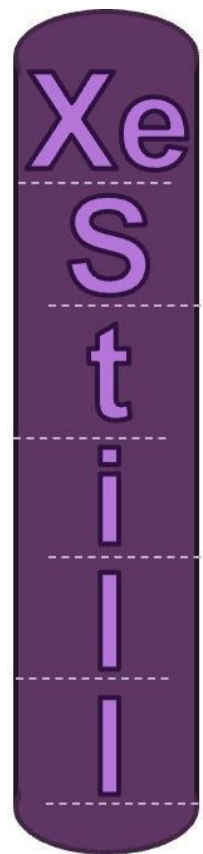


2025/02/04



Xe-Still Project Status/Update

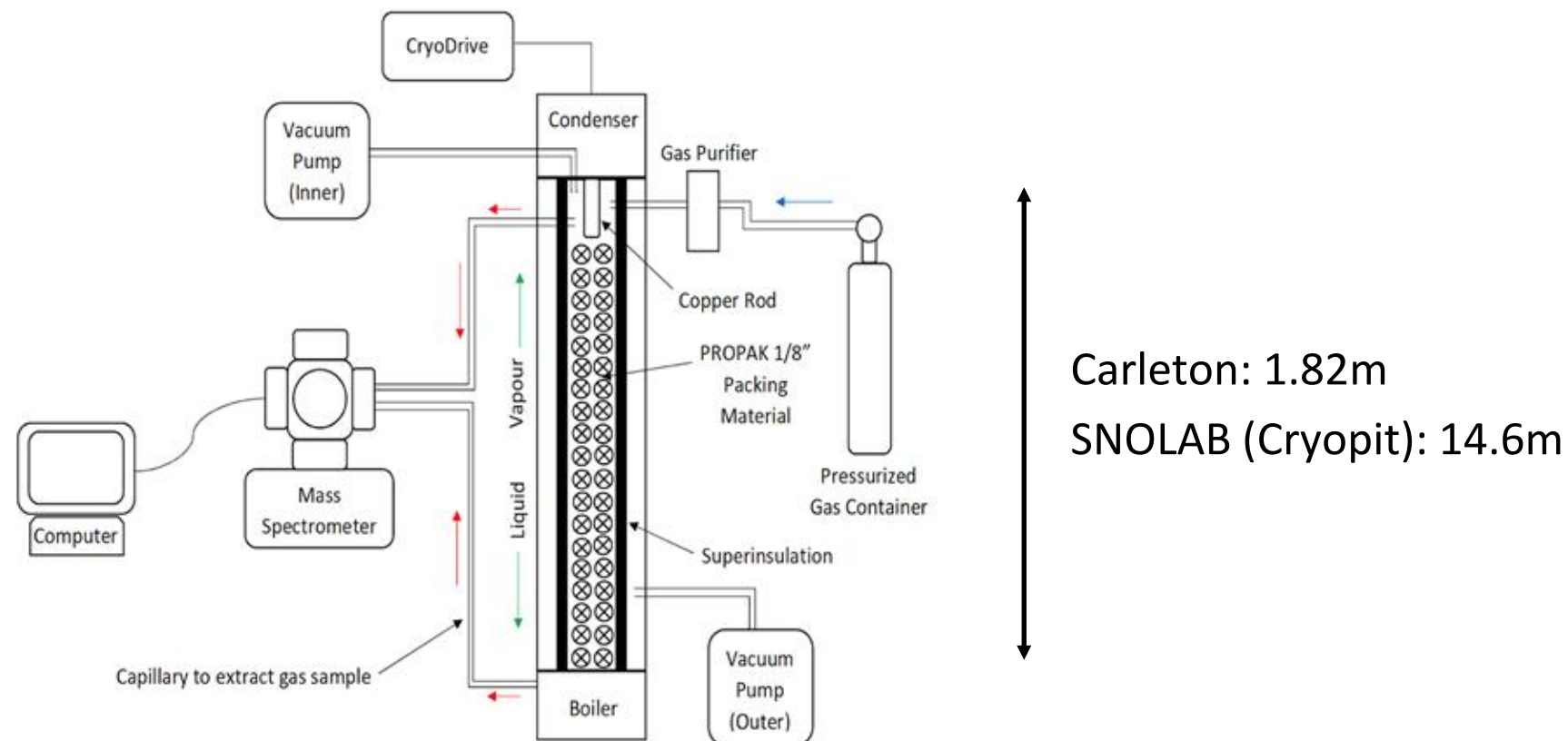
Caio Licciardi

Assistant Professor, University of Windsor
(for the XeStill group)

Xe-Still Project Overview

Goal: explore cryogenic distillation to enrich xenon in ^{136}Xe for $0\nu\beta\beta$ decay searches

- More specifically: measurement of isotopic dependence of vapour pressures



Procedure:

- cryogenic distillation runs with argon, krypton and xenon
- Isotopic sampling of top-bottom until stabilization period is reached (~ month at SNOLAB)

New science developments

The underlying objective of this study is xenon enrichment for neutrinoless double beta decay searches.

The field is working towards the next generation of experiments at the tonne-scale

- to probe the inverted ordering of neutrinos masses

and thinking ahead at the ktonne-scale:

- to probe the normal ordering of neutrinos masses

A secondary outcome of our measurements is information about Ar enrichment for other types of experiments, such as dark matter searches.

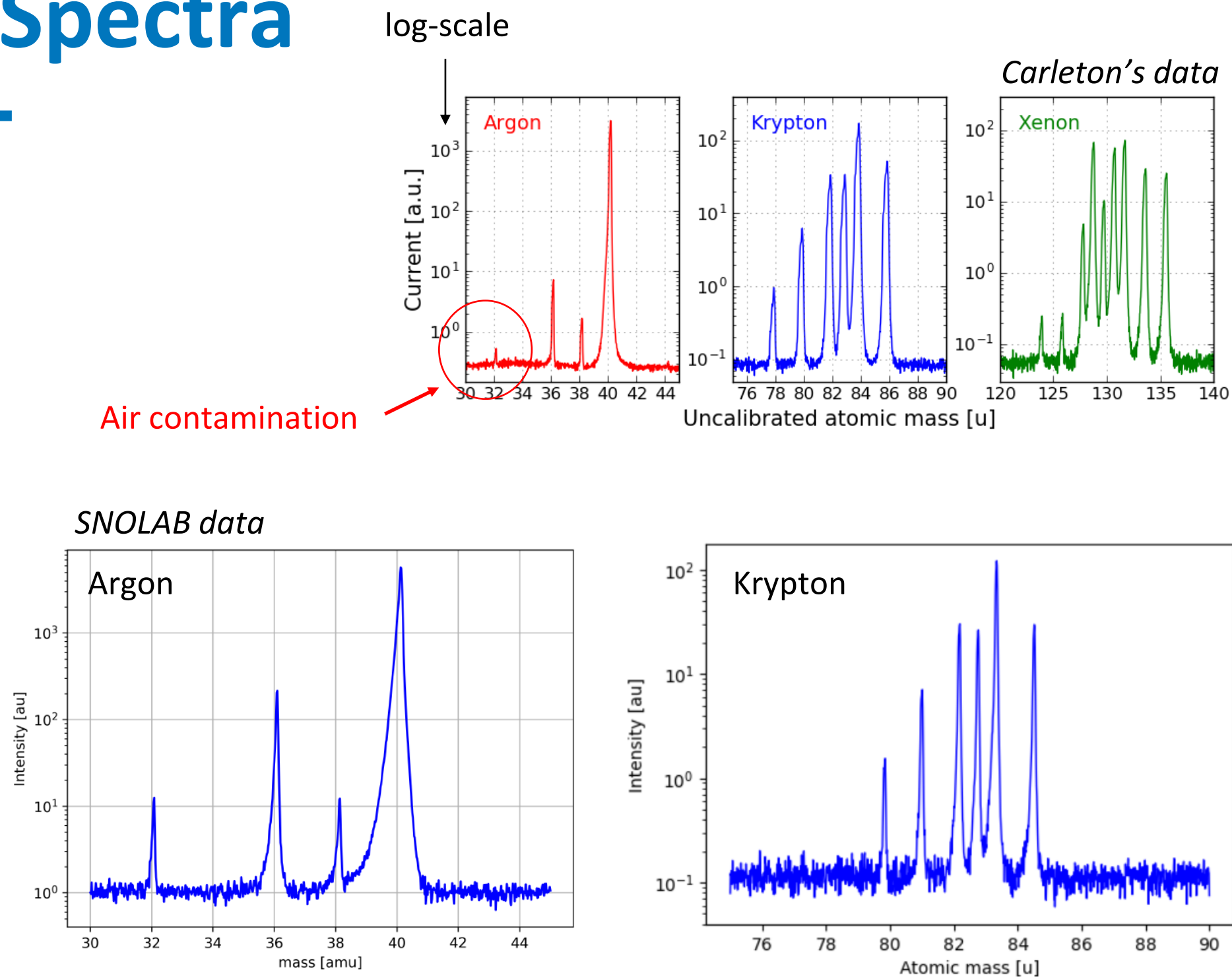
We now have three argon runs (2022/2023 runs) that can provide us with:

- HETP/vapour pressure calibration at subpercent error
- Investigate residual systematic observed at percent level (mass spectrometer, temperature)
- Study system variables during distillation

We have concluded study of krypton run (2023):

- Detailed analysis including temperature dependence
- Validate HETP/vapour pressure calibration from argon run

Mass Spectra



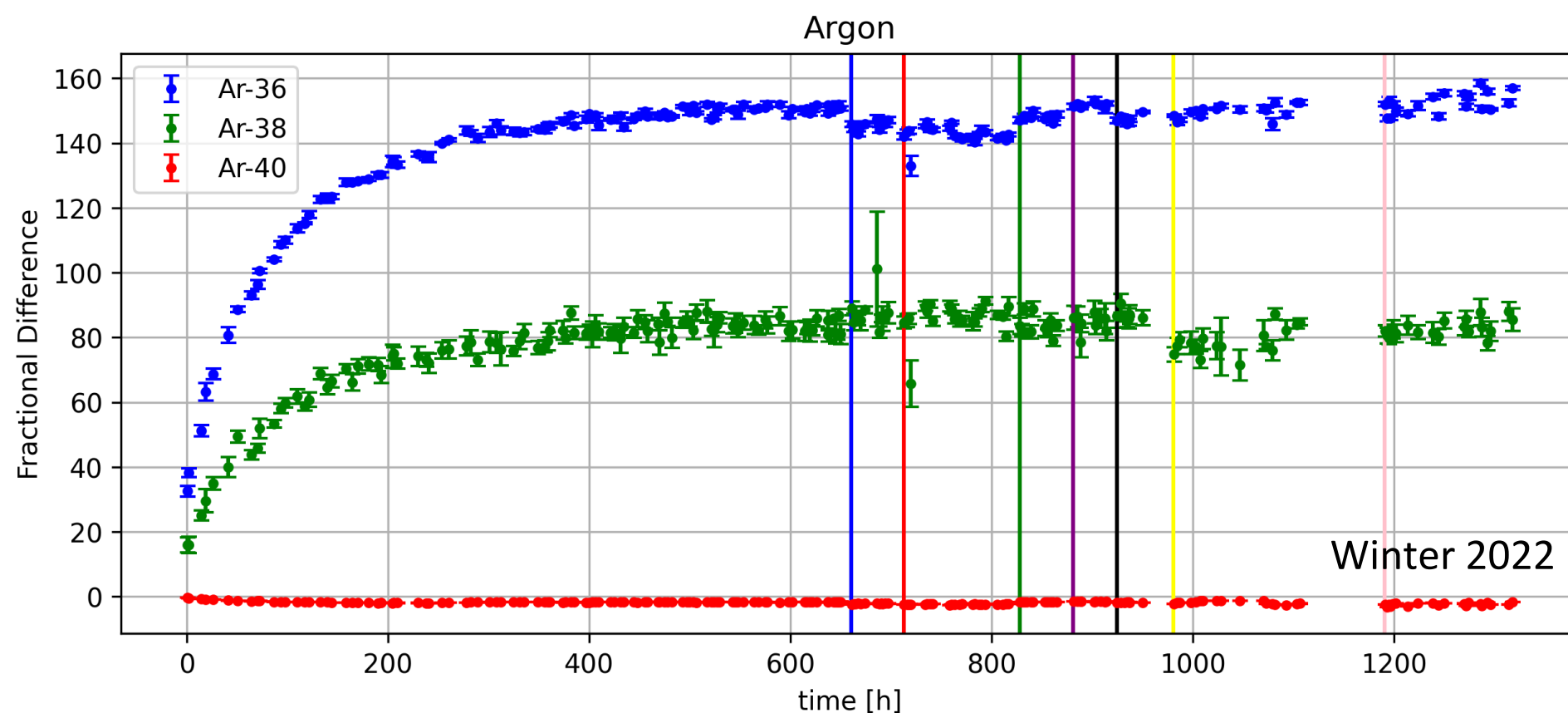
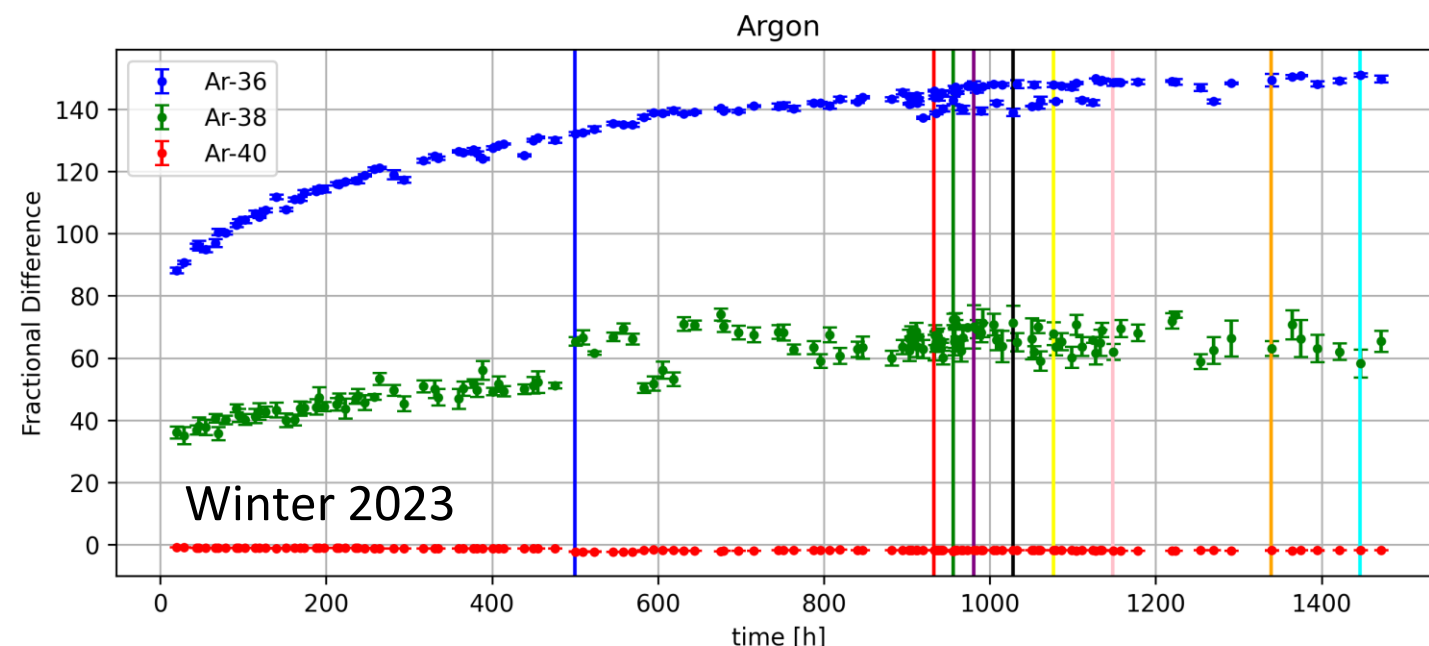
Recent Results

SNOLAB vs Carleton – Argon runs

Number of stages: 328.7 ± 0.9 (vs 42.5 ± 2.5)

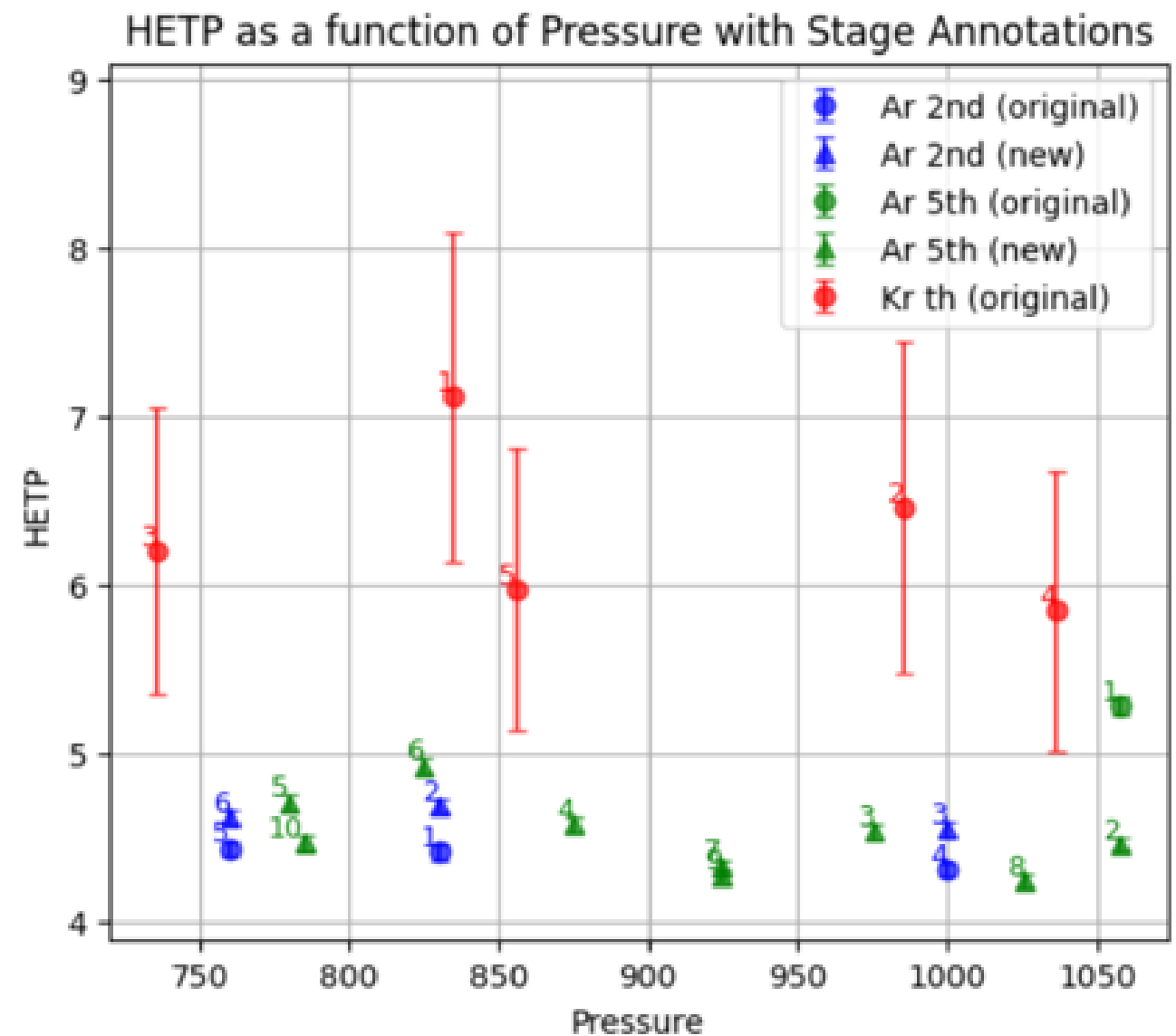
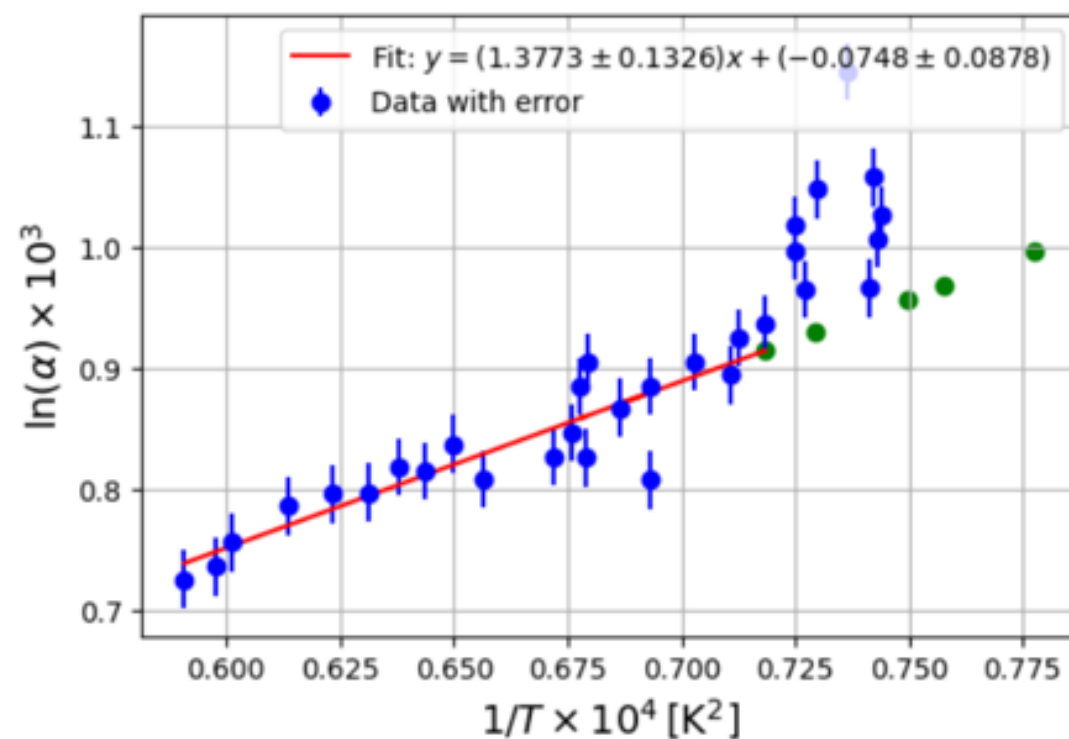
HETP: 4.29 ± 0.13 cm (vs 4.23 ± 0.25 cm)

2 argon runs with consistent results



Kr Results

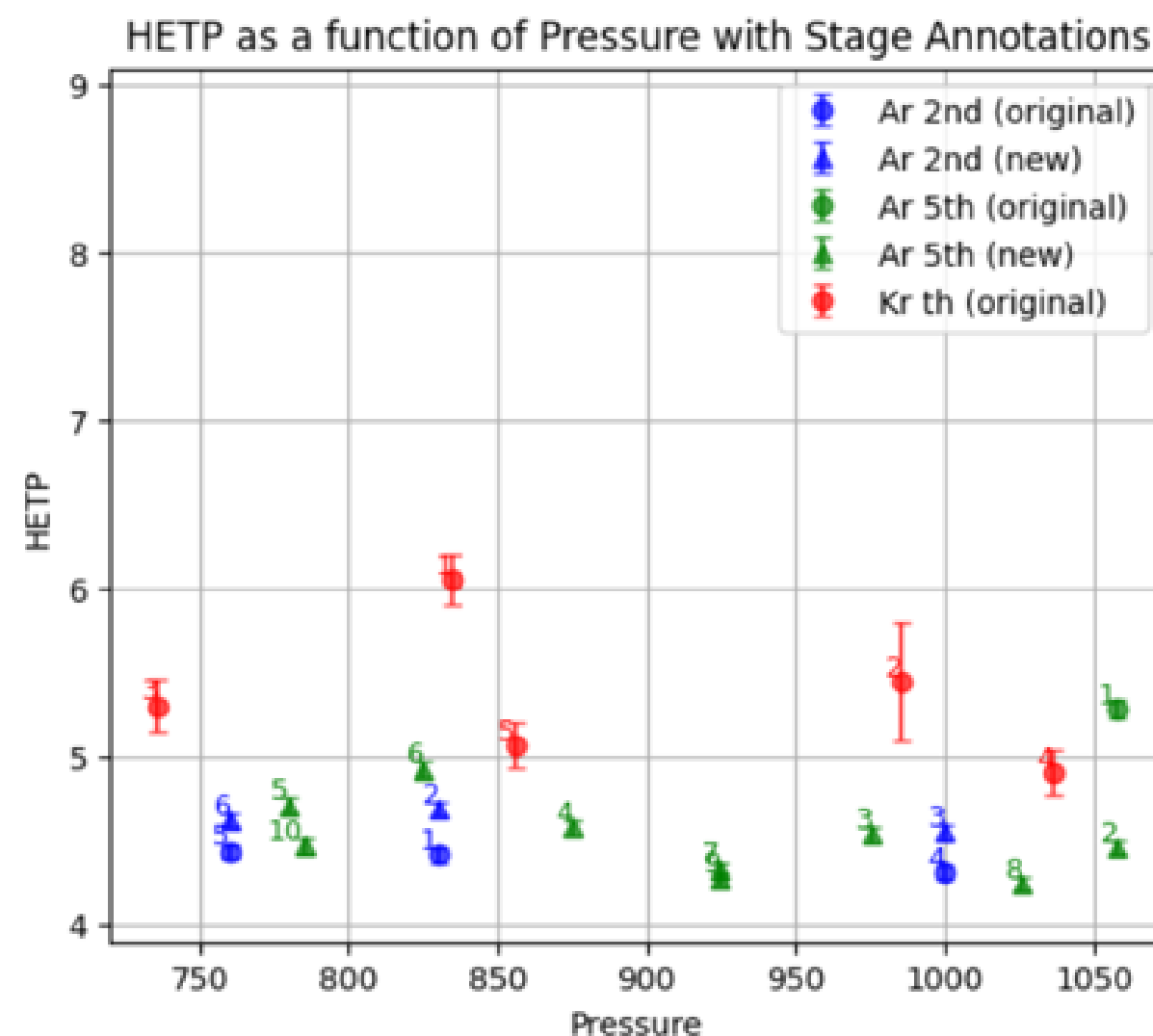
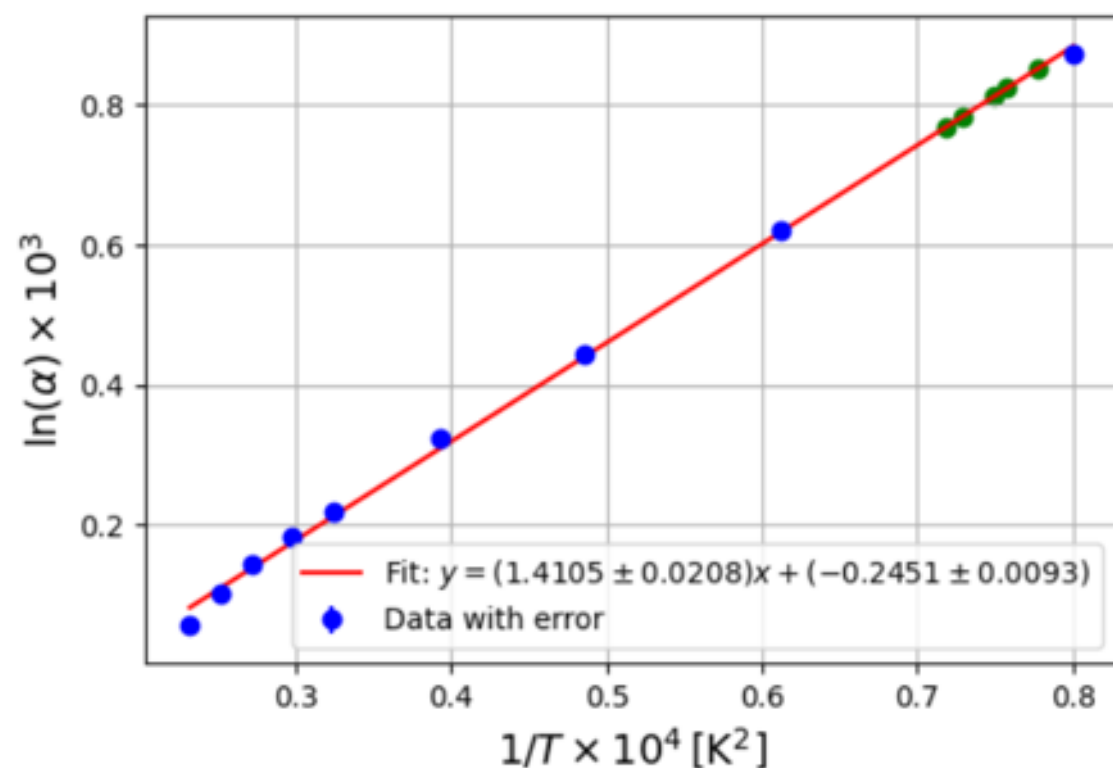
Existing literature data with large fluctuations
 Imply large errors in our verification, but
 systematically above argon's results
 Difference is not statistically significant



Recent Results

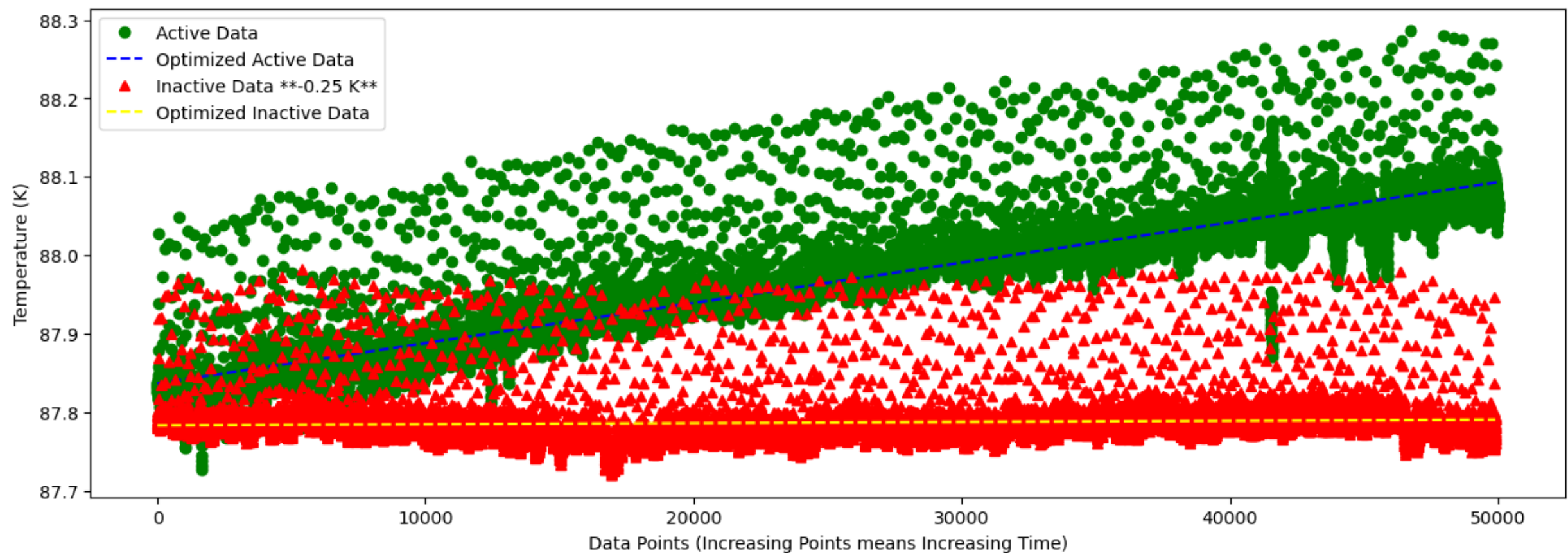
Existing models in literature have observed this systematic difference in krypton

Best existing model fits pulls agreement a little closer to argon results



On-going Studies

Undergrad student is looking at the impact of data taking on system variables



Experiment Status / Future Plans

- Stephen Sekula took over local leadership (in fall)
 - Ashley/Steffon continues to support local operations
 - Undergrad student (Liam) to provide analysis and data taking
 - Shaun Hall looking at mass transfer model (argon vs krypton)
- Pushing operations to start data taking in the next week(s):
 - Short argon run to test system (few weeks)
 - Prepare system for xenon run (final, likely ~months)
- Intention is to complete xenon run this summer
 - Requested use of Cryopit until the end of the year
 - Sufficient to achieve primary physics goals of the project
- Expected challenges
 - Run system stably for 1-2 months with xenon

Talks about decommissioning are on-going, reuse equipment for future operations at SNOLAB.

Collaboration Health

Our group welcomes members of any background.

It is a small group, overall total of 18 people / 6 currently active.

No policies or guidelines in place due to the short lifetime of the project, other than those already enforced by SNOLAB.