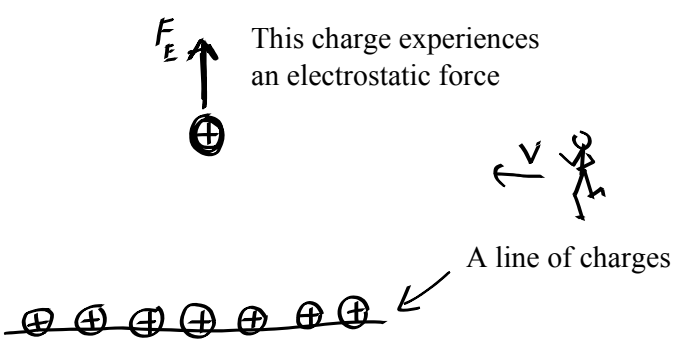
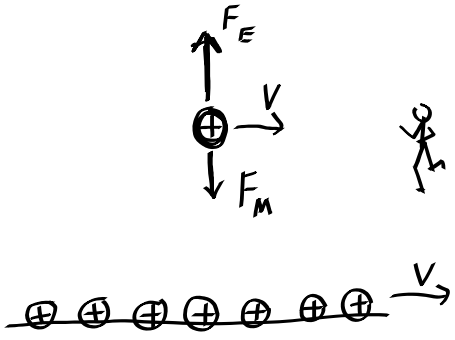
Lecture 3

-> clicker question

As we saw last time, the principle of relativity together with Galilean transformations required that forces be the same in all reference frames (another way to put this is that forces are invariant under Galilean transformations). In tutorial 1, however, we saw that this might not be the case with electromagnetism:





In the runner's frame of reference, the line of charges is moving (=> current), which leads to a magnetic field, which leads to a second force on the charged particle (which is also moving).

Something fishy is happening.
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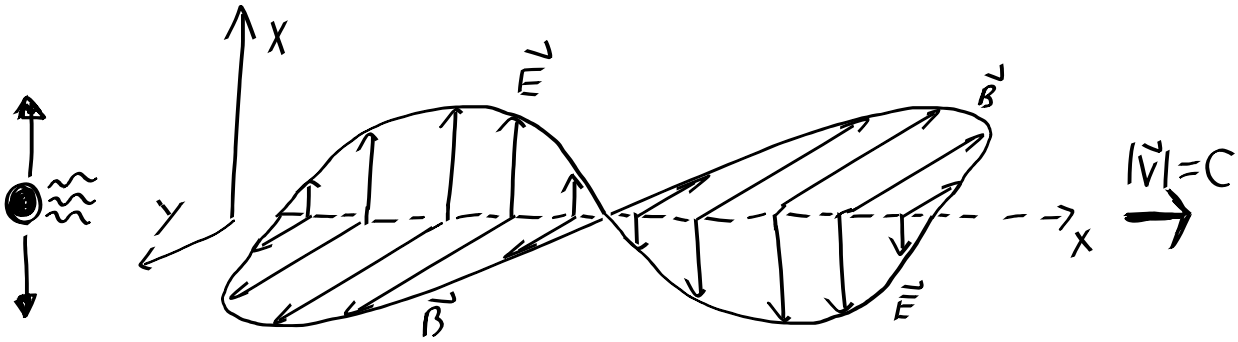
But the trouble is even deeper than that.
Consider light: light is an electromagnetic wave, sourced by an oscillating charge



Maxwell's equations tell us that electromagnetic waves (in vacuum) travel with speed c.
So what is light moving with speed c with respect to?
And if light is a wave, what is doing the 'wiggling'?

Analogy: with sound, there is a medium. Sound is a pressure wave travelling through, say, air.

The hypothetical medium that light travels through is called the aether. It lets all objects through it without any resistance, but is stiff enough to support EM waves.

-> clicker question

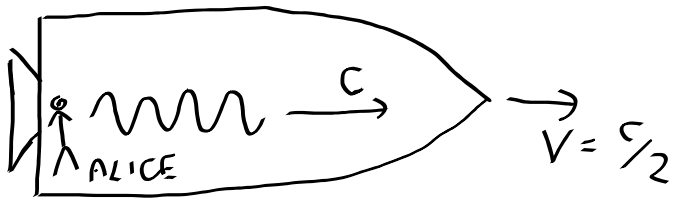
The Michelson-Morley Experiment was supposed to find the aether.

-> on-line simulation

The point was to detect Earth's motion through the aether. No such thing was found. The two pulses always moved with exactly the same speed.

-> clicker question

Einstein's principle of relativity: the speed of light is c in all frames of refence:



Alice, while in a rocket moving with c/2 w.r.t Bob, measured the speed of this light pulse to be c. Bob, on the ground also measured it to be c.

How can this be?
What if Alice was moving with v=c? v>c?