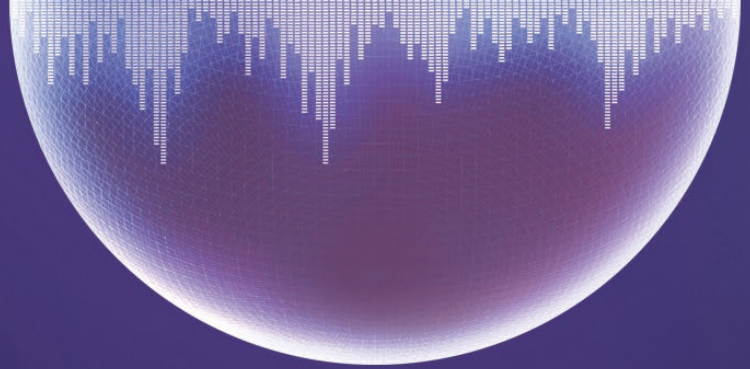
SnT 2021
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE



CTBTO
PREPARATORY COMMISSION

Long-term verification of radionuclide laboratory gain and efficiency stability

Michael Foxe, Theodore Bowyer, Ian Cameron, Matthew Cooper, James Hayes, Michael Mayer, Jennifer Mendez, Johnathan Slack

Oral Presentation O3.2-218

Pacific Northwest
NATIONAL LABORATORY

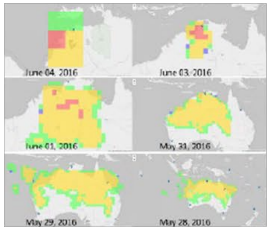
ORAL PRESENTATION

Funding for this research effort was provided by the Defense Threat Reduction Agency, USA

Cleared for Release

Path of Radioxenon

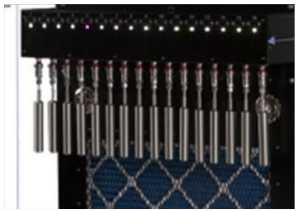
Release from Nuclear Explosion



Atmospheric Transport

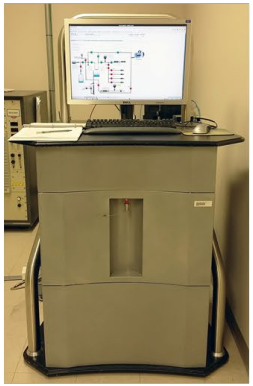
Field Collection and Measurement

Isotope	Half-Life
Xe-135	9.14 hours
Xe-133m	2.20 days
Xe-133	5.25 days
Xe-131m	11.84 days



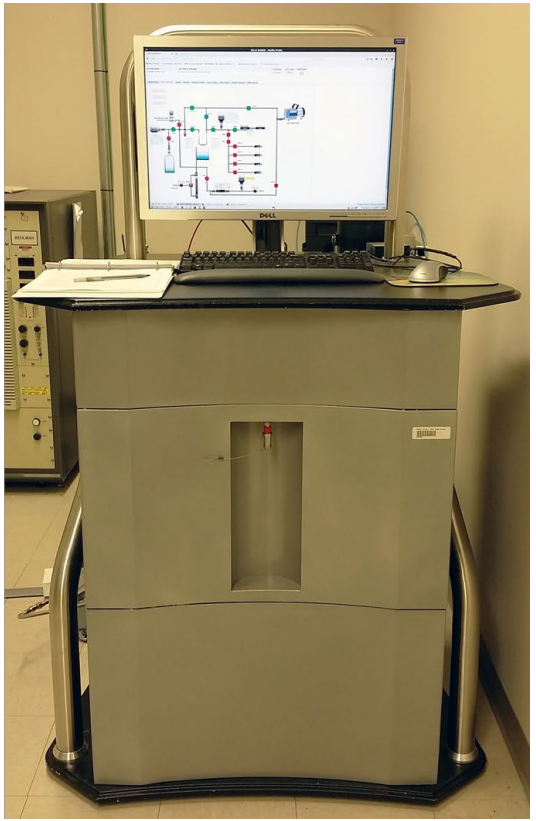
Archiving for subsequent measurement

Laboratory Processing and Measurement



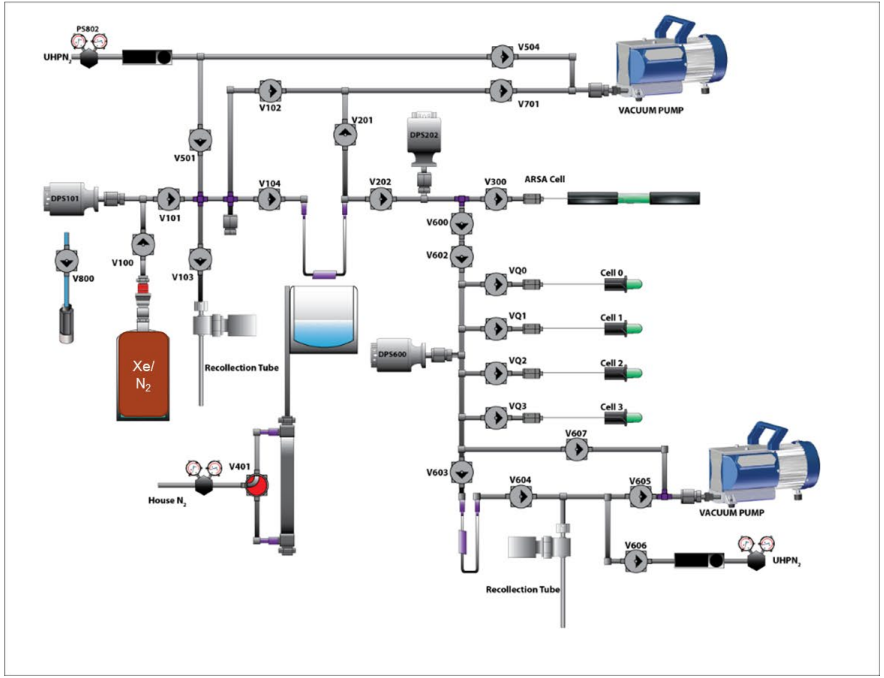
USL16-NGL

- Certified in December 2016
- Security
  - Certified Personnel
  - Chain of Custody
- Staff
  - Michael Foxe – NGL Lead
  - Jennifer Mendez – NGL Processing Deputy
  - Michael Mayer – NGL Analysis Deputy
  - Team: Johnathan Slack, Matt Cooper, Jim Hayes, Ted Bowyer, Ian Cameron



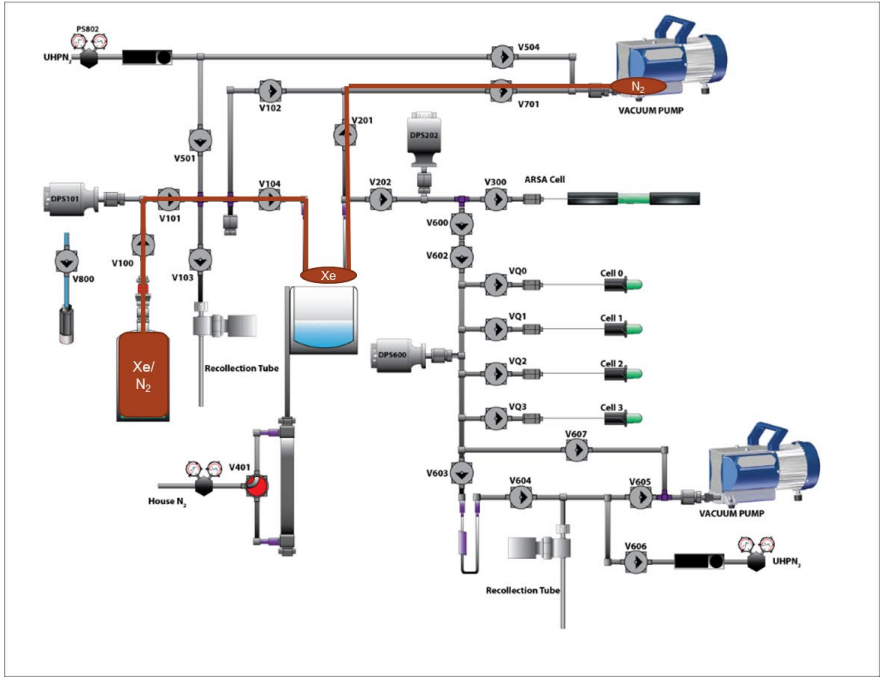
Collecting the Xenon

- Gas flow is regulated by electronically controlled valves



Collecting the Xenon

- Gas flow is regulated by electronically controlled valves
- Xenon is collected with a liquid nitrogen trap, while the He or N_2 carrier gas passes through



Collecting the Xenon

- Gas flow is regulated by electronically controlled valves
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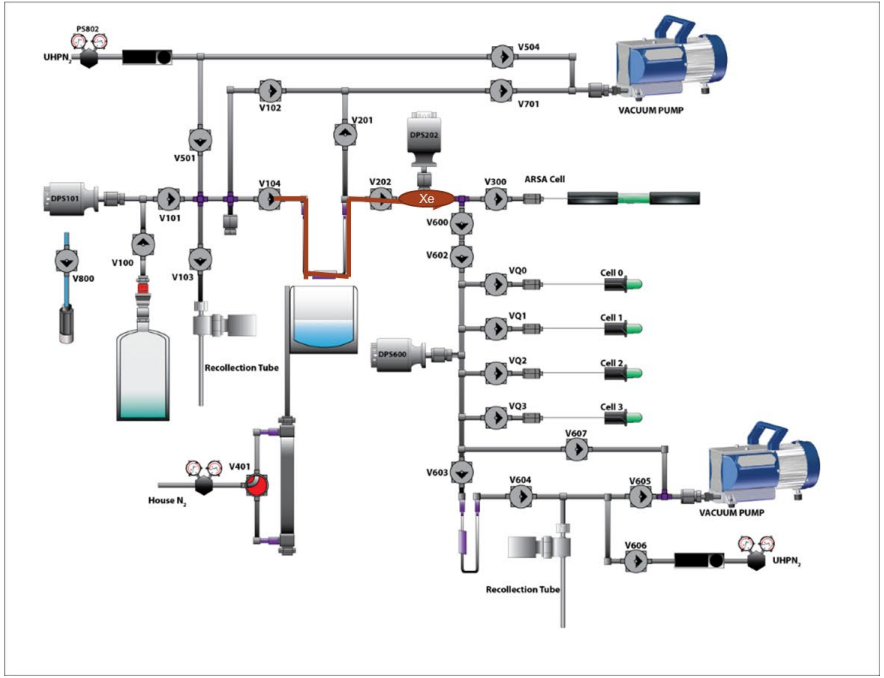
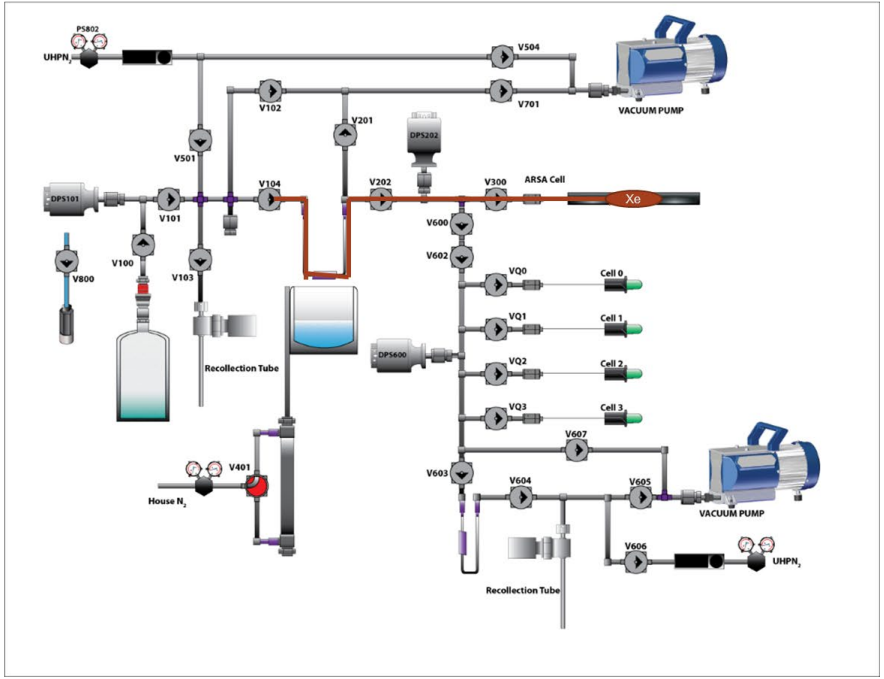
- Xenon volume is quantified using binary gas pressure sensors that have been calibrated at PNNL



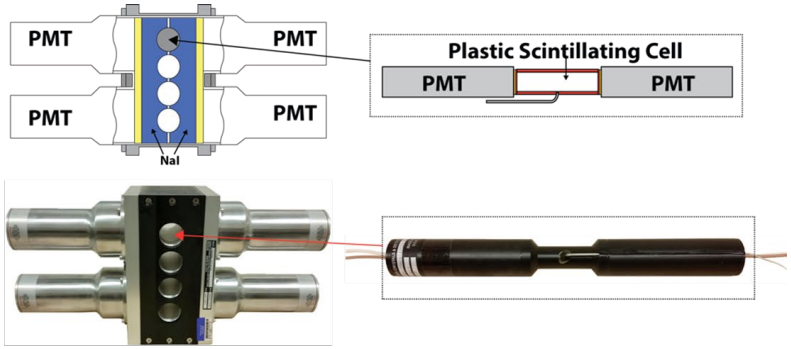
Collecting the Xenon

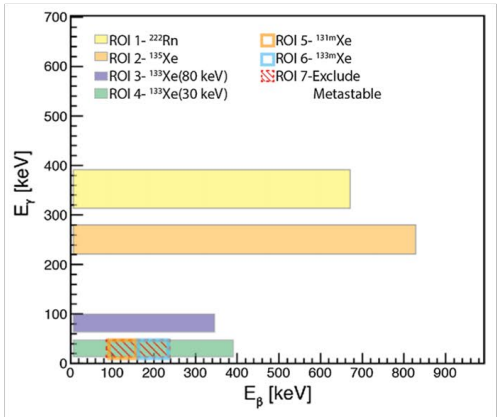
- Gas flow is regulated by electronically controlled valves
- Xenon is collected with a liquid nitrogen trap, while the He or N_2 carrier gas passes through
- Xenon volume is quantified using binary gas pressure sensors that have been calibrated at PNNL
- Xenon is volumetrically transferred to a beta-gamma detector
  - Residual xenon allows for a verification measurement



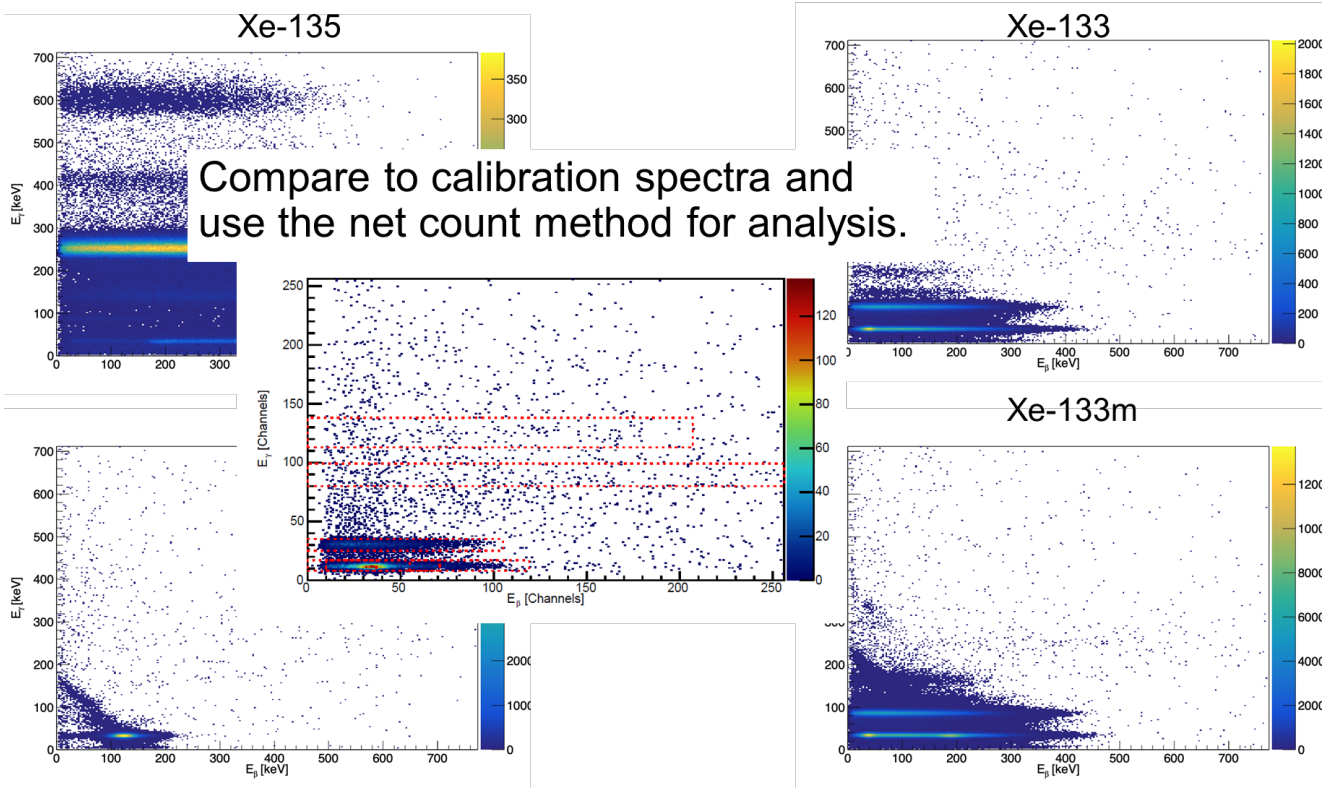
Beta-Gamma Detector

- Beta gamma system
  - Plastic beta cell
  - NaI
- Based on an early PNNL detector design
  - Efforts are underway to develop and implement detector improvements (single PMT, Silicon beta cell) – Story for another day
- Detector types, model numbers, manufacturer, dimensions, materials and date calibrated are required for routine audits



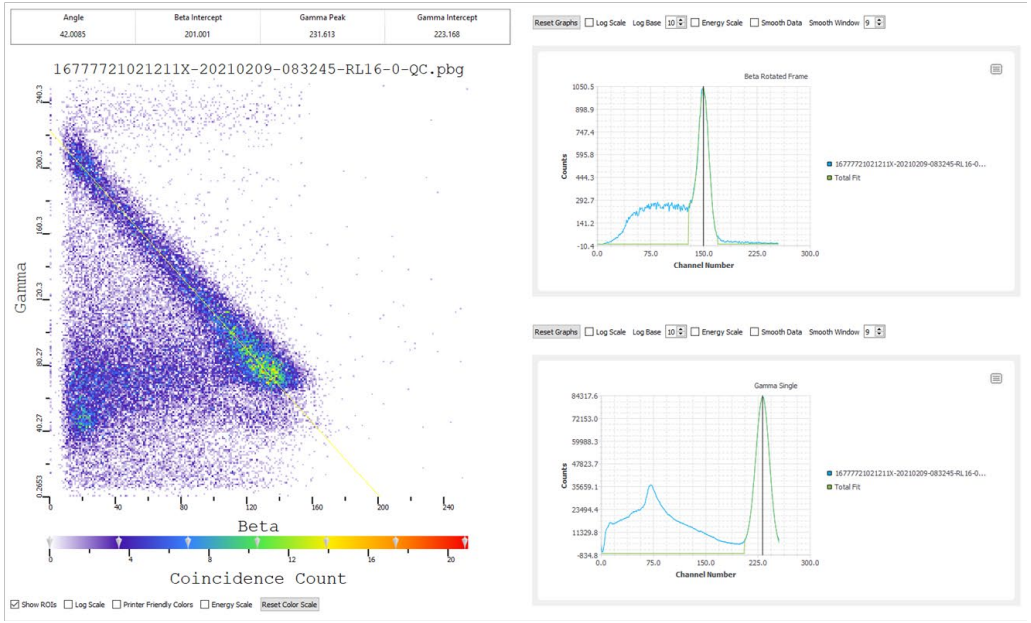


Radioxenon Analysis



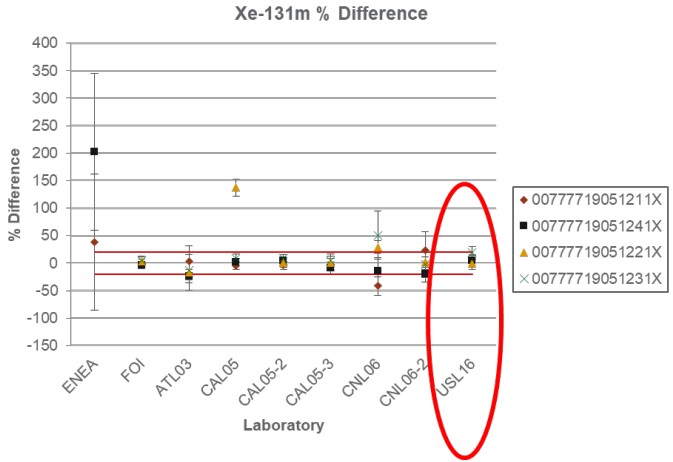
Monitoring Detector Trends

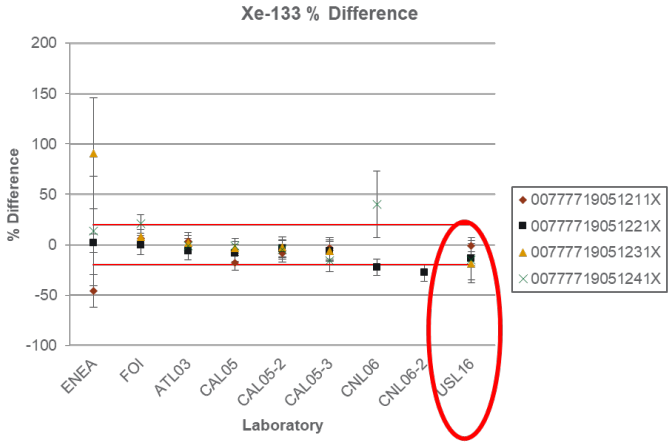
- Perform weekly Quality Control checks to monitor the detector performance
- Monitor the detector performance with PNNL Performance Monitoring software
  - Compare to a QC measurement performed during detector calibration
- Two QC measurements
  - Before/After to ensure stability
  - Monitor for gain shifts that would impact the measurement accuracy



Laboratory Proficiency Tests

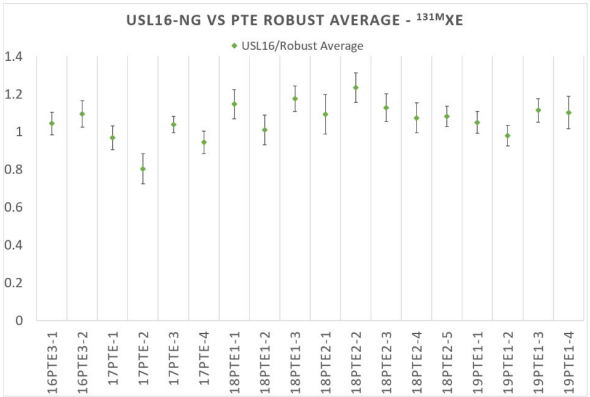
- The proficiency tests compare activity concentrations and ratios for the radioxenon isotopes.
- USL16-NGL has performed very well in these proficiency tests

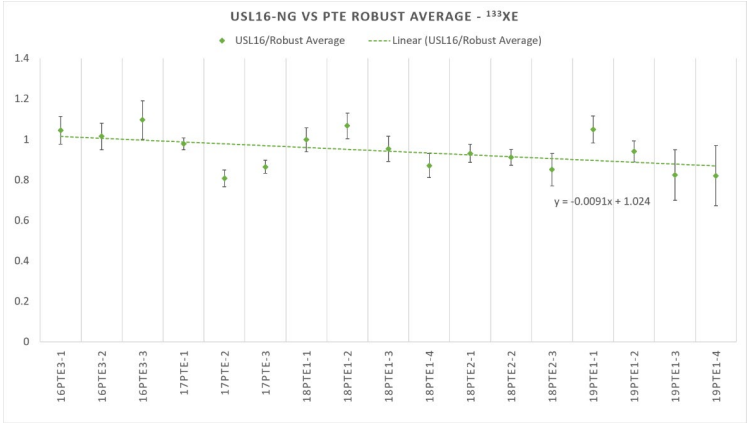




Monitoring Trends

- PTEs allow for the monitoring of any systematic variation that may appear in the system
  - Investigated long term stability compared to PTE samples



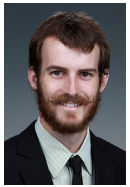


- See statistical variation within the Xe-131m data, but there was a slight decreasing trend in Xe-133
  - Updated calibration

Conclusions

- USL16-NGL has been certified for approximately 5 years and successfully operating for nearly 10 years.
- Routine performance monitoring is performed before and after sample analysis to look for energy gain shifts
- Routine measurements of stable xenon track the gas processing efficiency
- As more proficiency tests are performed, improved trend monitoring is possible for the entire system and not just the gas processing or nuclear detector portions
- Trend monitoring is important to verify laboratory operations between for sample measurements between PTEs

Thank you



For additional comments or questions….
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Backup