Calibration for the CERN Prototype Detector

9-month milestones

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Goals for Calibration

Measure electric field, purity, electron lifetime, drift velocity, electron recombination, temperature, fiducial volume, etc. Many of these quantities vary by location and time.

1. Provide key information for offline data reconstruction and calibration

2. Serve as a way to monitor the status of the detector [online, slow control]

3. Study the detection challenges to the precision measurements for a long-baseline large scale experiment [make an impact to DUNE detector design]

This talk focuses on developing a blueprint to initiate the calibration group effort

Physics Case Studies – what system to build

Back of the envelope

- How much each quantity could vary
- How much it affects the uncertainty to kinematics reconstruction, then to neutrino measurements
- What system needed for measuring these quantities
- To what accuracy the measurement could (need) achieve

Simulation

- Model studies with computers could lead to another level of precision and provide insight for sub-system development
- Introduce uncertainties to physics measurements and find the impact

You can (should) contribute

- Great for training students: fundamental understanding of detector technology
- Broad impact – both to detector design and to physics topics
- Easy to start up

Calibration System – build it

Impact to cryostat/TPC/Experimental hall designs

- Amount of feedthrough ports; the size; location
- Supporting structures inside cryostat
- Supporting structures on TPC; modification to TPC
- Space/Safety requirements
- These should be finalized in about 6 months

Sub-system R&D

- Most sub-systems can be first set as a stand-alone detector for studies
- Perform tests to verify if they match the needs
- Development software for future online/offline system integration

Take responsibility of these sub-systems

- Significant and distinctive detector contribution
- Significant experience – some are very new to the field

Current list of sub-system

Empirical; to give a picture of what would be involved

Not including people involved in reviewing and physics case studies

Task	Estimated Time	Manpower (FTE)	Est. hardware cost
Gas purity analyzers O_2: Servomex H_2O: Tiger Optics	8 months purchasing analyzers put together high purity lines Take/analyze data, tune Expertise level: mid	Engineer 0.3 Technician 0.3 Physicist+Student 0.6	60 k
Liquid purity monitors	A year Construct/assemble purity monitors Electronics Light source Mounting structures Feedthroughs Take/analyze data, tune Expertise level: high	Engineer 0.6 Technician 0.6 Physicist+Student 1.2	150k for 3 monitors
Temperature sensors	3 month Purchasing sensors feedthroughs Slow control system Expertise level: low-mid	Engineer 0.2 Technician 0.2 Physicist+Student 0.3	20 k

Current list of sub-system

Task	Estimated Time	Manpower	Est. hardware cost
Laser calibration system	A year Purchase laser, optics Laser table, safety equip R&D, decision, construction Laser monitoring system R&D, decision, construction Analyze data, tune Expertise level: high	Engineer 1 Technician 1 Physicist+Student 3	300 k
Muon detector	A year Decision, construction Data acquisition system take/analyze data, tune Expertise level: high	Engineer 1 Technician 1 Physicist+Student 2.5	?

Data Calibration

Probably will be integrated to the offline data group

- Is a significant part of the offline data effort
- Directly affect data reconstruction and physics measurements

A foundation for cooperation and synergy need to be planted there

Summary

Calibration has mixed effort from physicists, students, engineers, and technicians

It studies both fundamental detection technology and physics measurements

Contribution can be made on various aspects

It provides great chance for training students and building influential teams