



# The light detection system of ProtoDUNE-DP

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- **Motivation:** ProtoDUNE-DP (at CERN) is a prototype for DUNE, it is based on the LAr dual phase technology

- light detection system: 36 Hamamatsu 8'' diameter PhotoMultipliers tubes (PMTs) immersed in LAr (under the TPC cathode)

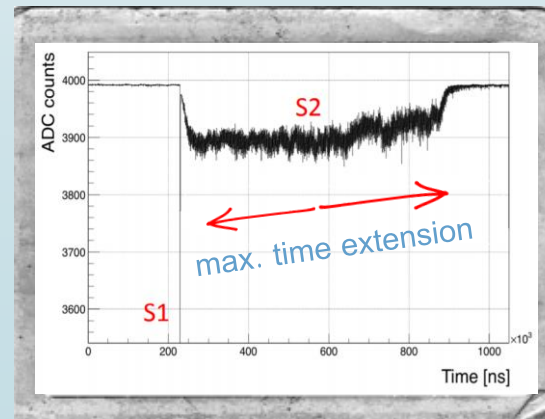
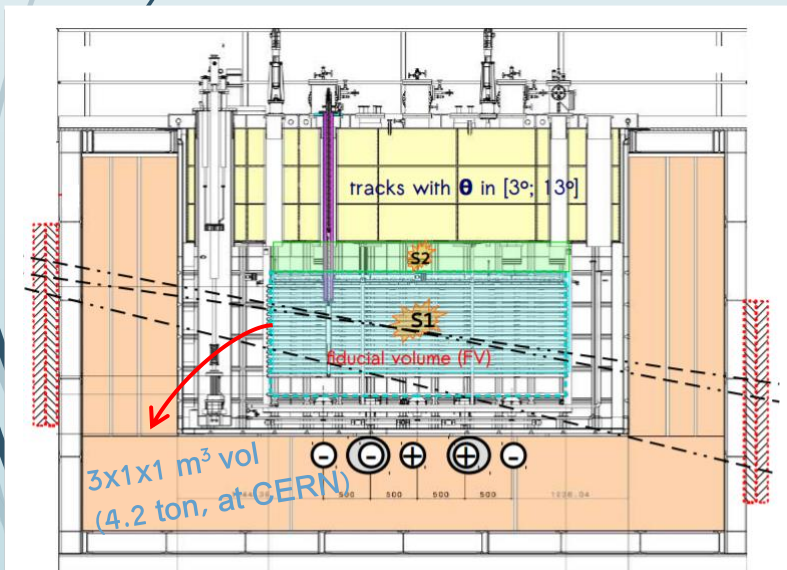
- **Method:** - characterization of the PMTs in the lab

- results of a previous smaller prototype that took data during 2017 (3x1x1 m<sup>3</sup> active volume, at CERN)

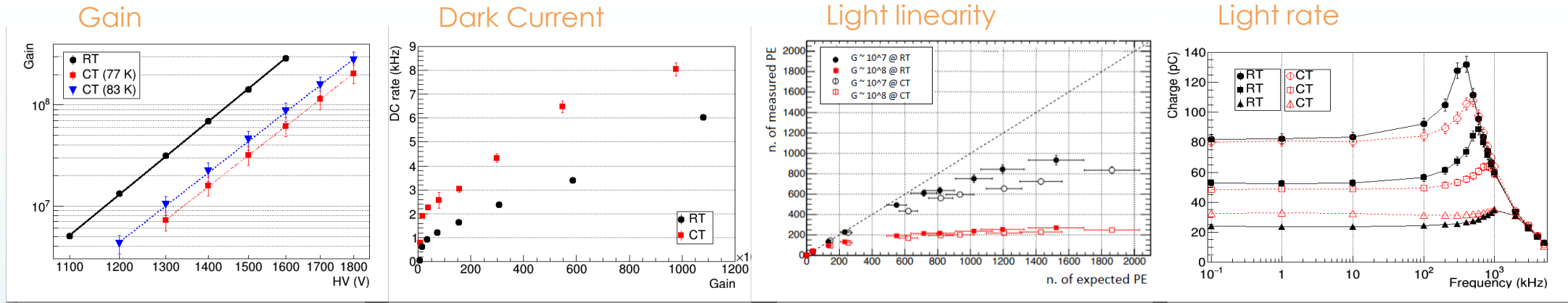
- > extrapolation of these results to ProtoDUNE-DP volume using MC simulation

- **Expected signal:** - primary scintillation light (S1) produced by a particle crossing the LAr fiducial volume (FV), fast comp. ~ 6ns, slow comp ~ 1.3 us

- electro-luminescence light (S2) by drifted electrons in GAr phase, maximum S2 extension related maximum electron drift time



► results from the characterization of the 36 PMTs in the lab (completed!)



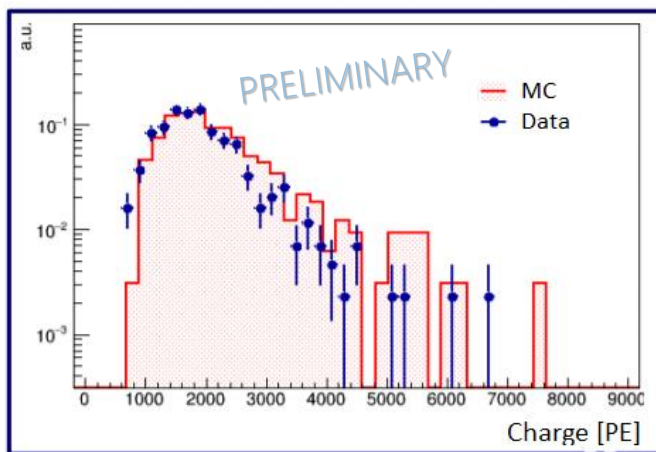
~70% decreasing at 77 K, on average

DC rate higher at CT (non thermionic emission)

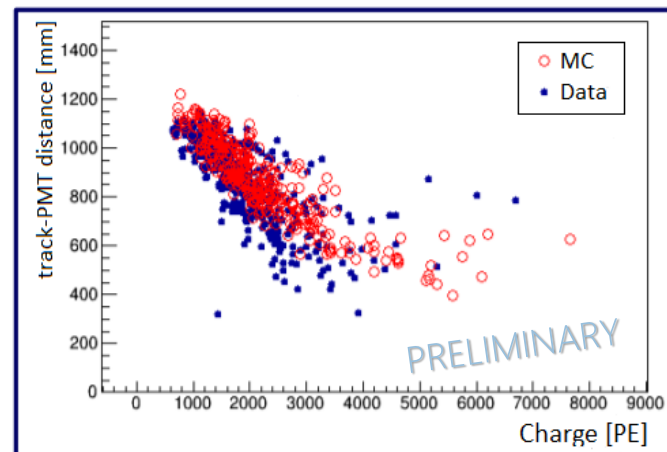
PMT linearity slightly lower at CT (light pulsed with a laser)

PMT response stable up to ~10kHz

► data results and comparison with MC (reasonable agreement, studies of some parameters impact as absorption length or Rayleigh scattering ongoing)



Charge distribution



Charge vs track-PMT distance

- travel time distr.: double exp param
- LAr absorption:  $\lambda_{\text{abs}} = 30 \text{ cm}$ , exp. param
- Rayleigh scattering:  $\lambda_{\text{Ray}} = 55 \text{ cm}$
- abs. on stainless-steel and Cu
- TPB simulation
- quantum eff. = 20%
- ideal PMT response simulated

