

# Scheduling the completion of the analysis of the Xe-doped run of ProtoDUNE-SP

Francesco Pietropaolo and Francesco Terranova

# A two-step analysis

Outcome of the 60% readiness review of the PDS

- The preliminary results of the Xe run are very promising
- It is likely that the Run II will be carried out in Xe-doping mode (10-20 ppm) **provided that the results are confirmed**
- This decision may have different impacts on the X-Arapuca:
  - (conservative) Use the baseline X-Arapuca
  - (more effective) Re-tune the dichroic filters to increase the light collection efficiency and fully benefit from the Xe doping
- Show the results to get feedbacks from the rest of the LAr community since they are quite unexpected

## Tentative proposal

Perform a two step analysis corresponding to two different papers:

- A “basic” paper that ground the decision to run with Xe in Run II to be published by november 2020
- A more complete paper(s) to discuss the physics of Xe doping observed in ProtoDUNE

# The “basic” paper

We want to show that:

- Xe light is clearly visible in the standalone X-Arapuca and in the Arapucas of ProtoDUNE and increases with doping, saturating at about 10-20 ppm
- Demonstrate that Xe-doping is a suitable solution to possible accidents in DUNE due to **Nitrogen contamination**
- Quantify the **uniformity** of the distribution of Xe in time and lack of accumulation effects (stability)
- Quantify (even approximately) the increase of light yield at 178 nm and the conversion from the fast component

## Tools:

- X-Arapuca system triggered in standalone mode: increase of Xe light, stability over time, saturation effects, nitrogen compensation,
- Arapuca: uniformity, consistency checks with the X-Arapuca system
- Whole PDS (bars): uniformity and stability

In a nutshell: the basic paper is focused on the **relative** changes of light yield and the taus of the waveform.

---

# Main tasks of the “basic” paper

- X-Arapuca basic performance (size of p.e., comparison among the channels, calibration) [Luca, Carla, Henrique and Niccolo, Umut]
- Comparison among the different runs for nitrogen compensation, increase of Xe light (quartz windows), increase of light in the various components [Niccolò, Henrique, Umut, Furkan, Fatma + Carla and Luca]
- Selection of runs with the ARAPUCA and test of consistency and stability in time [Stefania]
- Selection of runs with the full PDS and test of consistency and stability in time and space [Dante, Kyle, Brian]
- Refinement of the deconvolution (if needed) and comparison among the algorithms [Kyle, Niccolò, Luca, Carla]
- Analysis of the TPB+SiPM based system [Umut, Furkan, Fatma]
- Synchronization of triggers standalone-protodune for a particle by particle analysis [Sehran]

# Simulation

This is a **critical issue**: in principle the basic paper is conceived to reduce at minimum any simulation effort (relative comparison). However, there are issues that might be solved only by simulation (see Niccolò's presentation)

- Toy simulation based on muon distribution to evaluate the solid angles and convert in light reaching the detector [**Henrique, Niccolò**]
- Simplified GEANT4 simulation to determine the amount of charge deposited in the upper part of the cryostat, near the standalone system and uncover biases between the standard X-Arapucas and the one with quartz windows. Need a code for the **simulation of the cosmic ray soft component** [?? + LAr]
- Should we use the full ProtoDUNE already in the basic paper? Maybe needed if there are outstanding issues, which are not understood.

# Beyond the basic paper

Not the focus of this meeting but it is worth start thinking about it:

- Reyleight scattering
- Absolute light yields
- Light conversion mechanisms
- Reoptimization of the X-Arapuca

## Actions for today

- Latest news on analysis
- Identify missing items
- Identify contact persons
- Meetings: bi-weekly during summer, weekly from August 25 ?