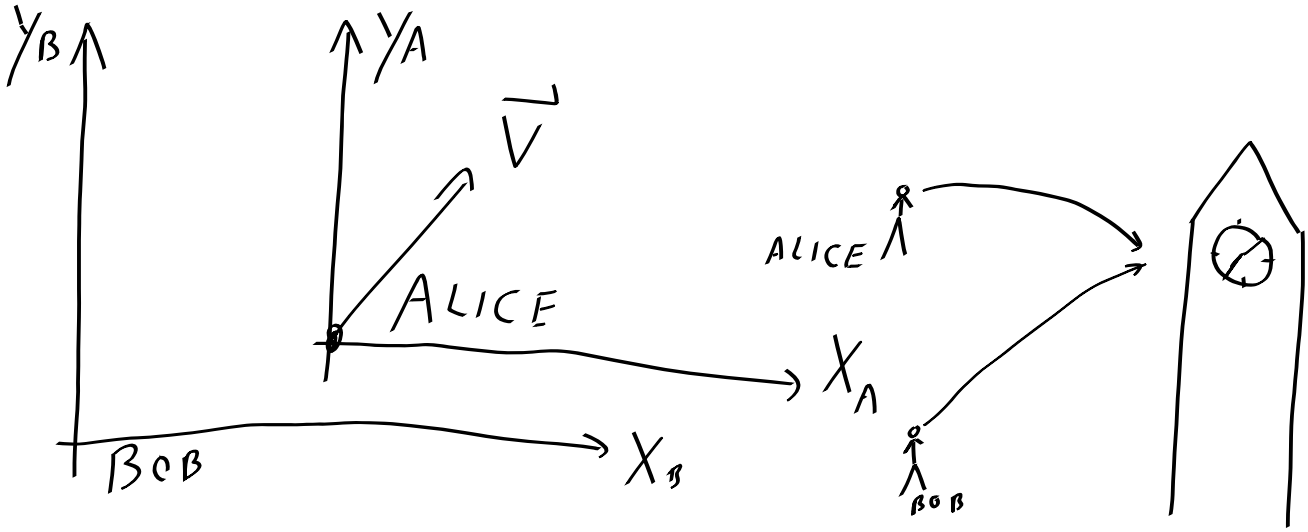
Principle of relativity: the laws of physics are the same in all IRFs.

To be able to verify this principle, we need trasformations: ways to compute quantities in one frame if they are known in another.

Eg: Galilean Transformations (familiar from everyday life and highshool/1st year physics)



$t_A = t_B = t$ UNIVERSAL CLOCK

$\vec{x}_A = \vec{x}_B - \vec{V}t$ → If the origins overlap at t=0, something we will usually assume for convenience

CHECK SIGN: ALICE'S ORIGIN IS AT $\vec{x}_A = \vec{0}$
$x_B = \vec{V}t$

DIFF

$\vec{V}_A = \vec{V}_B - \vec{V}$

DIFF AGAIN

$a_A = a_B$

Does the 2nd law hold?

$F_A = m a_A \iff F_B = m a_B$
ONLY IF $F_A = F_B$

Are forces the same in all IFR?
Most (gravity, contact forces...) are - but not all. Electromagnetic forces are not, as you saw in tutorial 1.

More to come next lecture.-