Fermilab

Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Engineering & Science in the IERC

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Community Advisory Board Meeting

22 September 2022

Topics

- Knock your glasses off
- Nothing, spinning around its axis
- Trapping birds in S America
- The universe we can’t see
- Camera parts to see it with
- The temperature of the universe
- Parts for the South Pole
- Not like in the movies
- I run out of time

Knock your glasses off

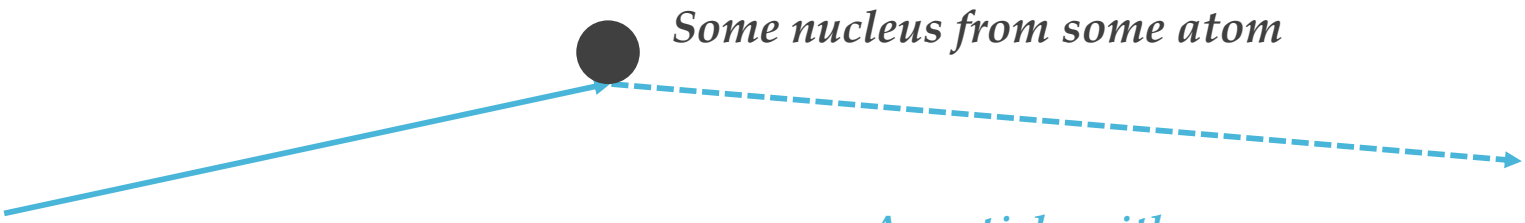
The basic techniques of experimental particle physics:

Ionization → Electric fields → wires → electronics

Scintillation → light → photon detectors

Nothing, spinning around its axis

- But it only spins in one direction
- And there's three different kinds of nothing



An electron (e)

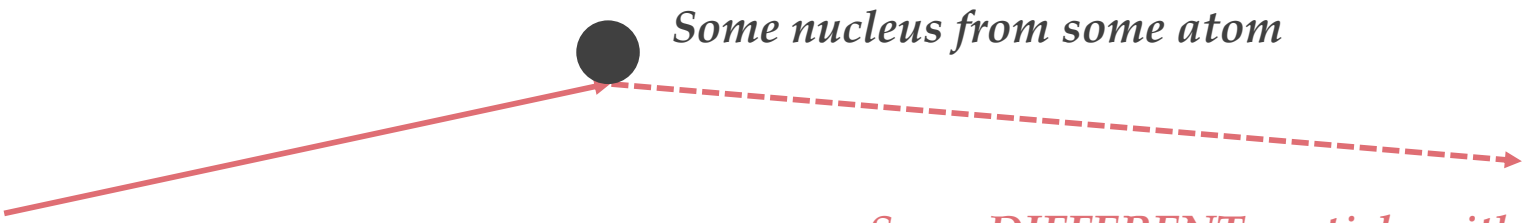
Actually we don't know what that is!

A particle with:
no size – totally pointlike
no electrical charge
no mass
travels at the speed of light
but it spins – has angular momentum
only spins in one direction (lefty)

The (electron) neutrino, ν_e

Nothing, spinning around its axis

- But it only spins in one direction
- And there's three different kinds of nothing



A muon (μ)

What's a muon?

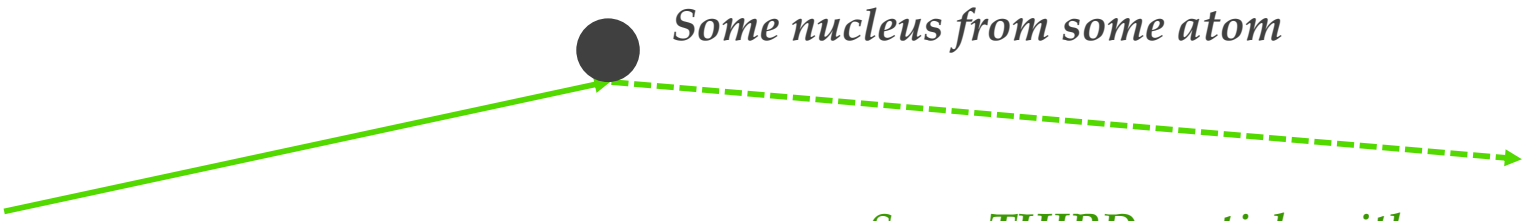
Well, it's like an electron, but heavier.

Some DIFFERENT particle with:
no size – totally pointlike
no electrical charge
no mass
travels at the speed of light
but it spins – has angular momentum
only spins in one direction (lefty)

The (muon) neutrino, ν_μ

Nothing, spinning around its axis

- But it only spins in one direction
- And there's three different kinds of nothing



A tau (τ)

What's a tau?

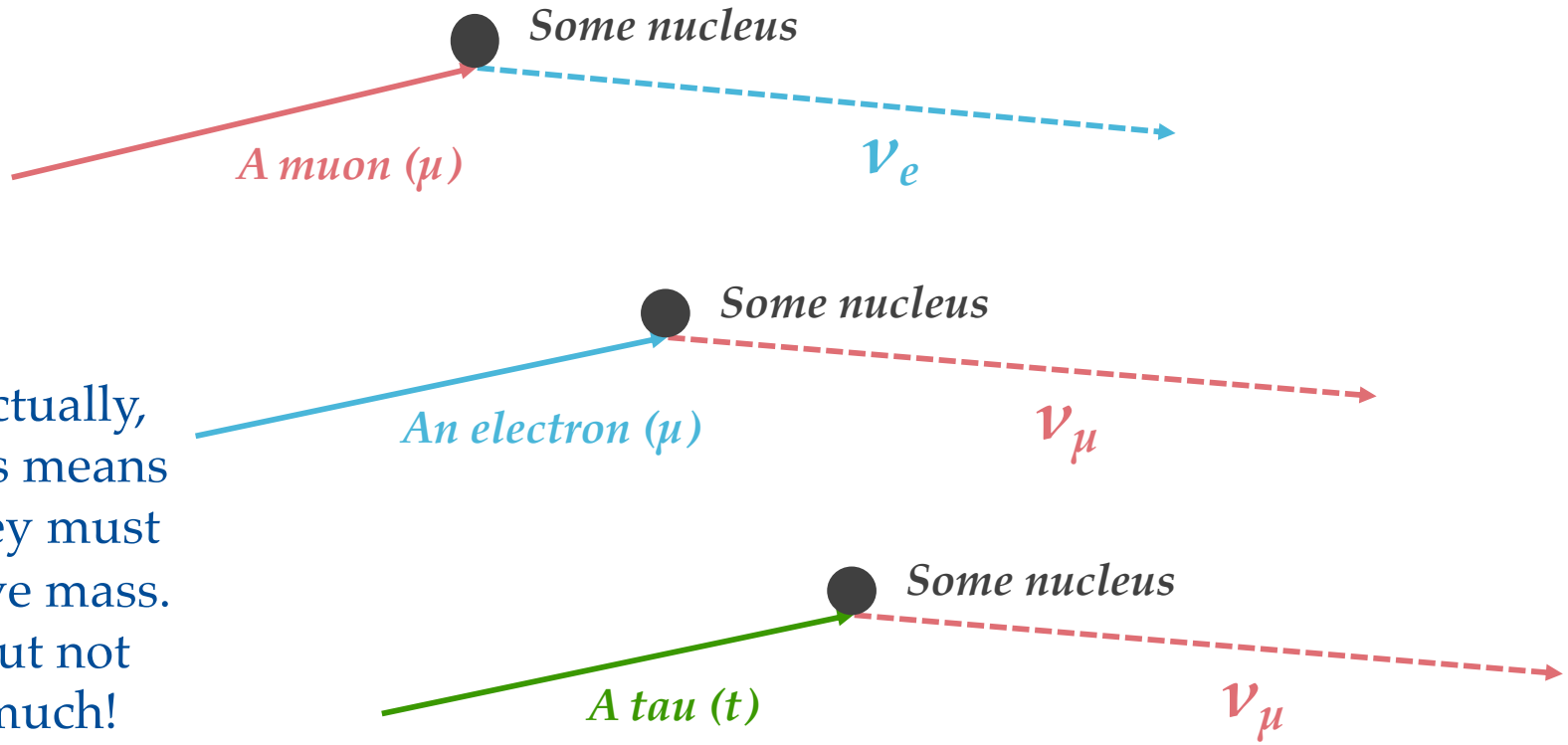
Well, it's like an electron or a muon, but even heavier.

Some THIRD particle with:
no size – totally pointlike
no electrical charge
no mass
travels at the speed of light
but it spins – has angular momentum
only spins in one direction (lefty)

The (tau) neutrino, ν_t

Nothing, spinning around its axis

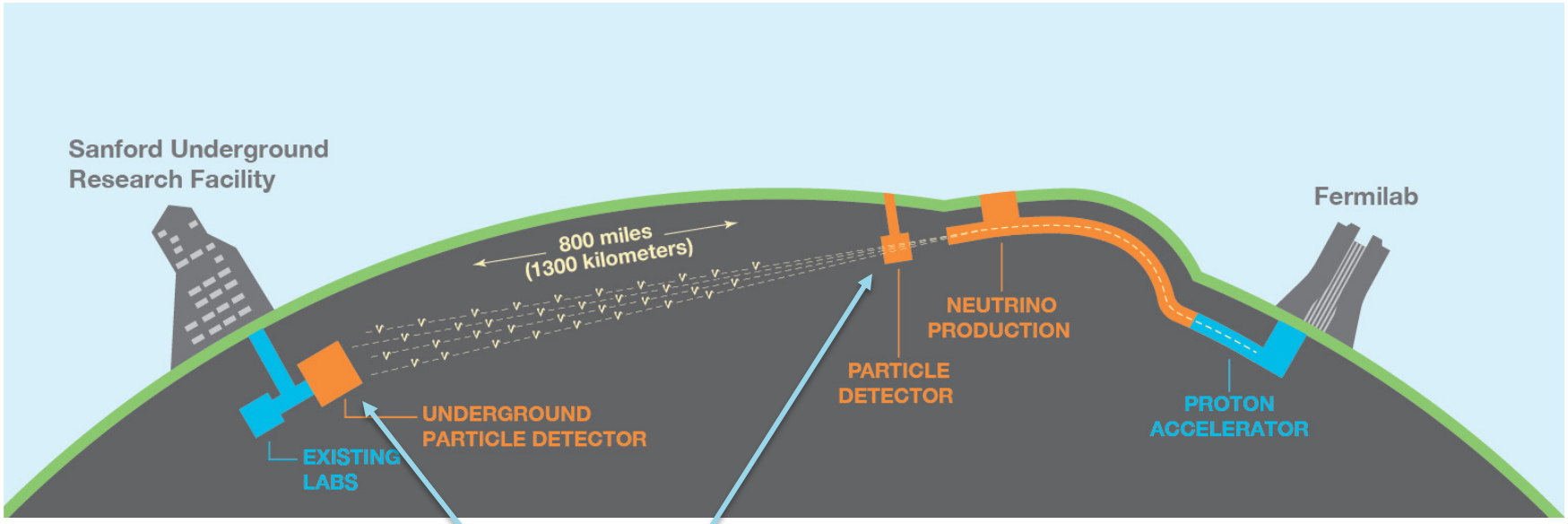
- Well, that what they told ME in school. But.
- By ~1995, we could do much better experiments than Lederman, Steinberger & Schwartz did and we started to see things like this:



Actually, this means they must have mass. But not much!

Nothing, spinning around its axis

- The DUNE project is the flagship program of the lab to measure these neutrino things



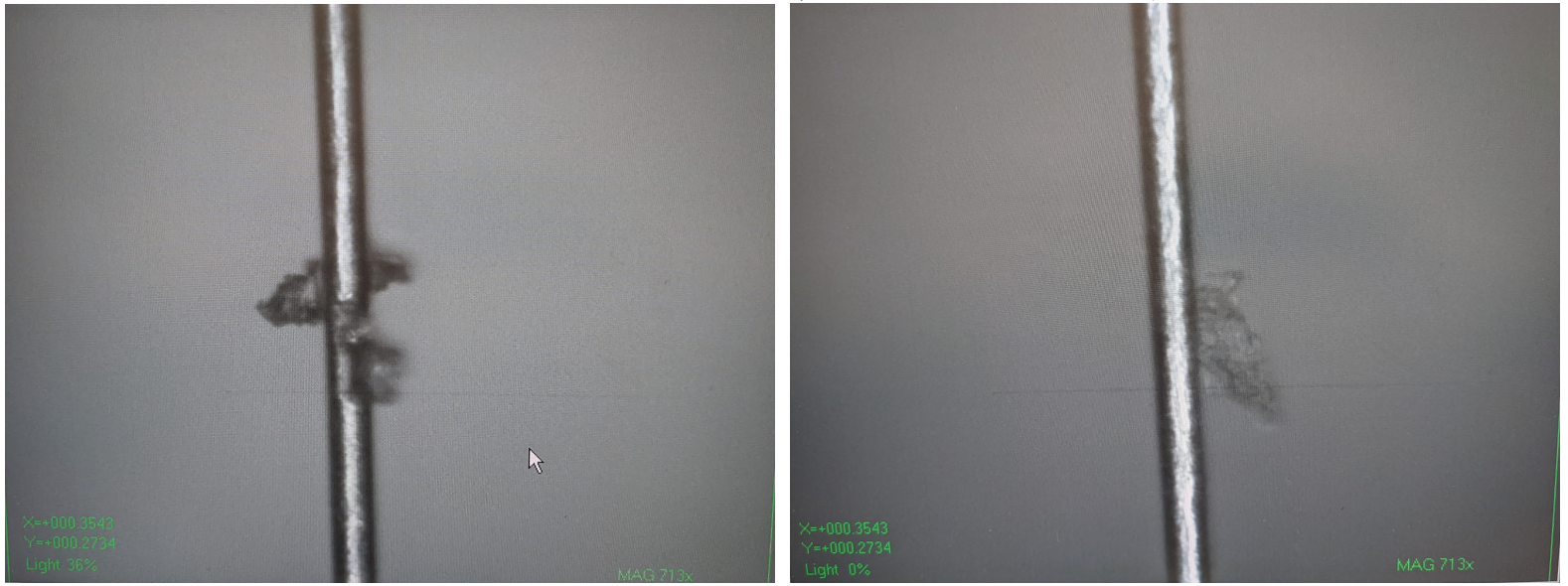
Wires, electric fields, photon detectors and electronics
... and Argon

Trapping birds in S America

Investigating the Low Amplitudes

- Meanwhile, a close inspection of the anode wires revealed that either some of the coatings have peeled off or chemical compounds have accumulated
- GOAT's IROC have previously been used for calibration and is possibly older than the other chambers we've acquired from ALICE
- More investigations are underway

images obtained with an optical CMM, by G. Teafoe



Trapping birds in S America