Light detection in DUNE Dual-Phase

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Lepton-Photon 2019
9th August 2019
Deep Underground Neutrino Experiment

DUNE is a long-baseline neutrino oscillation experiment. It will detect a beam of neutrinos 1,300km away.

It has a rich physics program:

- **CP violation** and **neutrino mass** ordering using neutrino oscillations.
- **Proton decay searches** and **neutrino astrophysics**.

4 x LAr TPCs of 12x12x60m$^3$ 10kton fid. mass. each.

**Dual Phase module:**

12m drift distance.

Argon gas layer in the top to amplify the charge signal.
The Light Detection System will provide:

- Event time reconstruction (needed to do 3d reconstruction in non-beam events).
- Trigger for non-beam events.
- It can contribute to calorimetric reconstruction.

It consists on:

- 720 8” Hamamatsu PMTs coated with TPB.
- A LED-based fiber light calibration system.
- Reflective foils in the top part of the detector “walls”.
Performance of the system with simulation studies

To validate the system, several Monte Carlo simulation studies have been performed:

Detected photo-electrons per MeV of deposited energy

Light yield > 1PE in the worst case, 12m away from the PMTs.

Beam energy reconstruction

Deposited energy resolution below 10%, and total energy resolution below 18% for $\nu_e$CC interactions at different energies.
Performance of the system with simulation studies

Supernovae neutrinos light trigger

>95% triggering efficiency on a Supernova Burst at 20 kpc, the far side of the galaxy.

Proton decay searches

>90% time reconstruction efficiency and purity at all fiducial volume.
... stay tuned!

• Dual-Phase technology is being tested at large scale at CERN.

• ProtoDUNE DP finished its filling this morning and data taking will start in the forthcoming weeks!

Inside of protoDUNE DP during the filling on July 7th 2019.