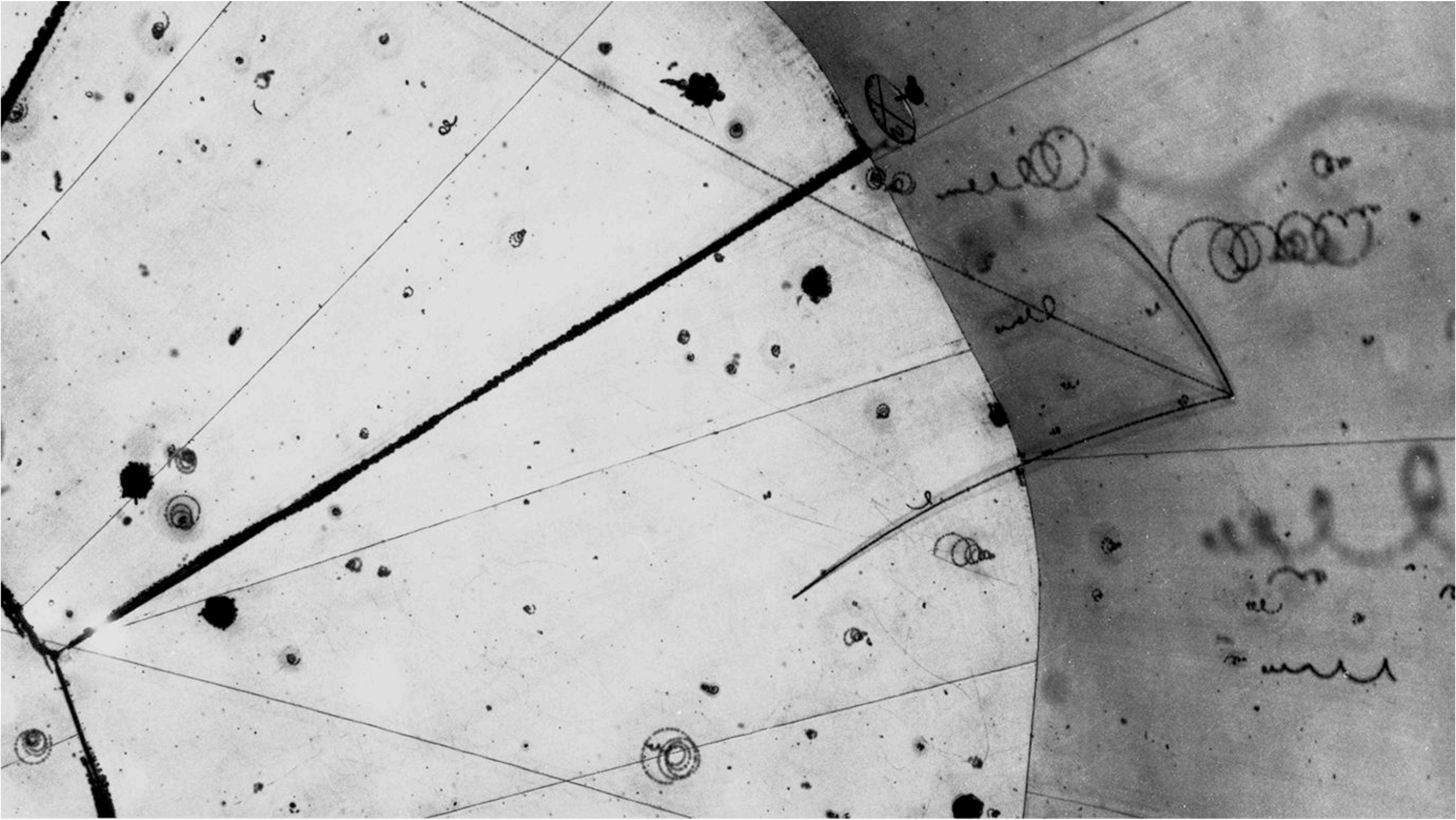


The Keys to New Physics

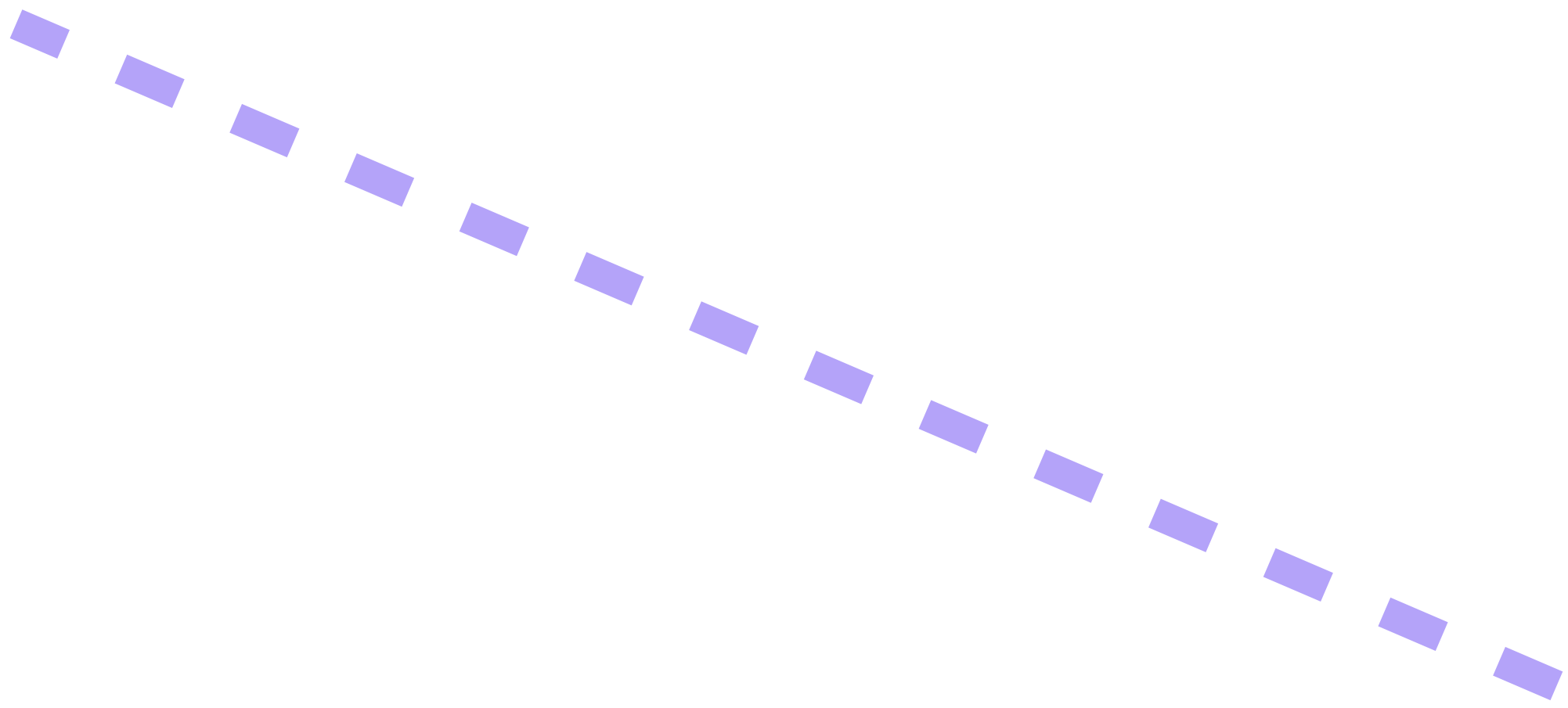
- Particle Accelerators.

2


Muon


Pion


Proton



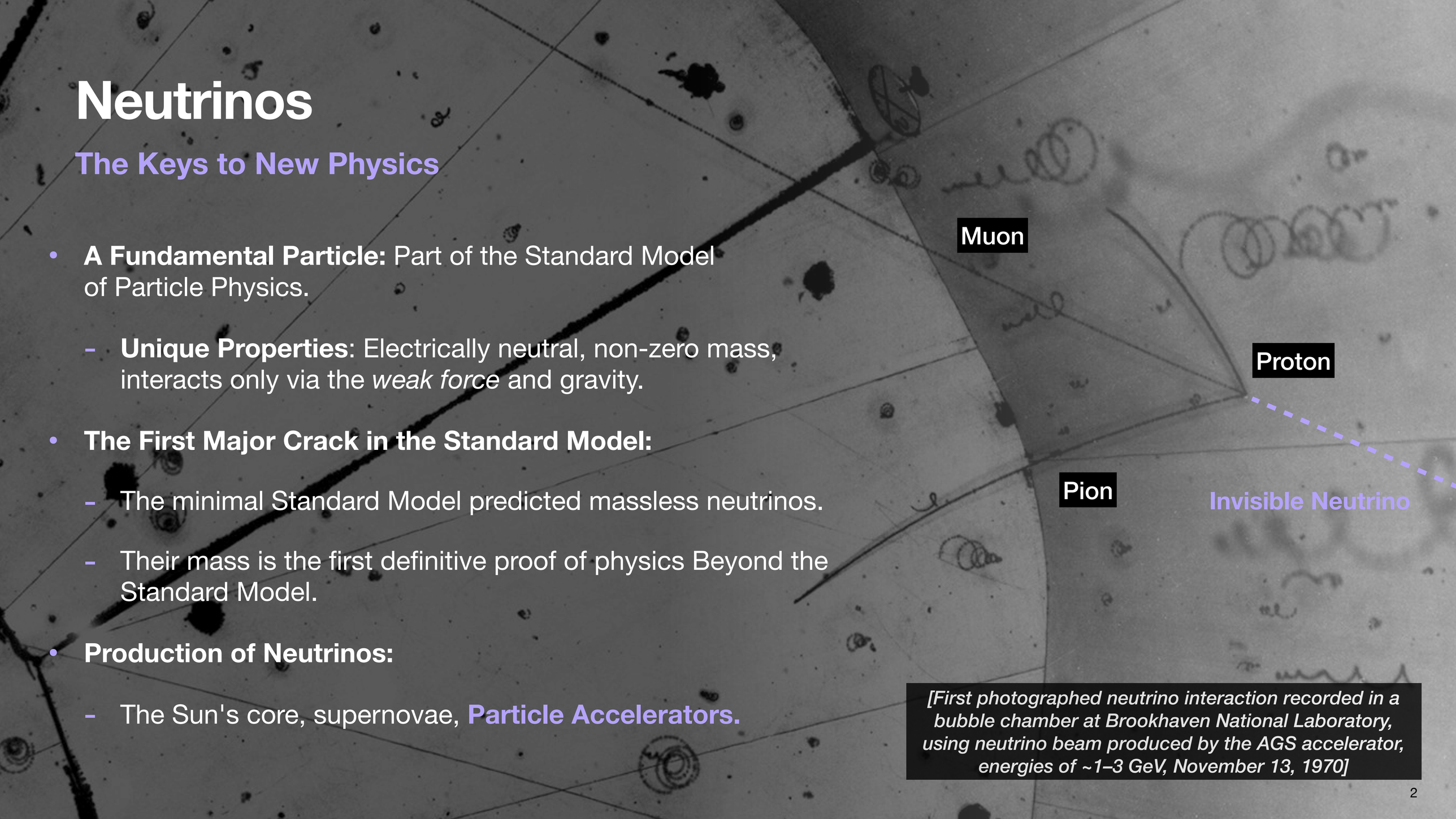
Invisible Neutrino

[First photographed neutrino interaction recorded in a bubble chamber at Brookhaven National Laboratory, using neutrino beam produced by the AGS accelerator, energies of ~1–3 GeV, November 13, 1970]

Neutrinos

The Keys to New Physics

- **A Fundamental Particle:** Part of the Standard Model of Particle Physics.
  - **Unique Properties**: Electrically neutral, non-zero mass, interacts only via the *weak force* and gravity.
- **The First Major Crack in the Standard Model:**
  - The minimal Standard Model predicted massless neutrinos.
  - Their mass is the first definitive proof of physics Beyond the Standard Model.
- **Production of Neutrinos:**
  - The Sun's core, supernovae, **Particle Accelerators.**

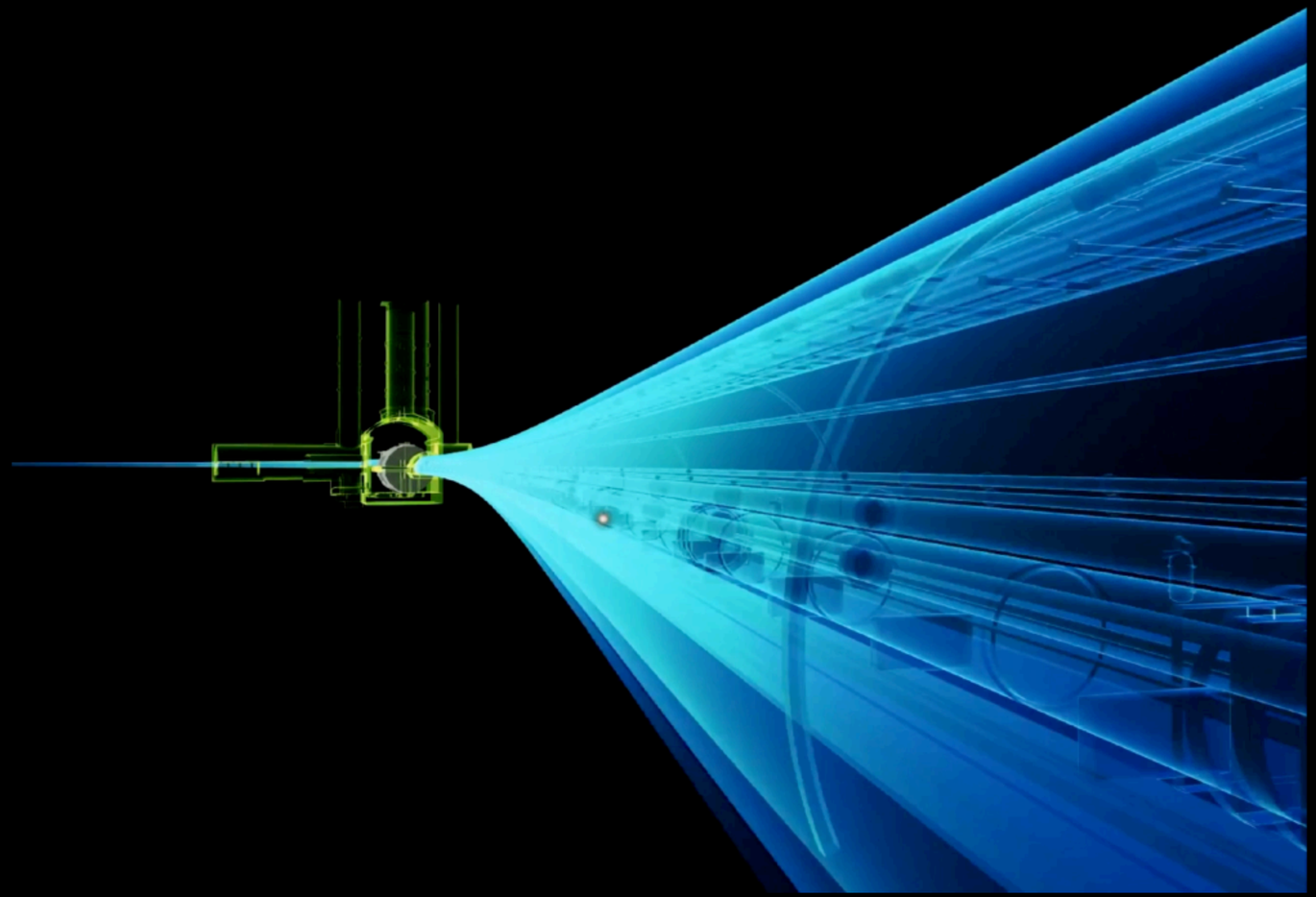


[First photographed neutrino interaction recorded in a bubble chamber at Brookhaven National Laboratory, using neutrino beam produced by the AGS accelerator, energies of ~1–3 GeV, November 13, 1970]

Large Hadron Collider

Proton accelerator: Neutrino Factory

- **An Unexplored Source:** LHC provides the highest-energy neutrinos ever produced in a laboratory.
- **The Ring:** Protons travel around a **27-Km ring (LHC)** before they are guided into collision.
- **Detection:** p-p collisions at $\sqrt{s} = 13\ TeV$ (13.000x higher than AGS) inside detectors like ATLAS.
- **Forward secondary particles:** These collisions create a massive spray of secondary **hadrons** (π , K , …).



[ATLAS Experiment: Link]