SnT 2023

CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

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Impact of Nuclear Detector Technologies on Radioxenon Laboratory Operation

Michael Foxe, Theodore Bowyer, Ian Cameron, James Hayes, Michael Mayer, Jennifer Mendez, Rose Perea, Johnathan Slack

Pacific Northwest National Laboratory

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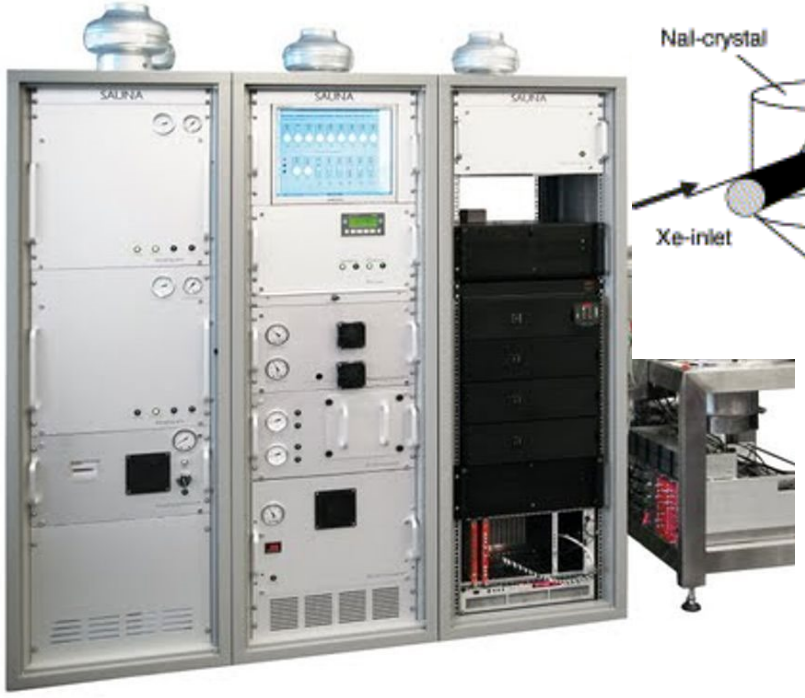
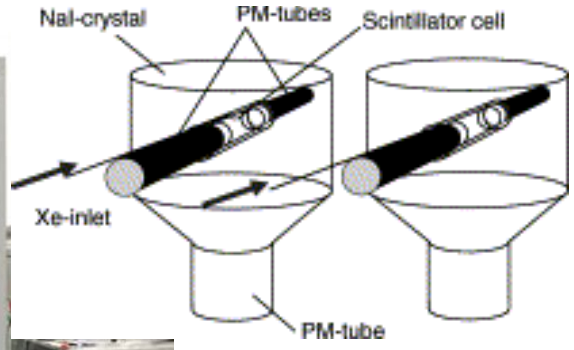
Outline

- Current IMS Systems
- New Generation IMS System Changes
- Beta Cell Resolution
- Radionuclide Laboratory Operational Scenario
- Radionuclide Laboratory Impact

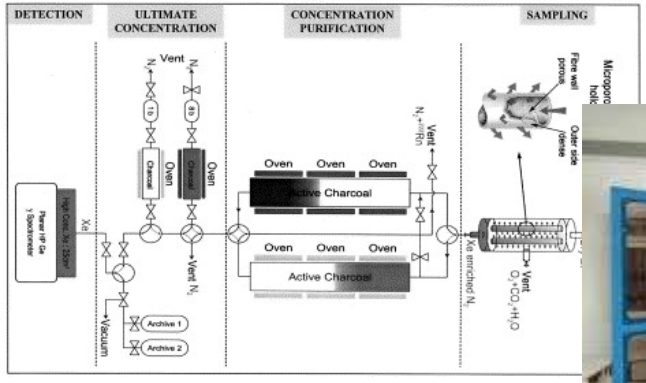
Current IMS Systems

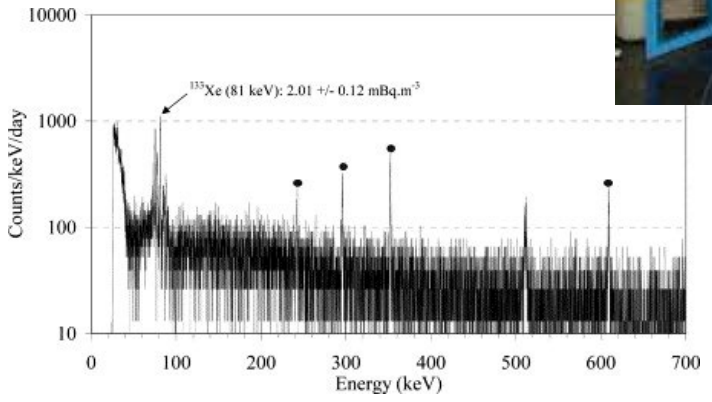
- Beta-gamma detection with plastic scintillator beta cell and NaI gamma detector





- Gamma spectroscopy with HPGe detectors





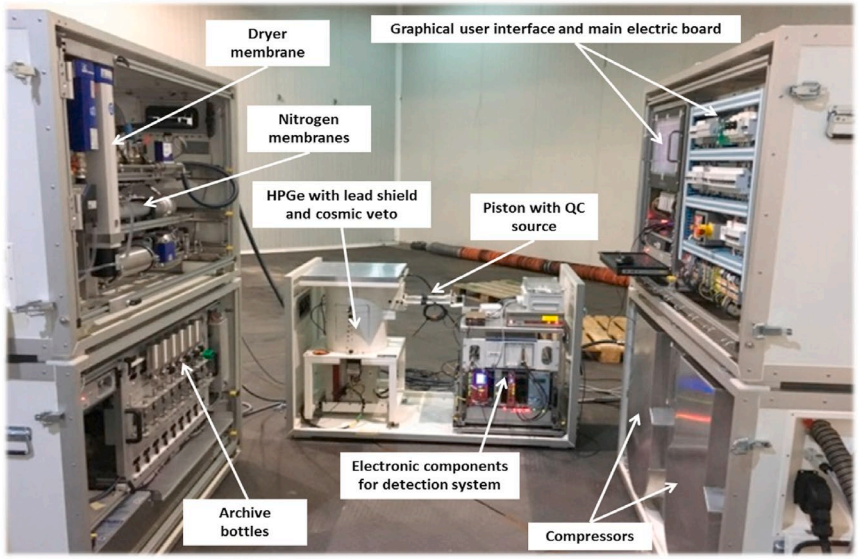
New Generation of Accepted IMS System

- Beta-gamma detection with plastic scintillator beta cell and NaI gamma detector

SAUNA III

- Beta-gamma detection with silicon beta cell and HPGe gamma detector

Xenon International



SPALAX-NG

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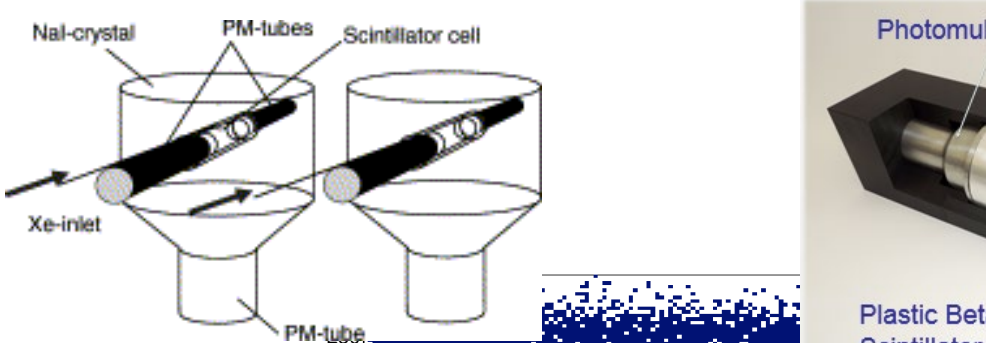
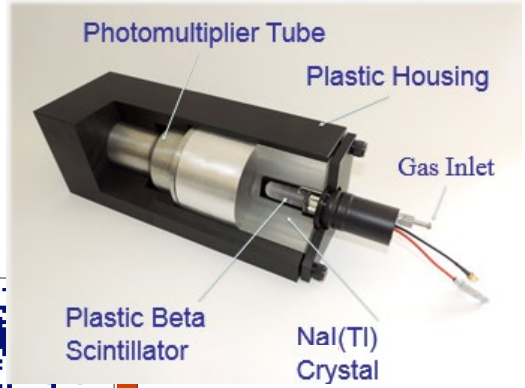
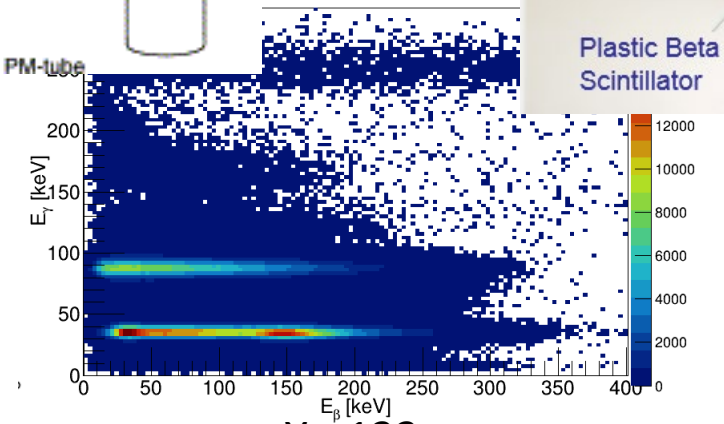


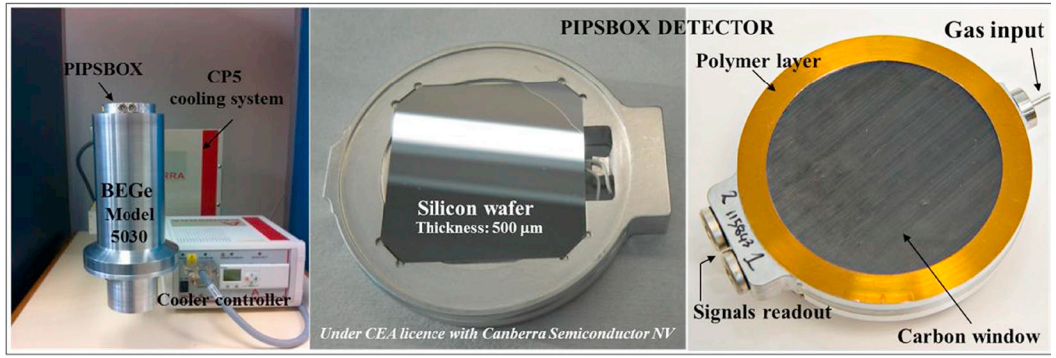


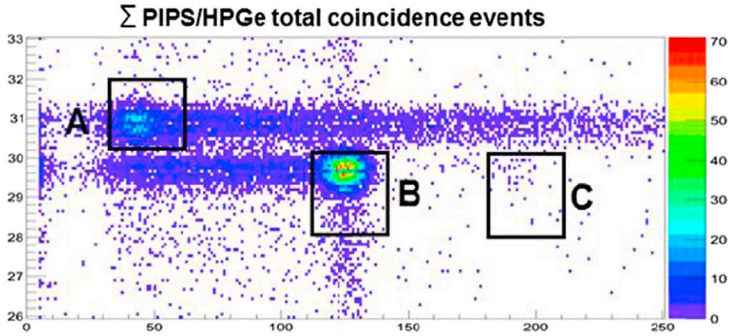


Xe-133

SAUNA III

- Beta-gamma detection with silicon beta cell and HPGe gamma detector



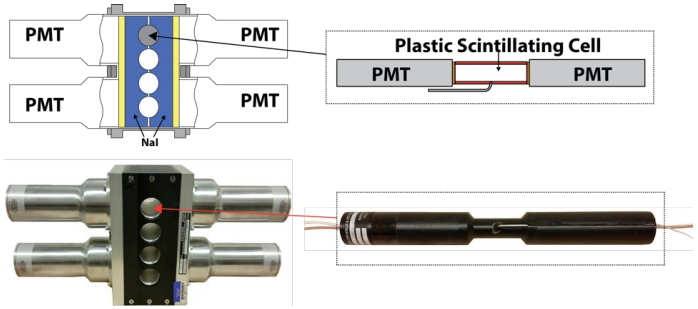


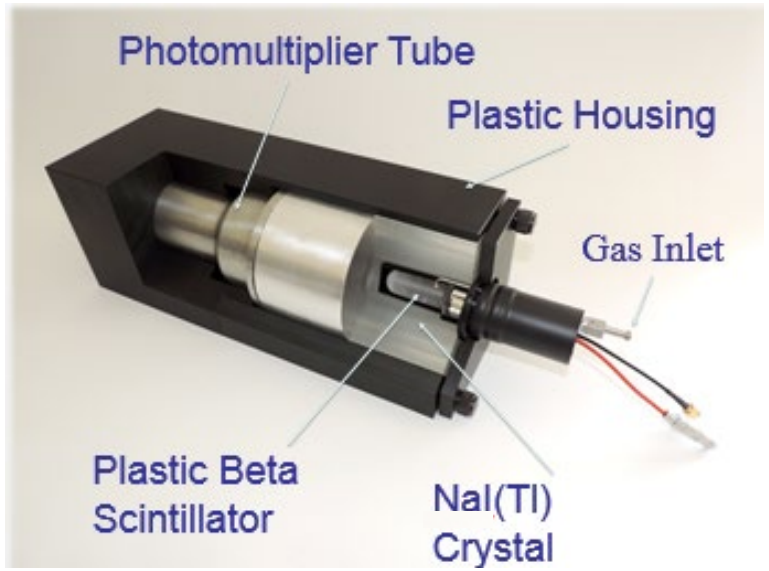
Xenon International

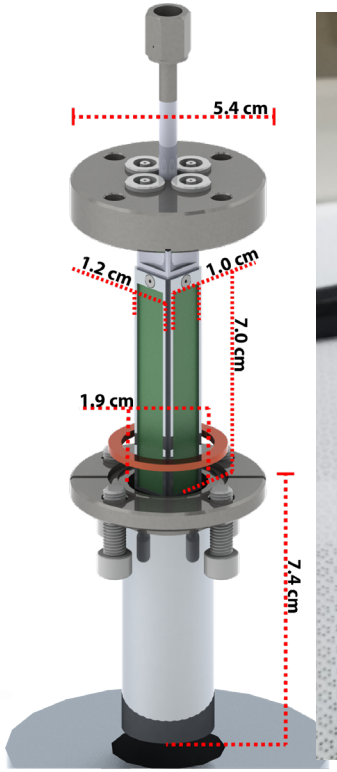
SPALAX-NG

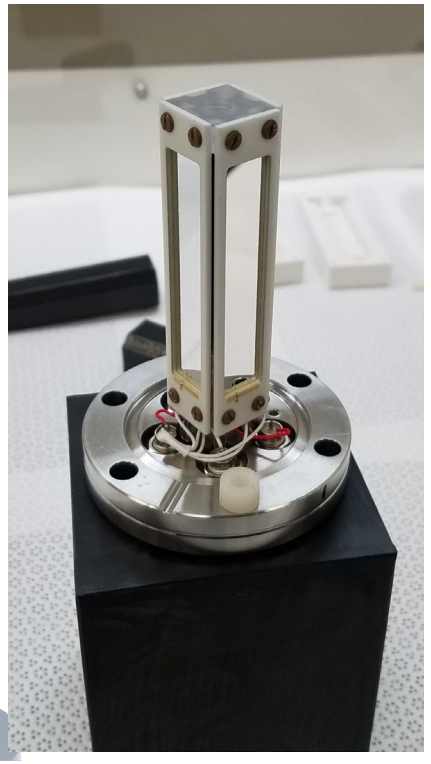
Beta-Gamma Detectors Investigated

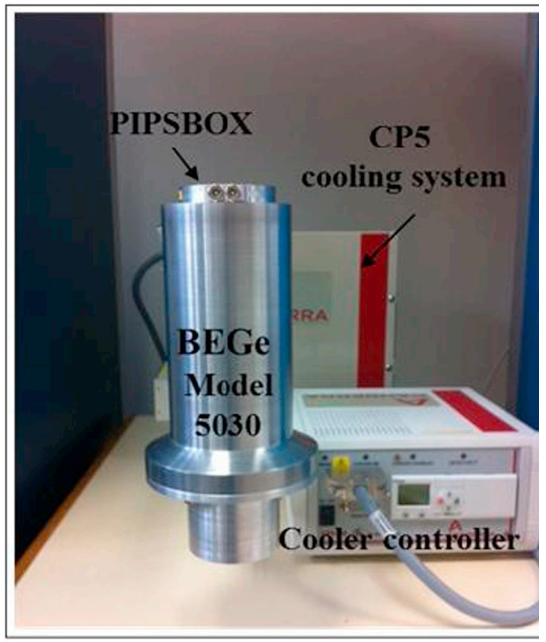
- Ongoing research into silicon beta cell and NaI gamma detector or plastic scintillator beta cell and HPGe gamma detector











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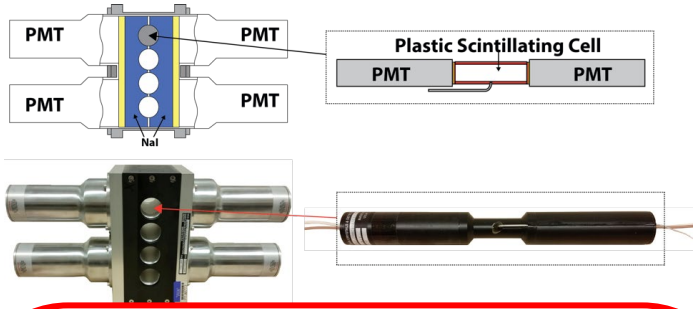
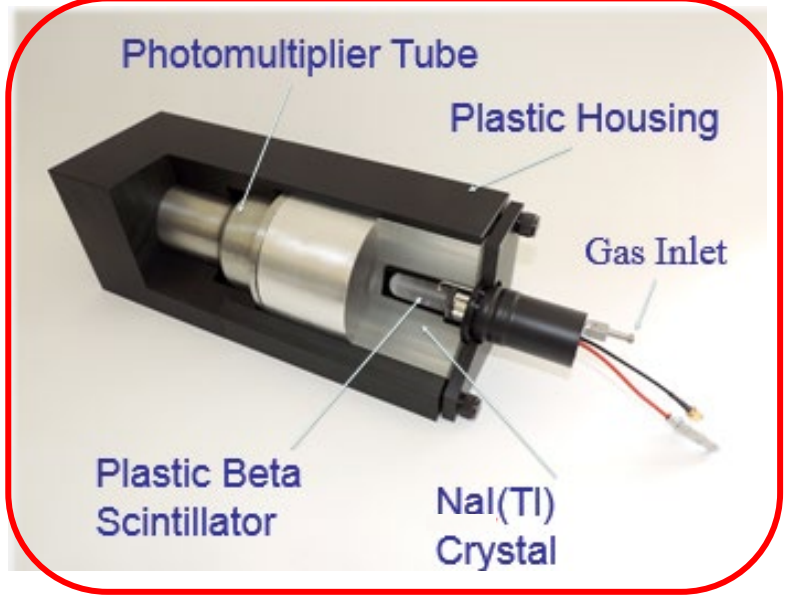
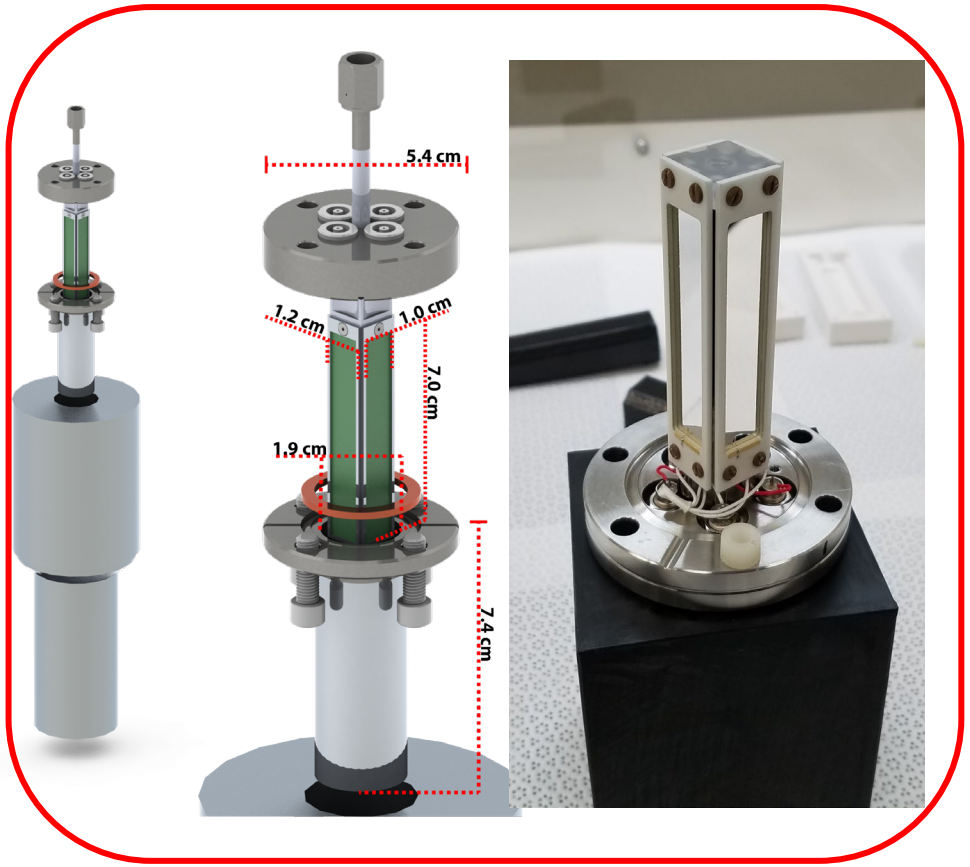
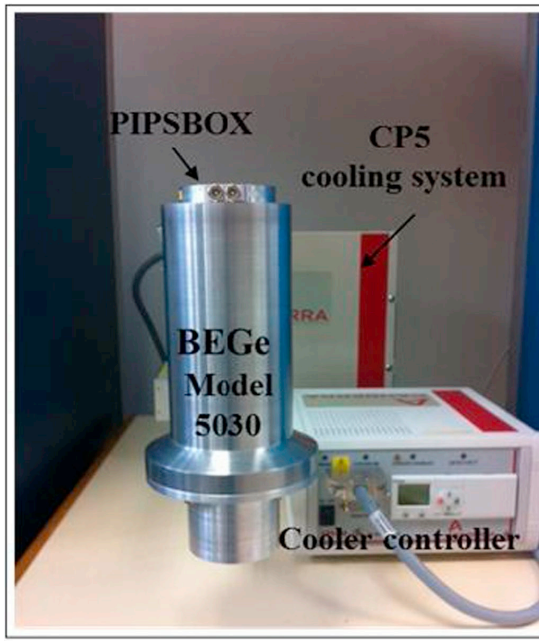


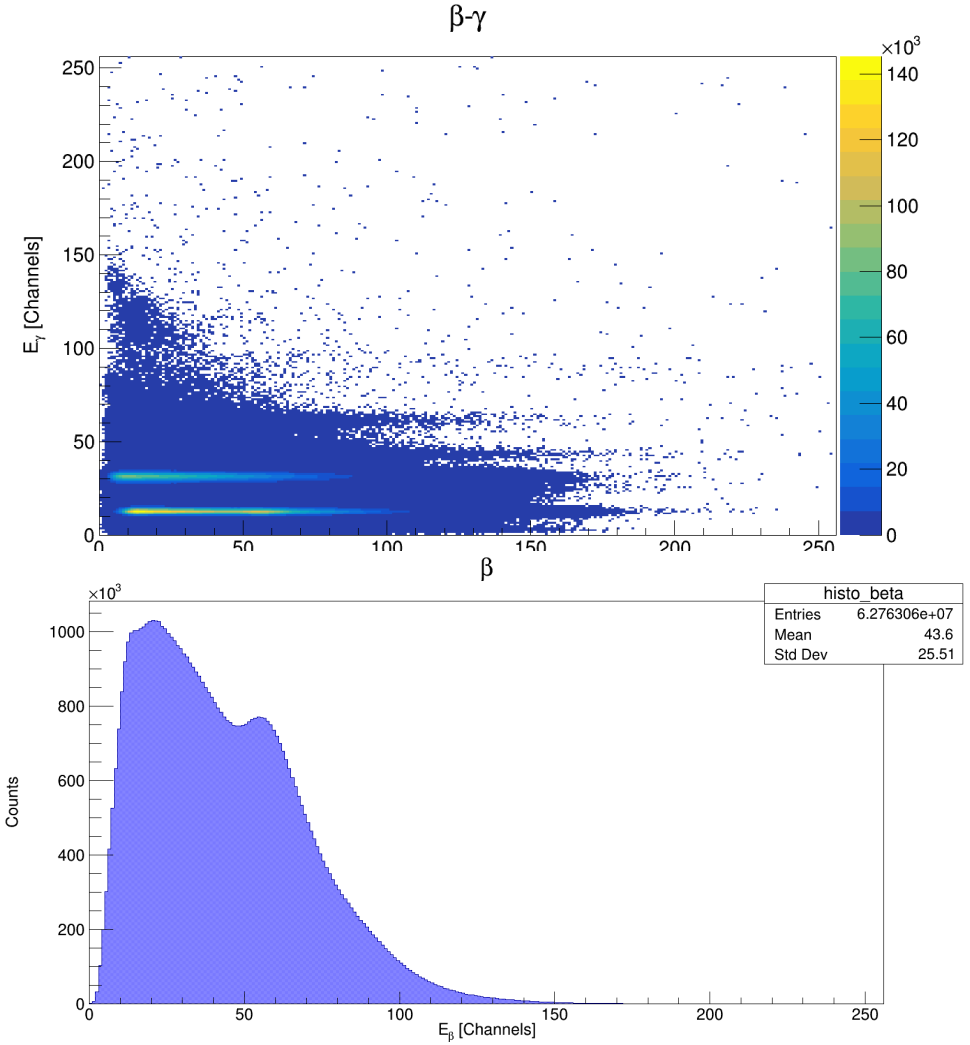




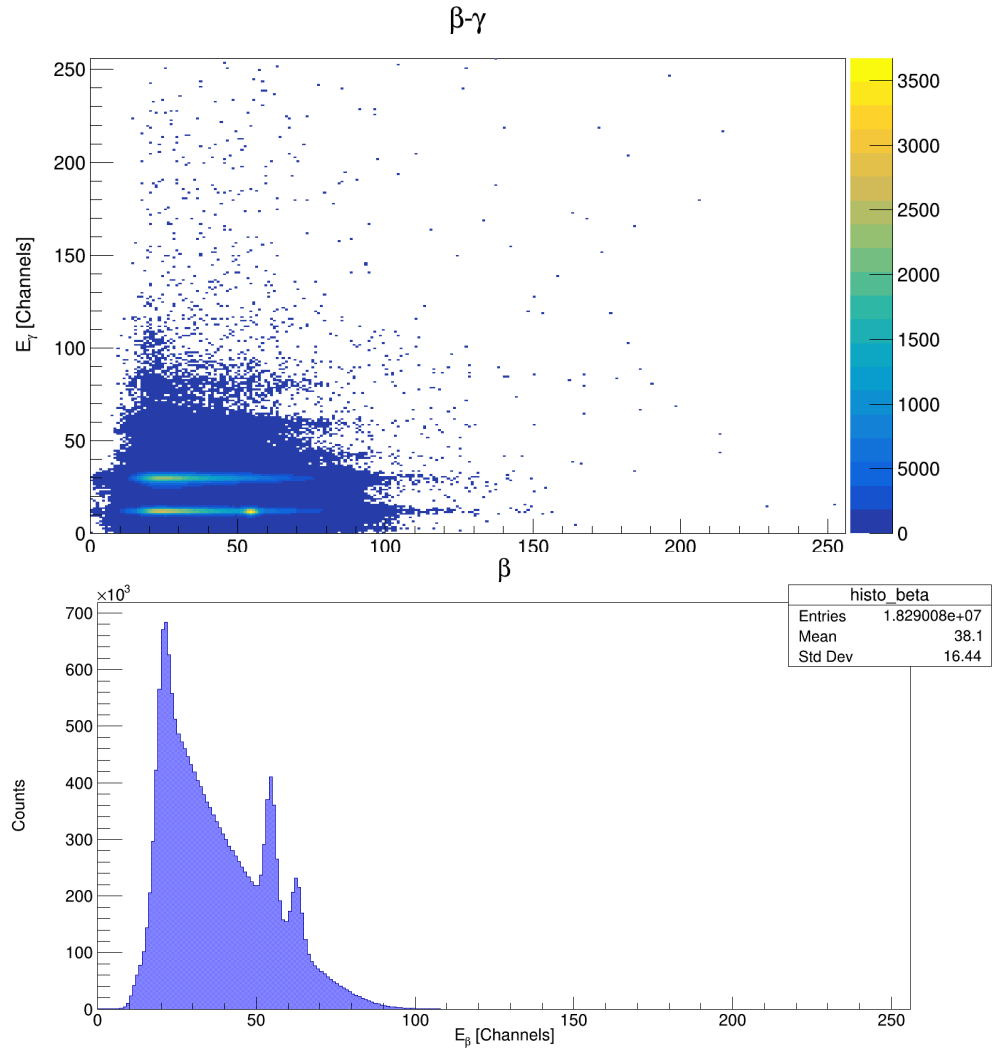


Beta Cell Resolution

- Plastic Scintillator Beta Cell



- Silicon Beta Cell



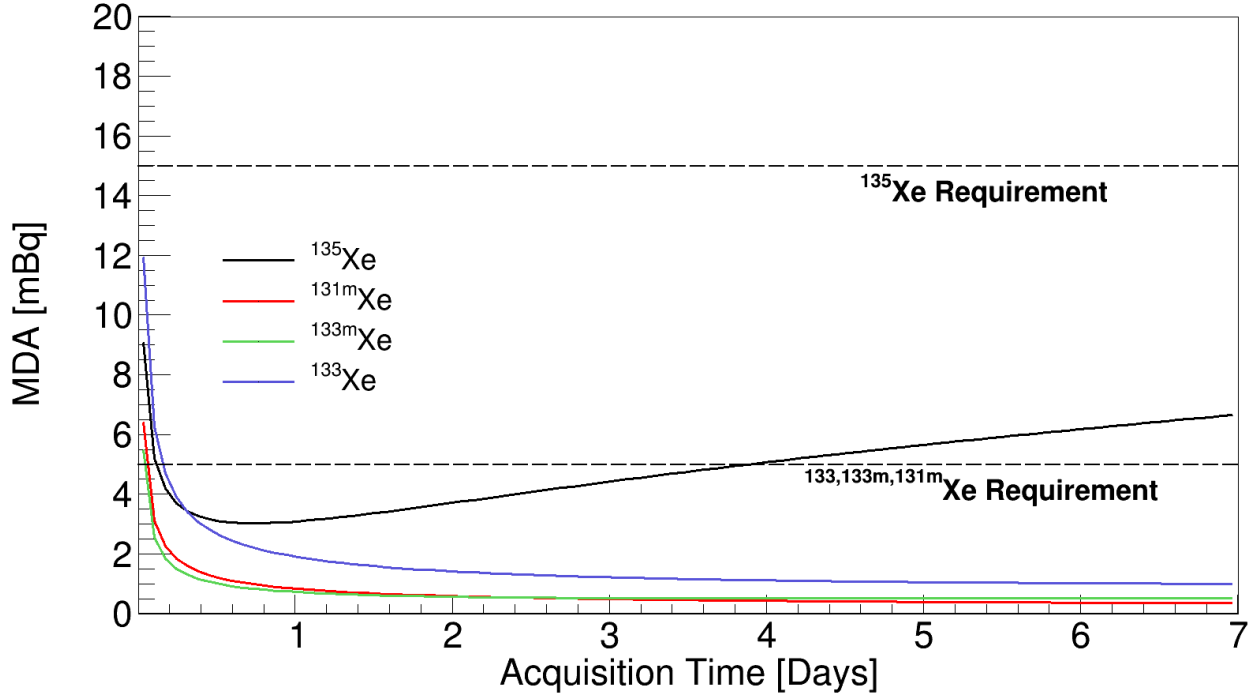
Radionuclide Laboratory Operational Scenario

- Sample Types
  - QA/QC radioxenon spikes
  - Proficiency Test Samples
  - Environmental Samples
- Shipping Timeline
  - Approximately 7-15 days between collection time and arrival at the laboratory
- Isotopes
  - Isotopes focused on Xe-133 and Xe-131m for the QA/QC spikes
  - Possible to have all four isotopes, but Xe-135 and Xe-133m are rarely present when a sample arrives at the laboratory

In the scenarios where all four isotopes are present, it is a short shipping time and the evaluation of the beta cell impact on a station will apply

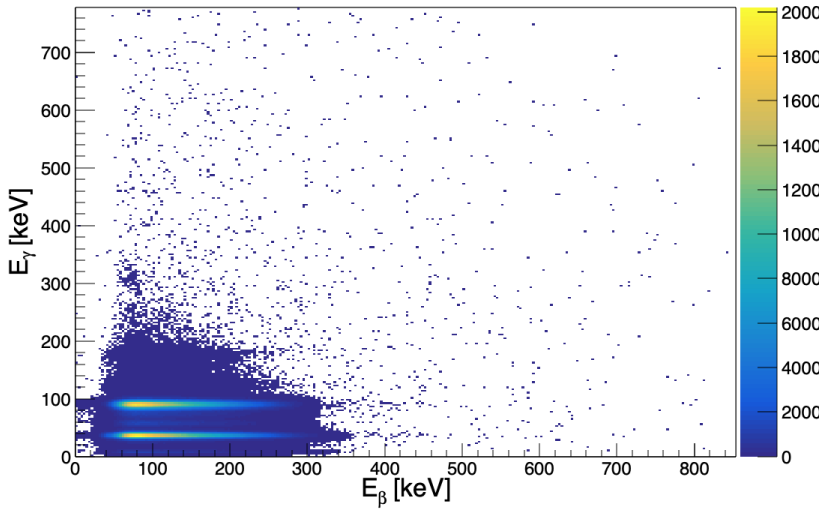
Radionuclide Laboratory Impact

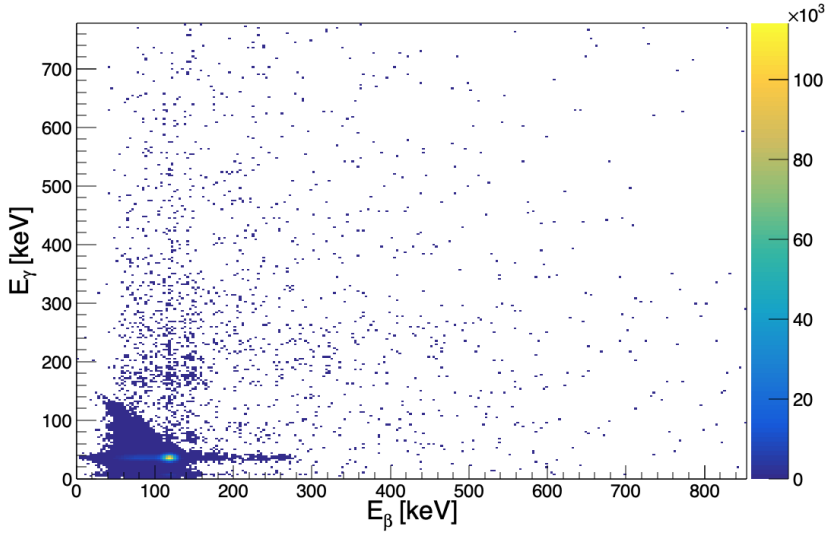
- Count duration
  - Optimal counting duration depends on the background in the detector
- MDA
  - With improved energy resolution, Xe-131m MDA improves
  - Less than 4π geometric efficiency slightly worsens Xe-133 MDA.



Radionuclide Laboratory Impact

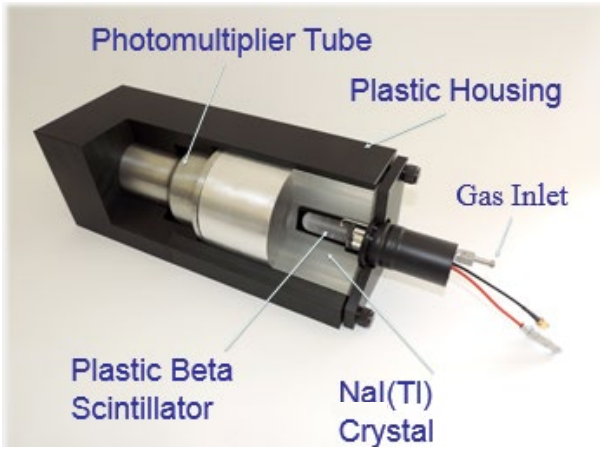
- Interferences
  - Samples from the environment are generally higher Xe-133 than Xe-131m
  - Important to be able to quickly detect Xe-131m in a Xe-133 background without waiting for Xe-133 to decay
- Gain Stability
  - Both plastic scintillator and silicon beta cells are stable for the course of the measurement and a energy check can be performed before a sample is processed.

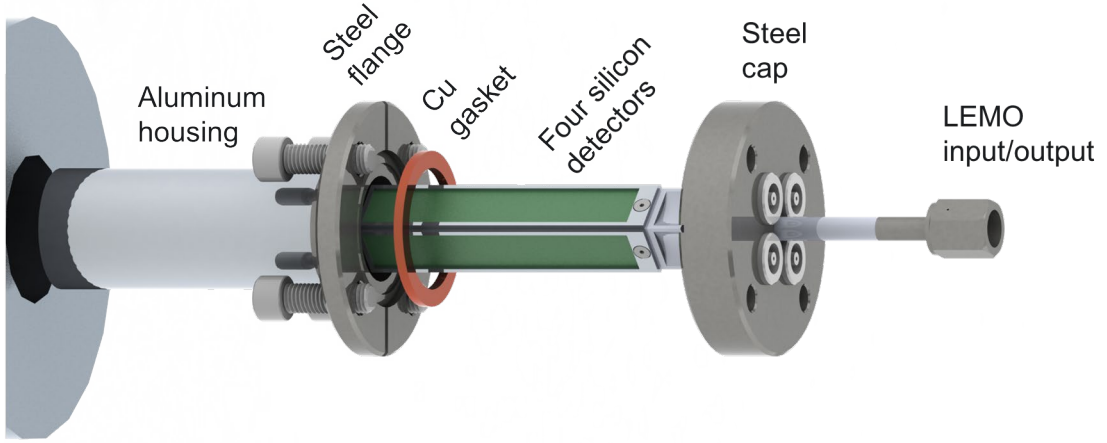




Conclusions

- Plastic scintillator appears to be better than silicon for detection of Xe-133
- Silicon outperforms plastic scintillator when looking at Xe-131m detection
- With the shipping delays, being able to achieve the best sensitivity for Xe-131m is important to laboratory operation
- Utilizing multiple detector types for tailored sample analysis may make sense for radioxenon laboratories.





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