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First light detection with an optical Time Projection Chamber

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An optical Time Projection Chamber (TPC) is proposed for future neutrino experiments. Its excellent particle detection momentum threshold, together with cost-effective scale-up prospects, make the TPC a strong candidate for reducing systematic errors due to neutrino-nucleus interactions.
In order to produce a high number of photons, the TPC is equipped with a thick gaseous electron multiplier (ThGEM). Per each electron produced in the ThGEM holes, thousands of photons are created. Next, the electrons created in the ThGEM are extracted and drifted further towards a mesh. Here, by applying a high enough electric field to excite the Argon atoms, but low enough in order not to ionise them, electroluminescence (EL) photons are produced. The photons, normally in the UV range, are shifted to visible using a PEN wavelength shifter.

The firsts tests of the chamber were carried with a photo-multiplier tube. Several methods, including drift velocity, and trigger rate studies confirm that the TPC works as expected.

For a second phase of tests, voltage was placed on the EL mesh too, and a light yield increase was observed, as expected due to the electroluminescence effect. Surprisingly, a yield increase was observed even for small electric fields. This can not be explained through EL but it is rather an effect of the electrons being forced out of the ThGEM holes; the more towards the exterior the photons are produced, the less they get absorbed by the walls of the ThGEM.

For a third, and final study of the TPC, a 256 SiPM array has been set up.
Simulations show that by using two simple bi-convex lenses, hundreds of photons can be detected per cosmic-ray crossing the detector. Moreover, magnitudes of up to 12 can be obtained. In other words, if a particle leaves a track of 12cm in the real detector, the projected image on the SiPM array is only 1cm.
Currently, the SiPM array is in its first analysis phase, being very close to its first full track reconstruction. Thank you!

Attendance type

In-person presentation

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