LAr R&D Progress Updates 06/09/26

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Lab Safety and Space Management

- High Bay clean up
  - South side wall cleaned up for EIC R&D in need of additional electrical upgrade
  - No impact on the compressed air which is needed for our setup
- New EEI inspection sticker
  - The EEI inspection stickers are updated
  - Expected to receive the new stickers from our ESA soon

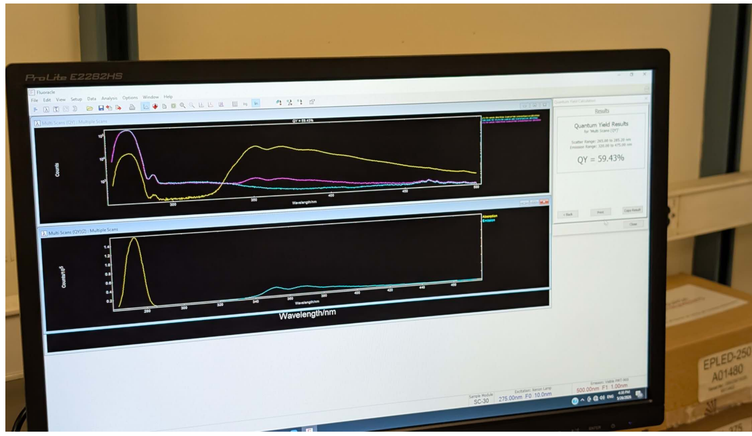
Measurement taken last week

- SiPM calibration measurement
  - We got all 18 VUV SiPMs back from Chemistry Department
  - Conducting SPE calibration measurement on 2 VUV SiPMs, still in progress
- Coating thickness measurement with profilometer at IO
  - Longest scan range to study the substrate shape
  - SBU sample measured from edge to edge
- Spectrum measurement of scrap filter from Yumin
  - 3 pcs with 147x147m size received from Yumin
  - Emission spectrum measured, 1 from 2nd batch, 2 from 3rd batch
- We are going to conduct transmission measurement at Chemistry Department today

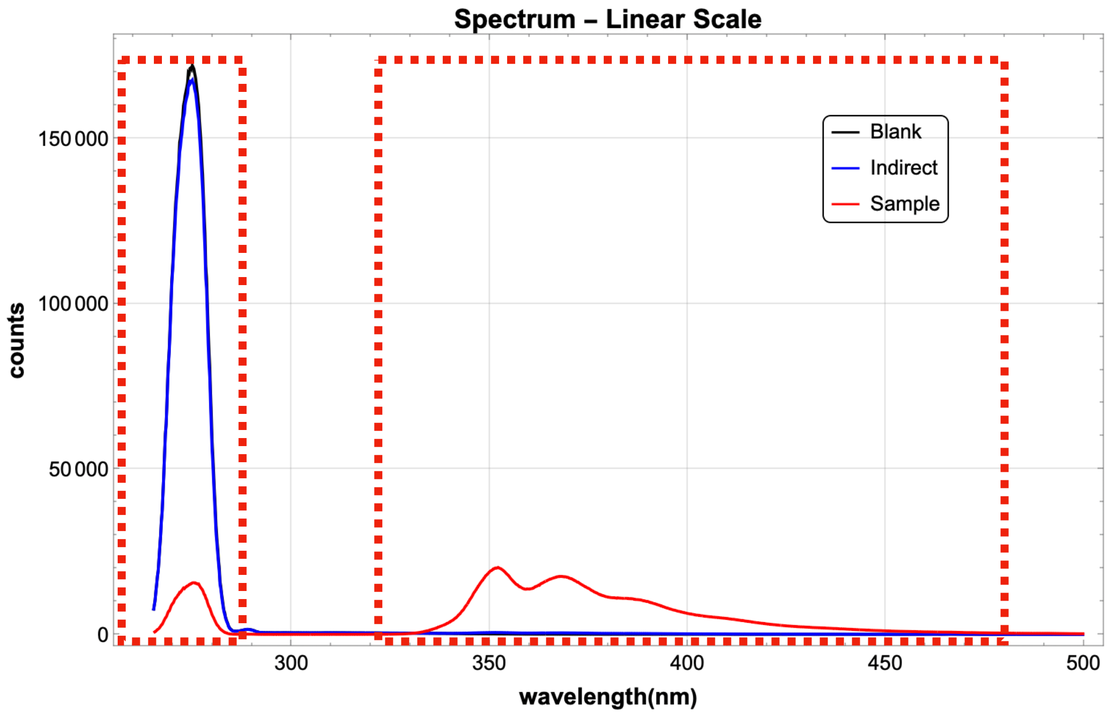
Quantum Yield Results

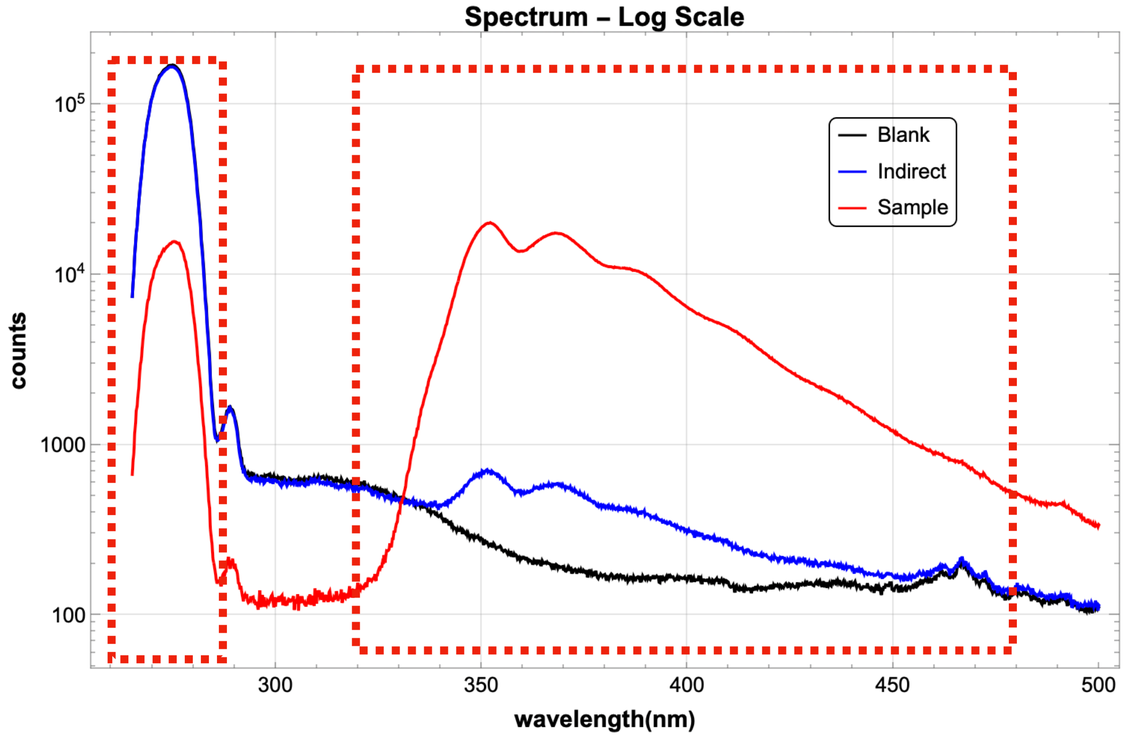
- The Quantum Yield with the measurement method

$$\varphi = \frac{S_{sc}(I_{em} - B_{em}) - I_{sc}(S_{em} - B_{em})}{B_{sc}(S_{sc} - I_{sc})}$$



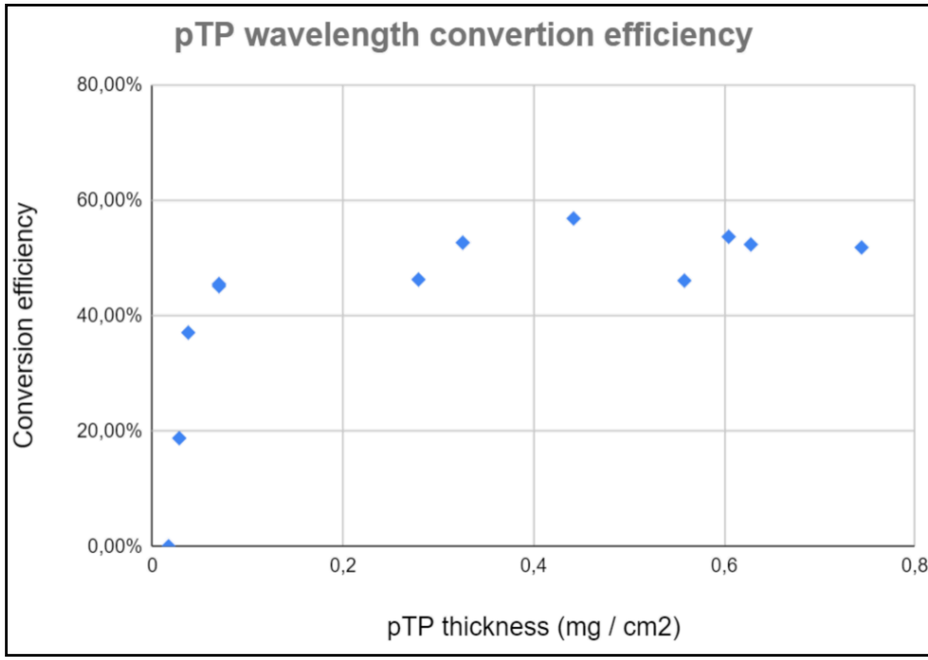
- It takes three measurement get the full dataset
- The QY is calculated by the software with manually selected window for excitation and emission
- The QY efficiency is **59.43%(3 scan)** for the sample with the software, agrees with the offline analysis
- The QY efficiency is **59.47%(2 scan)** by offline calculation, difference is very small





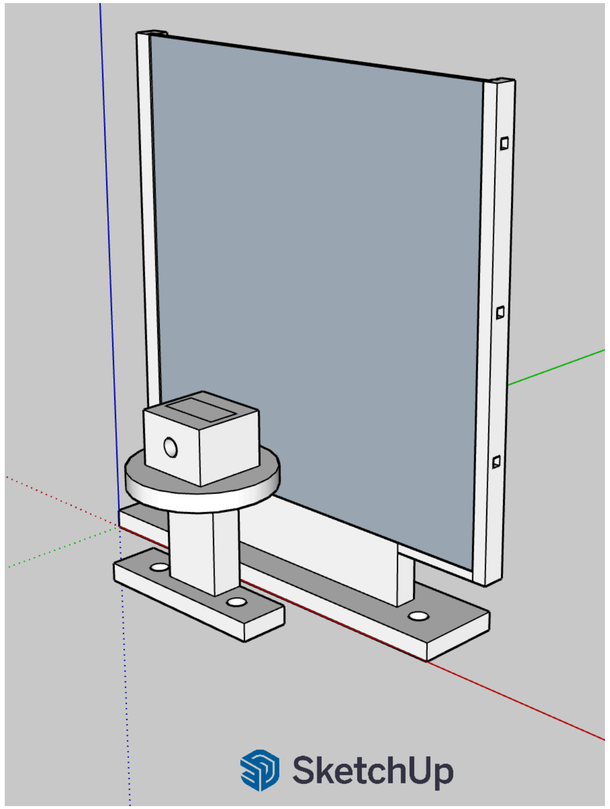
Quantum Yield Results Reference Study

- I looked up for the previous measurement on the pTP quantum yield results
- There just a few reference exist
  - Unicamp group reported some relative measurement:
    - Impact of the surface density of paraTerphenyl films on the Vacuum Ultra Violet light conversion efficiency https://iopscience.iop.org/article/10.1088/1748-0221/20/05/C05027
    - Impact of p-Terphenyl Surface Density on the Efficiency of Filters https://indico.cern.ch/event/1390649/contributions/6061502/attachments/2917675/5120418/Poster_LIDINE.pdf
  - The only reported result I found is found is a work but INFN Pavia group:
    - Experimental setup for the measurement of optical properties in the vacuum ultraviolet region: https://iopscience.iop.org/article/10.1088/1748-0221/19/04/C04036/pdf
    - Good agreement with our measurement
    - One interesting statement in the paper:
      "*…For the three thinnest samples it was not possible to directly measure the coating thickness…*"
- Very few direct thickness measurement….



CAD design for the total internal reflection study

- I made a preliminary design
  - pTP filter can be slide into the holder
  - 3 SiPMs on both sides with mounting points
  - Light injection with rotational base with fiber input to change the injection angle
  - All setup on an optical breadboard
  - Just bought a 3D printer at home
  - Expected to print the first version this week



Plan for summer intern students

Photon Detection System Development and Optical Characterization

Project Goals

- Characterize pTP wavelength-shifting (WLS) filters for PDS applications.
- Calibrate and evaluate VUV SiPM performance.
- Develop a prototype optical detector assembly.

Major Tasks

1. pTP Filter Characterization

- Complete measurements of remaining pTP filter samples.
- Study effects of:
  - Filter thickness
  - Manufacturing variations with longer scanning distance
- Evaluate coating conditions
- Comparison measurement with SBU samples
- Quantum yield measurement
- Transmission measurement

2. VUV SiPM Characterization

- Single Photoelectron (SPE) measurements using oscilloscope.
- Gain calibration and breakdown voltage determination.
- Gain vs. Overvoltage.

3. Detector Prototype Development

- CAD design and 3D printing (PLA prototype).
- Assembly of:
  - Filter mount
  - SiPM holder
  - Detector base
- Mechanical integration testing.

4. Optical Studies

- Investigation of Total Internal Reflection (TIR) effect
- Angular response measurements.
- Relative light collection efficiency measurements.

5. Monochromator Measurements

- Debris sample expected from Yimin

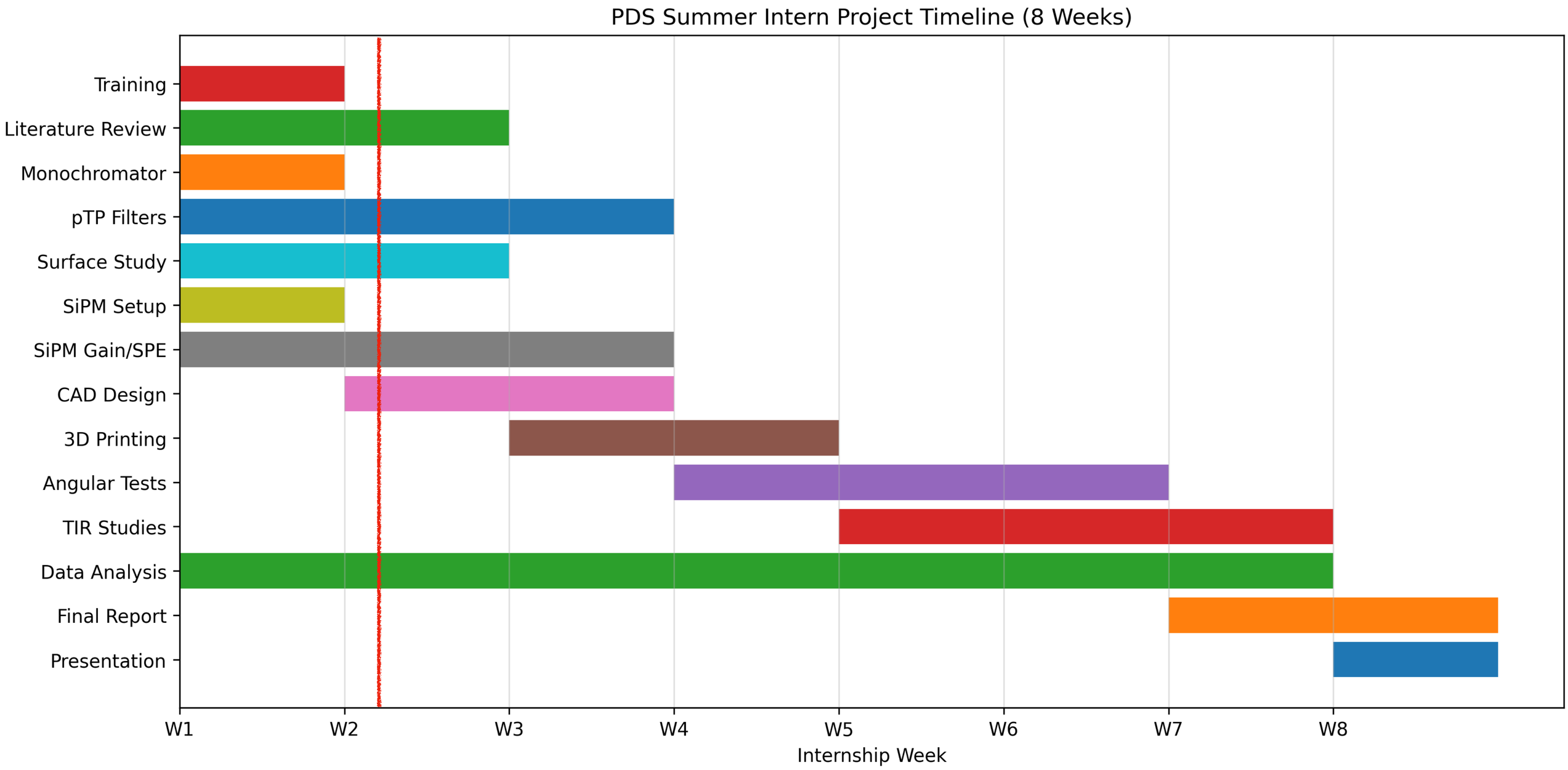
Deliverables

- Complete pTP filter performance database.
- SiPM calibration and SPE analysis package.
- Prototype detector assembly.
- Final technical report(tentative):
  "Characterization of pTP Filters and VUV SiPMs for Photon Detection Systems"

Skills Gained

✓ Optical measurements
✓ SiPM characterization
✓ Data analysis
✓ Mechanical design & 3D printing
✓ Detector instrumentation: spectrometer, profilometer, oscilloscope and etc.

Photon Detection System Development and Optical Characterization Plan



Plan for summer intern students

LAr Stand and Xenon Collection System Project

Cryogenic Operations, Xenon Collection, and Purity Monitoring

Project Goals

- Gain hands-on experience with liquid argon cryogenic systems.
- Support xenon collection and cryogenic operations.
- Construct and commission Xenon collection system
- Operation of cryogenic system

Major Tasks

1. Xenon Collection System

- Study system design and operation.
- Participate in system construction
  - Cryogenic plumbing
  - Leak check
  - Gas handling
  - Hardware installation
- Monitor xenon recovery performance.

2. Cryogenic Hardware & Controls

- Learn detector support infrastructure.
- Work with sensors, instrumentation, and controls.
- Introduction to LabVIEW monitoring and operation.

3. Inline Filter Construction

- Assemble new inline filter
- Leak checking and validation.
- Activation and commissioning procedures.

4. LAr Filling and Purity Measurements

- Liquid argon fills.
- Monitor purity evolution and system performance.
- Analyze purity-monitor data.

Deliverables

- Xenon collection performance assessment.
  Commissioned inline filter system.
- Purity measurement dataset and analysis.
- Final technical report:
  "Commissioning and Performance Evaluation of the Xenon Collection System"

Skills Gained

✓ Cryogenic operations
✓ Vacuum and gas systems
✓ Detector support systems
✓ Hardware assembly and troubleshooting
✓ LabVIEW controls
✓ Experimental data analysis

LAr Stand and Xenon Collection System Project Plan

TBD