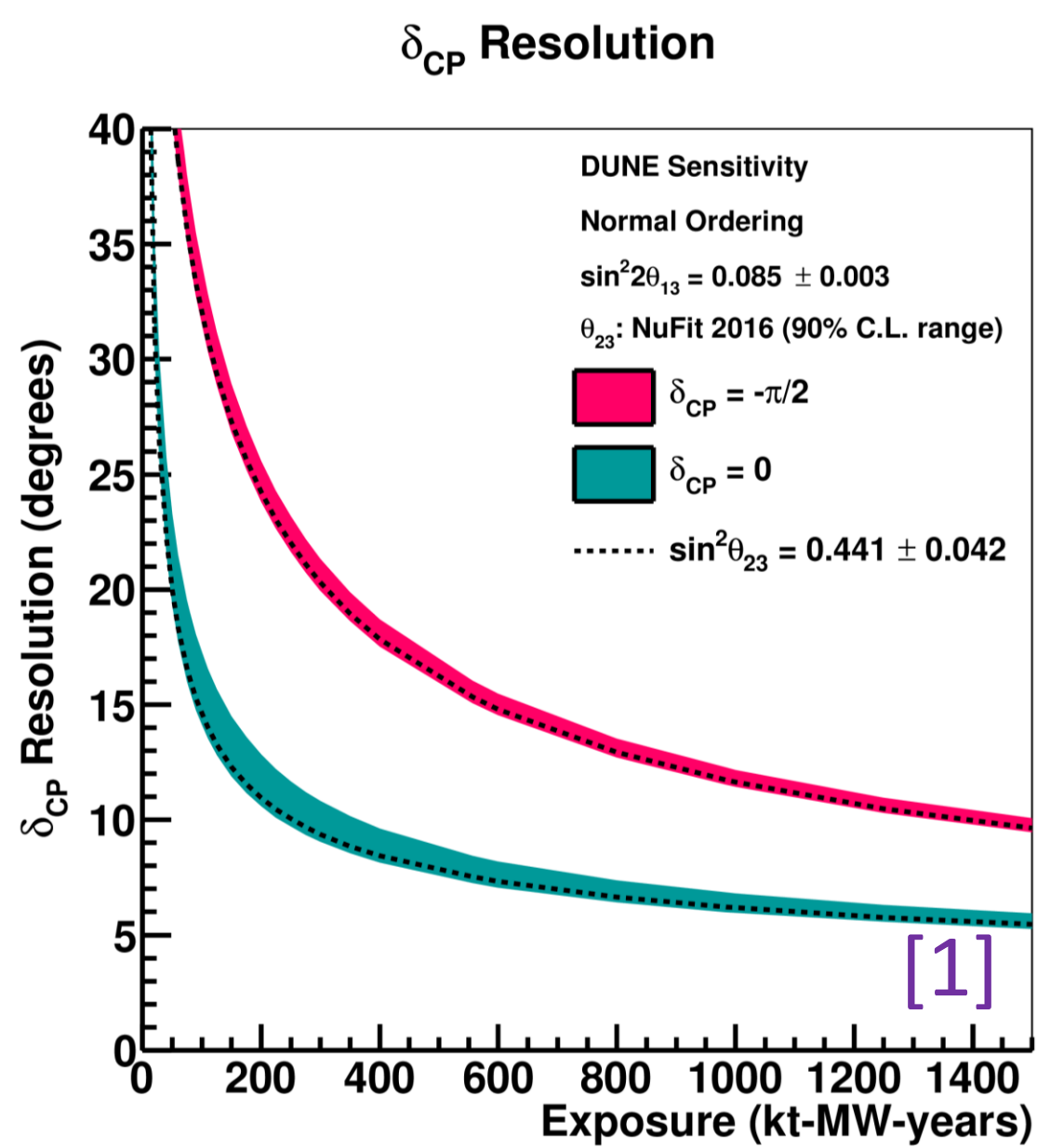


What is DUNE?

The Deep Underground Neutrino Experiment (DUNE) will be the largest neutrino detector of the next decade.

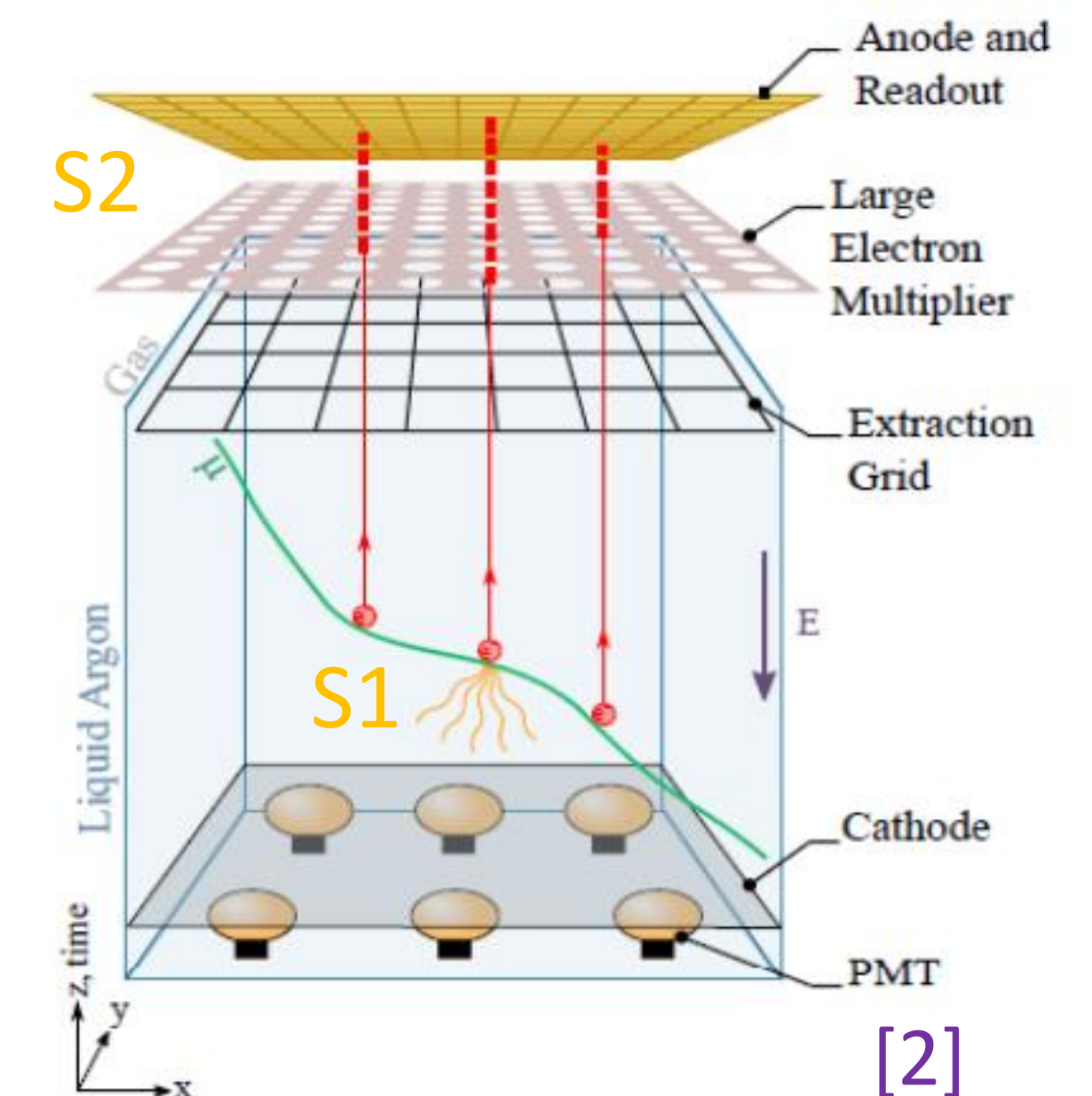


- ❖ It will detect a beam of neutrinos 1,300km away.
 - ❖ Physics goals: **CP violation** and **neutrino mass ordering** with neutrino oscillations, **proton decay searches** and **neutrino astrophysics**.
 - ❖ 4 x LAr TPCs of 12x12x60m² 10kton fid. mass.
- Dual-Phase Far Detector module:**
- ❖ 12m drift distance.
 - ❖ Argon gas in the top, to amplify the signal.

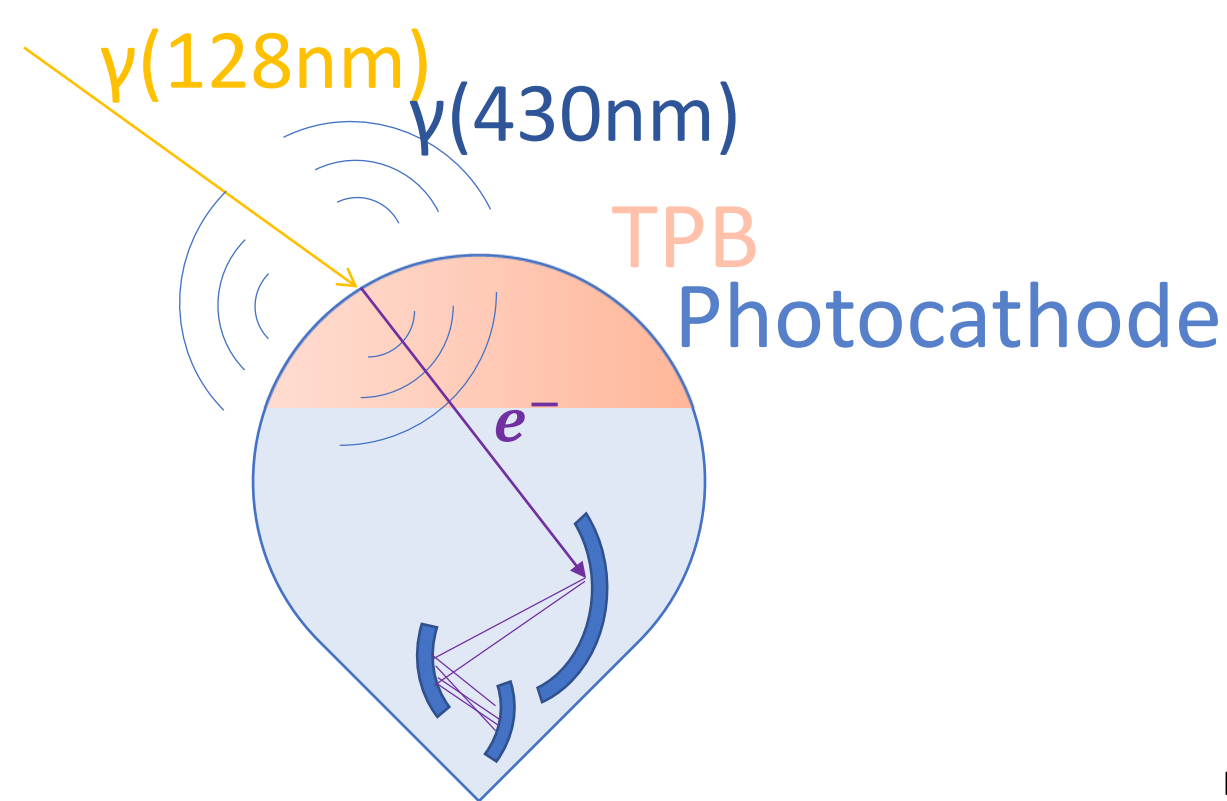
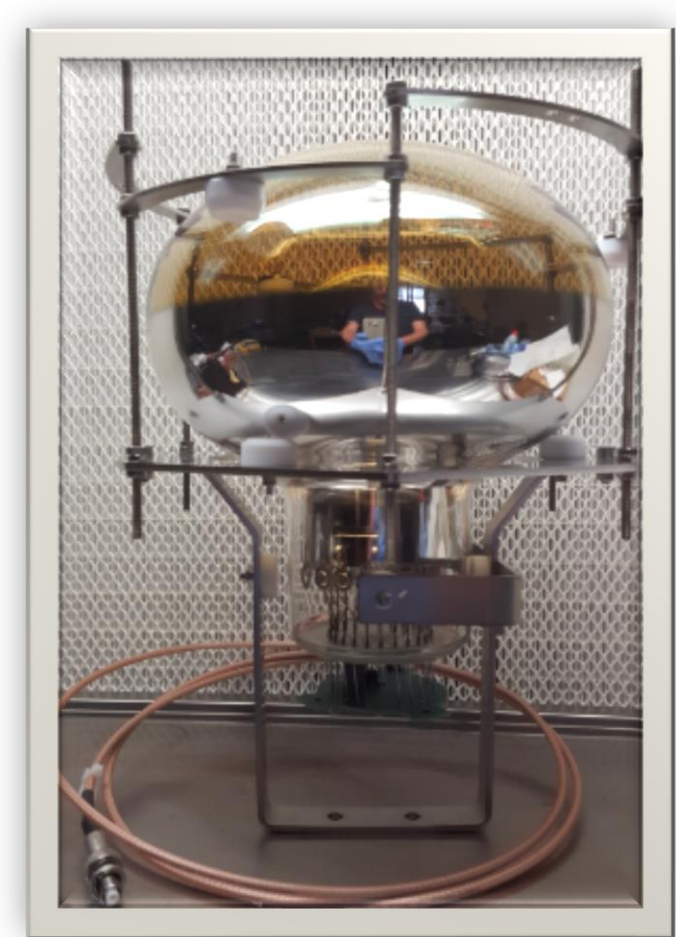
Why is the light important?

Ionizing particles produce **scintillation light (S1)** and ionization electrons, which are drifted and extracted producing **electroluminescence light in gas (S2)**.

- ❖ The light provides event **time reconstruction**.
- ❖ It provides a trigger for non-beam events: Light is a prompt signal to detect neutrinos coming from **supernovae**, or even looking for **nucleon decay** candidates.
- ❖ It can contribute to the **calorimetric reconstruction**, improving the energy resolution of the detector.

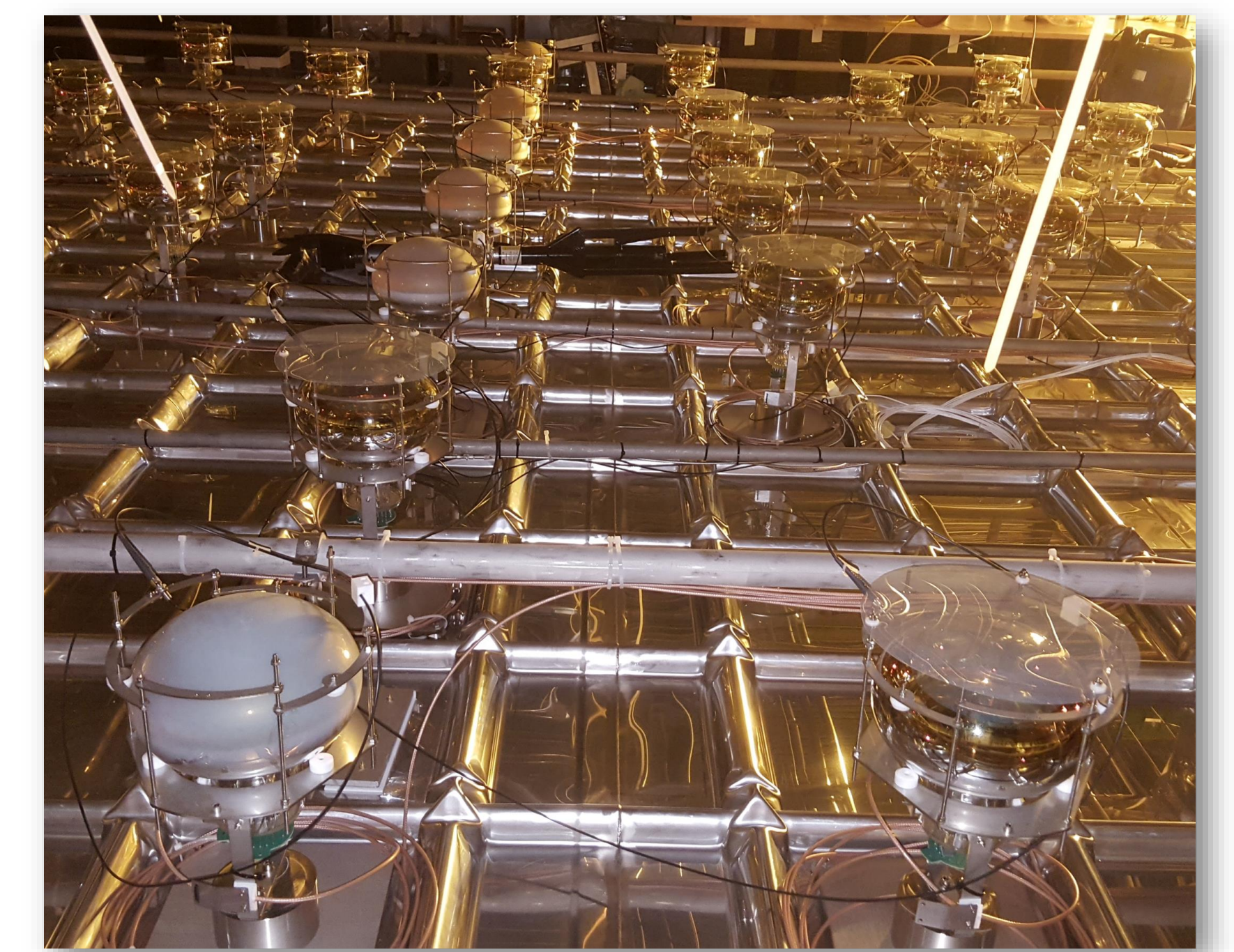
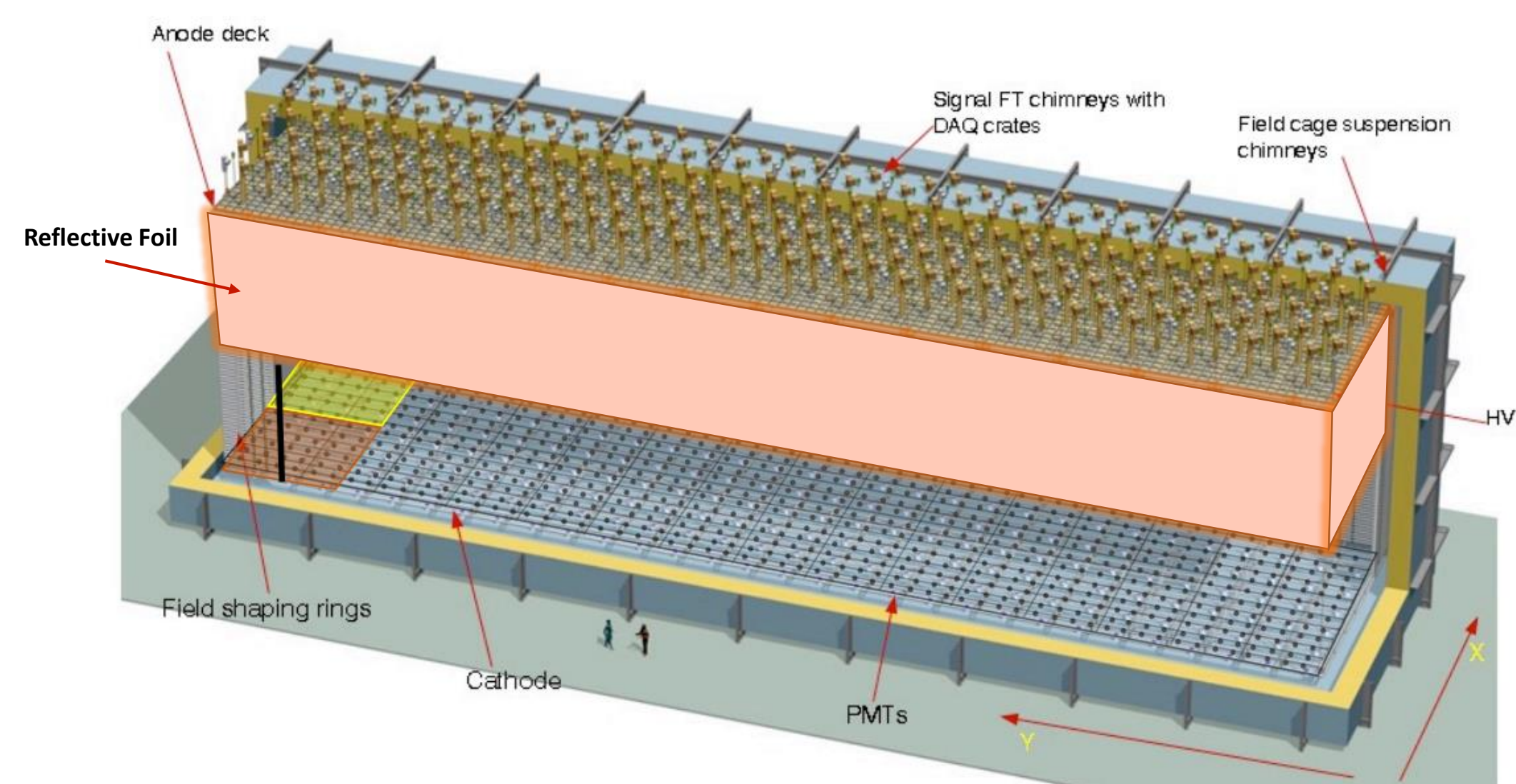


Light Detection System of DUNE Dual-Phase



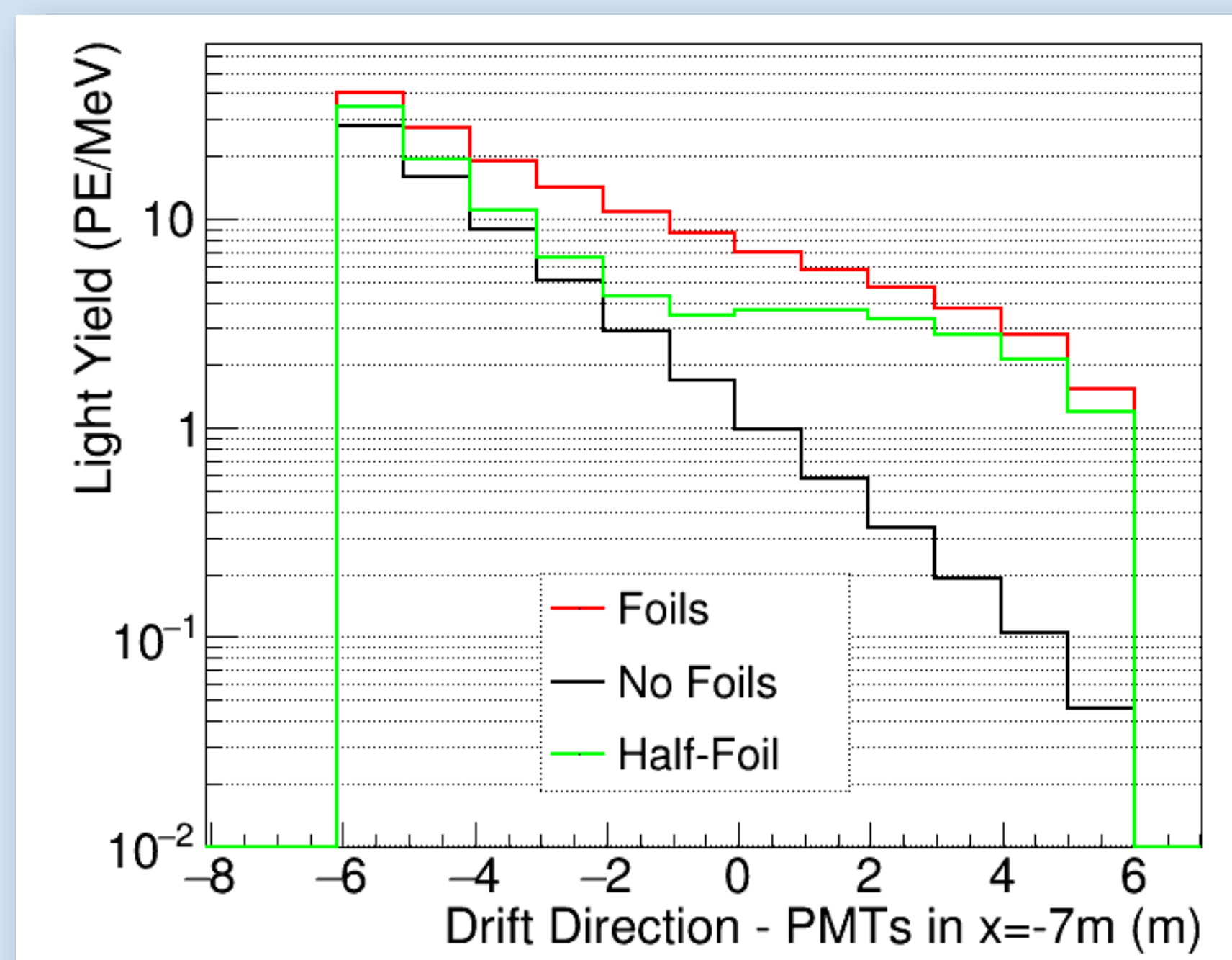
- ❖ 720 8" **cryogenic PhotoMultiplier Tubes** highly sensitive to visible light.
- ❖ PMTs are coated with **TPB**, a wavelength shifter.
- ❖ LED-based fiber **calibration system** [3].

- ❖ The top part of the detector "walls" will be covered with TPB-coated reflective foils.
- ❖ Reflective foils increase the average light yield in the top part and improve the uniformity.



- protoDUNE DP Light Detection System**
- ❖ PMTs are distributed uniformly at the bottom.

Performance of the system with simulation studies

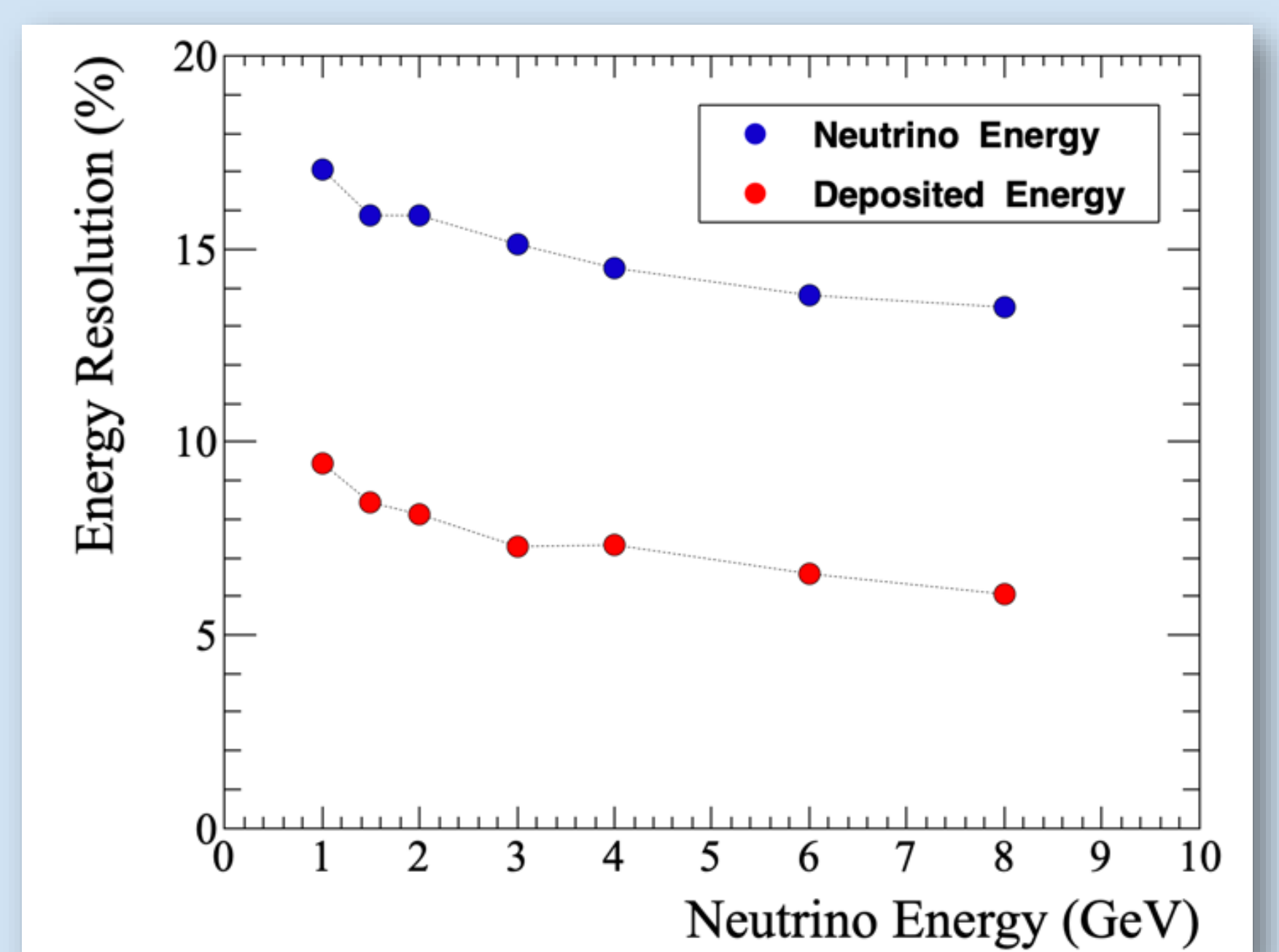
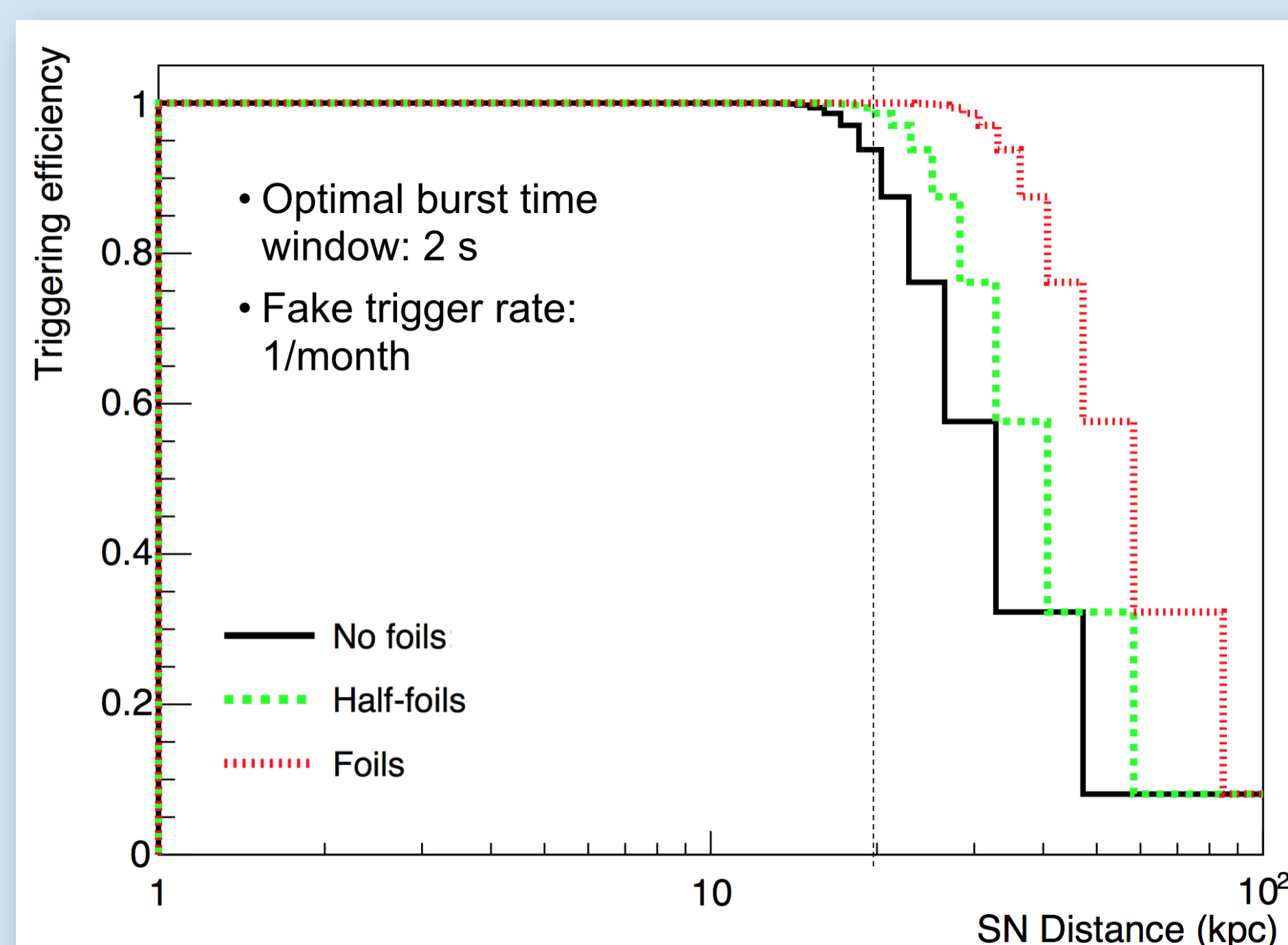


Detected photo-electrons per MeV of deposited energy

- ❖ Light yield > 1PE in the worst case, 12m away from the PMTs [4].

Supernovae neutrinos Light Trigger

- ❖ >95% triggering efficiency on a Supernova Burst at 20 kpc, the far side of the galaxy [4].

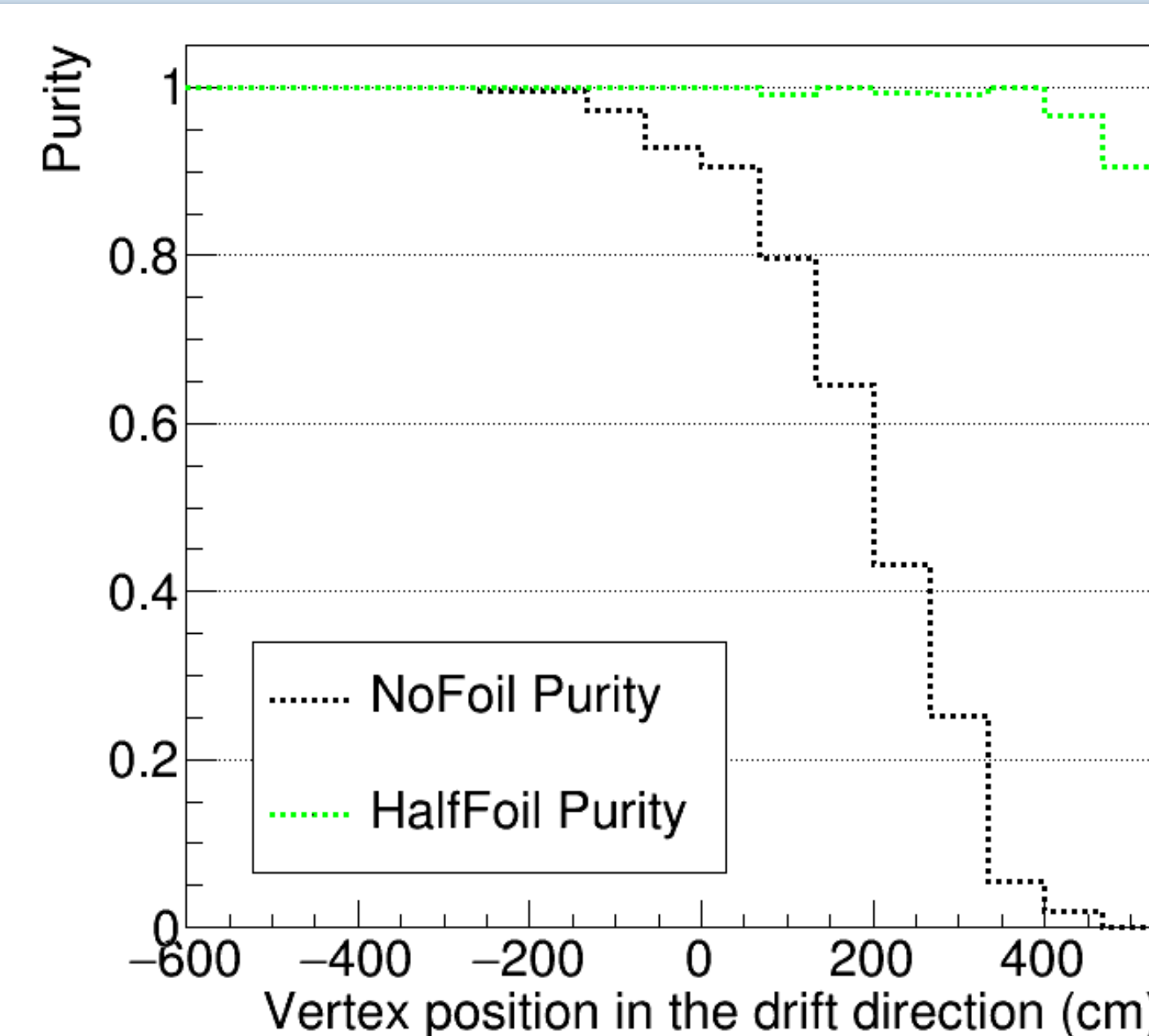
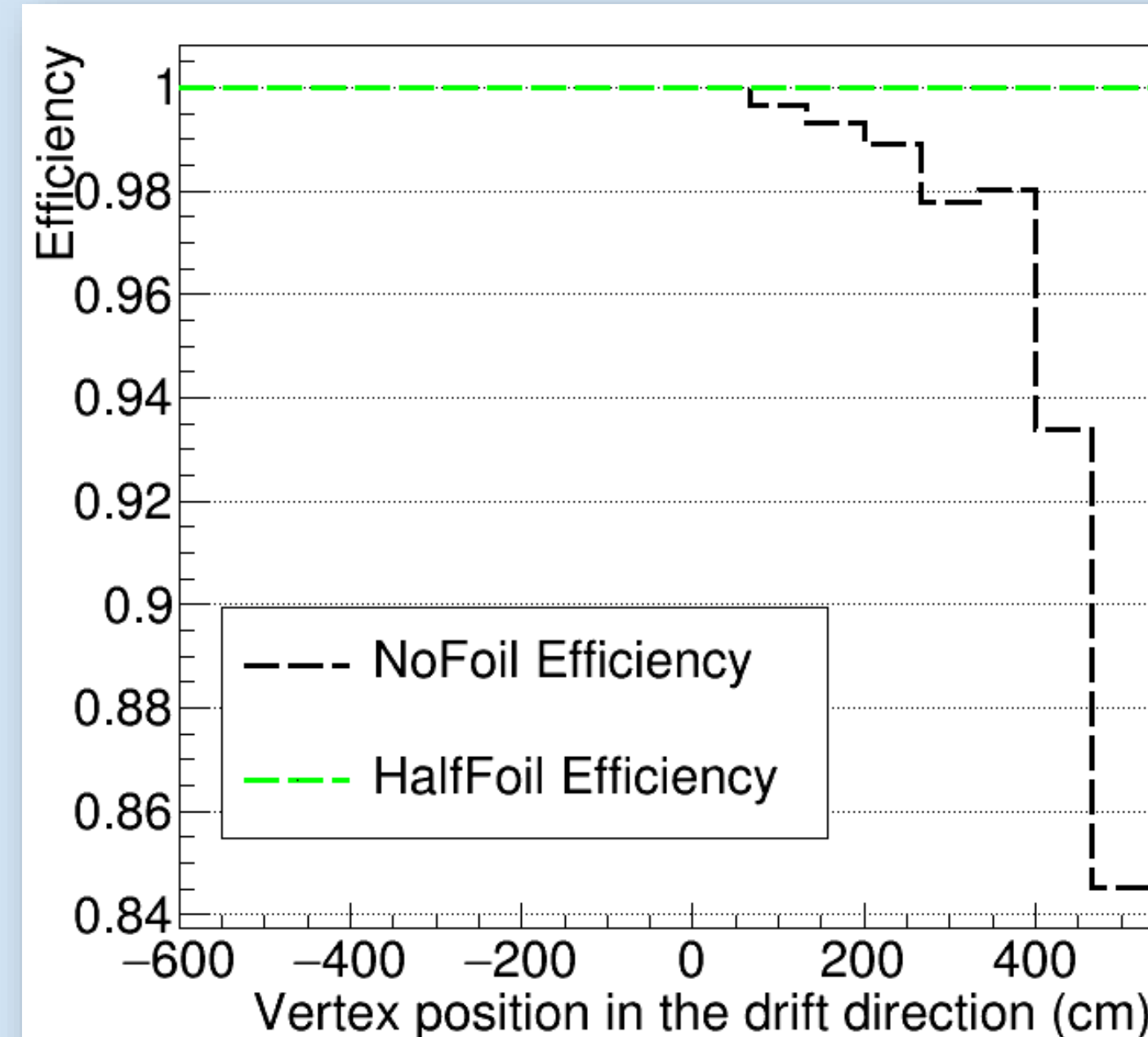


Beam neutrino energy reconstruction

- ❖ Deposited energy resolution below 10%, and total energy resolution below 18% for ν_e CC interactions at different energies [4].

Proton decay searches

- ❖ Study on $p \rightarrow \bar{\nu} K^+$ channel.
- ❖ >90% time reconstruction efficiency and purity at all fiducial volume, which comprises all detector volume except a 70cm buffer at the boundaries [4].
- ❖ PMTs at -700 cm.



REFERENCES

- [1] The DUNE Collaboration, arXiv:1807.10334. [physics.ins-det]
- [2] The DUNE Collaboration, arXiv:1807.10340. [physics.ins-det]
- [3] Beller et al (2019) A light Calibration System for the ProtoDUNE-DP detector. *J. Inst.* 14 T04001
- [4] The DUNE Collaboration. (2019). TDR Physics Volume (in preparation)