DIY particle physics

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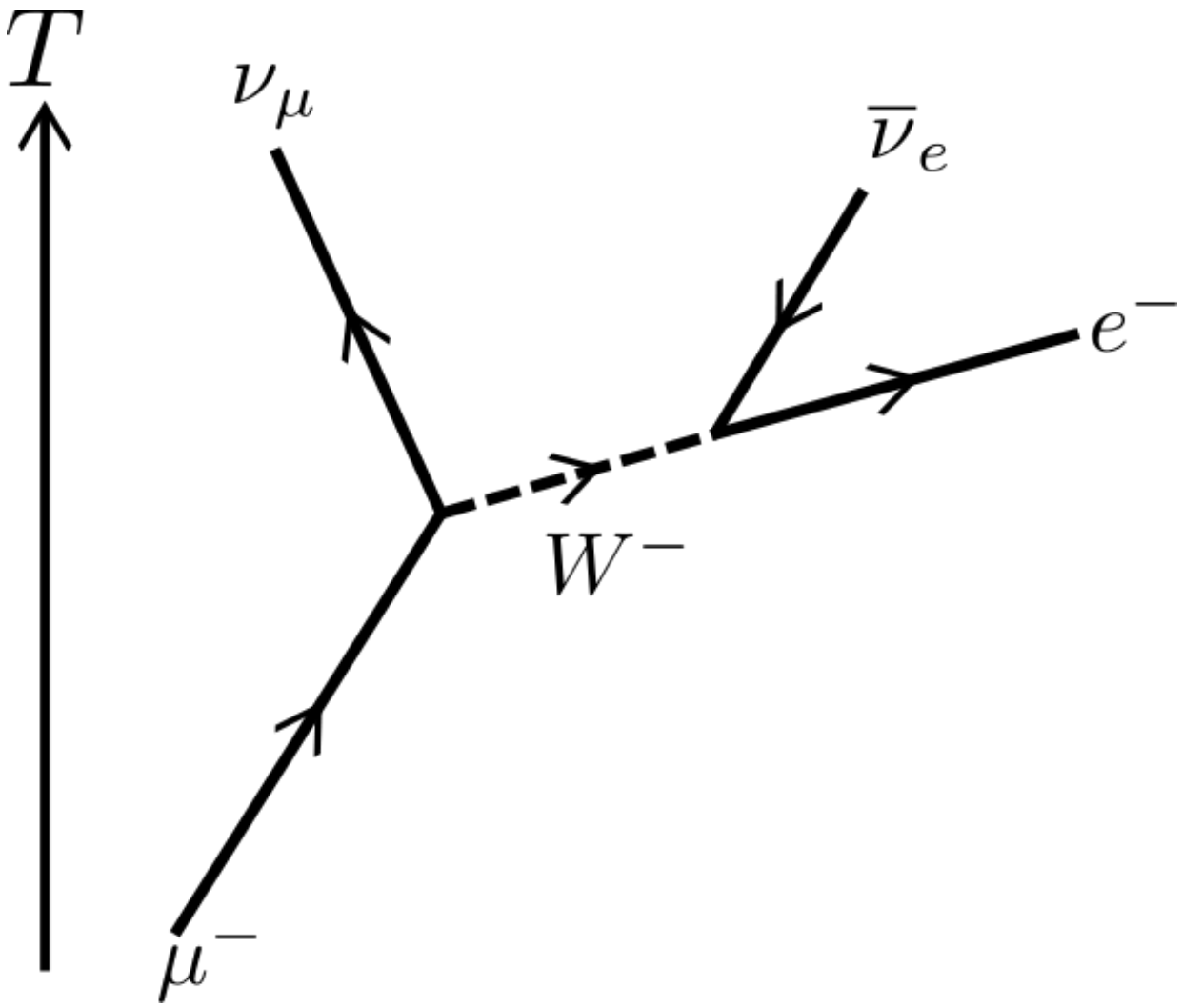

The most common decay of the muon. Credit: Public Domain

A team of two undergraduate students and their adviser at Missouri

Southern State University has built a type of particle detector usually found only at large research organizations like CERN.

Using a little more than five hundred dollars worth of off-the-shelf parts, the team constructed a ring-imaging Cherenkov (RICH) detector, which can identify electronically charged subatomic particles by analyzing the eerie glow of light the particles emit when they travel faster through a material than the speed of light in that material.

The project was born from the desire to help students without access to expensive facilities perform hands-on experiments in particle physics, said Kristina Pritchard, a physics student at Missouri Southern State University in her junior year. Pritchard collaborated with fellow student Shemaiah Khopang and faculty advisor David McKee to build the detector.

Pritchard will present the team's design on Saturday, April 11 at the APS April Meeting in Baltimore, Maryland.

The core of the inexpensive RICH detector is a commercial digital camera made by Sony. Pritchard and Khopang took apart the camera and inserted a piece of material with an index of refraction lower than glass. Finding the right material was the toughest part of the project, said Pritchard. The team ultimately used a piece of magnesium fluoride, which has an index of refraction of n=1.37, compared to typical glass indices of refraction that range from n=1.5 to n=1.6. The new material was needed to lower the angle of the emitted Cherenkov radiation in order to see the ring of light.

Another challenge came from an unexpected source: 1.6mm diameter screws. Once the team disassembled the camera, they realized they needed additional screws to put it back together, but the screws they needed were not a size typically available in the U.S.

With persistence and luck, Prichard located a rare stash of 1.7mm screws at a local hardware store that were just small enough to do the job. "Boy, have I felt like MacGyver through this process!" she said.

The team plans to validate their detector by measuring the cosmic muon energy spectrum. Muons are a type of negatively charged elementary particle. Most muons that reach earth are formed when cosmic rays collide with molecules in the atomosphere. "About 1 muon goes through your hand each second," Prichard said.

The team has finished modifying the camera and Prichard and Khopang have already spotted their first photon ring. They will continue to gather data in the months ahead.

"When we first saw the photon ring we started jumping up and down," Prichard said. "Assuming all goes well, we hope to share this design with universities all around the world so that others with little to no financial help from the school will be able to experience hands-on research in particle physics."

More information: Presentation: C5.00008: Muon Detection with a Ring Imaging Cerenkov Radiation Detector, Saturday, April 11, 2:54 PM, Room: Key 1. ABSTRACT: meetings.aps.org/Meeting/APR15/Session/C5.8

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