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Comparison of Radioxenon Signals from a Nuclear Explosion and Alternative Background Sources

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INTRODUCTION

While the IMS is monitoring for nuclear explosions, it primarily sees anthropogenic backgrounds that must be understood to better identify potential nuclear explosions.

METHODS/DATA

During testing of Xenon International in Knoxville, TN, non-traditional radioxenon isotopes (i.e. Xe-125) were observed from nearby Oak Ridge National Laboratory.

START

RESULTS

We have investigated the potential signals that we expect from anthropogenic sources like spallation neutron sources or certain nuclear reactors and compared them to a nuclear explosion source.

CONCLUSION

We see that there is a different on the isotopes present, there are also differences with isotopic ratios. Additional study to determine the network wide impact is still needed.

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P2.4-383

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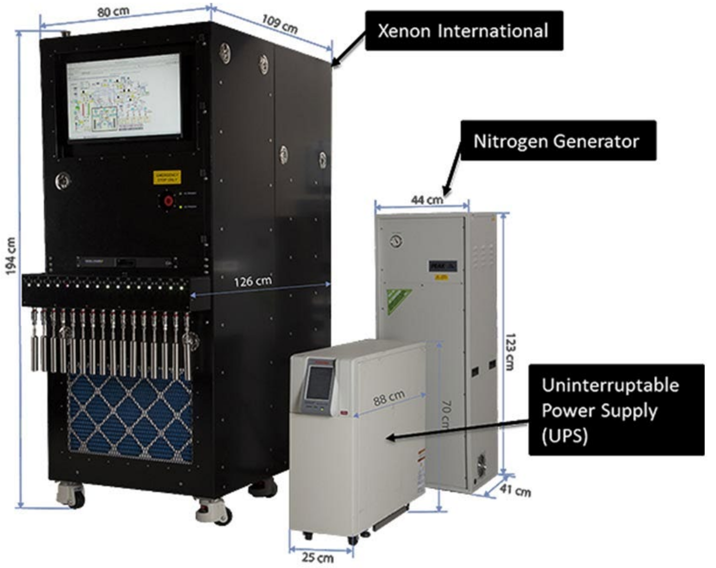
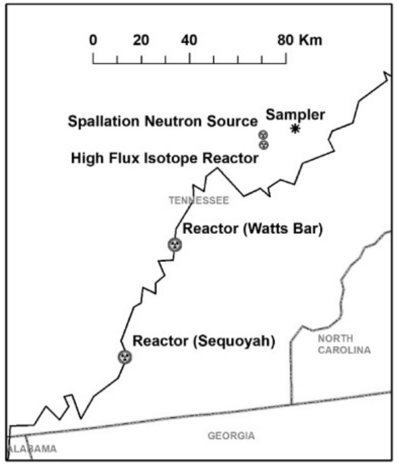
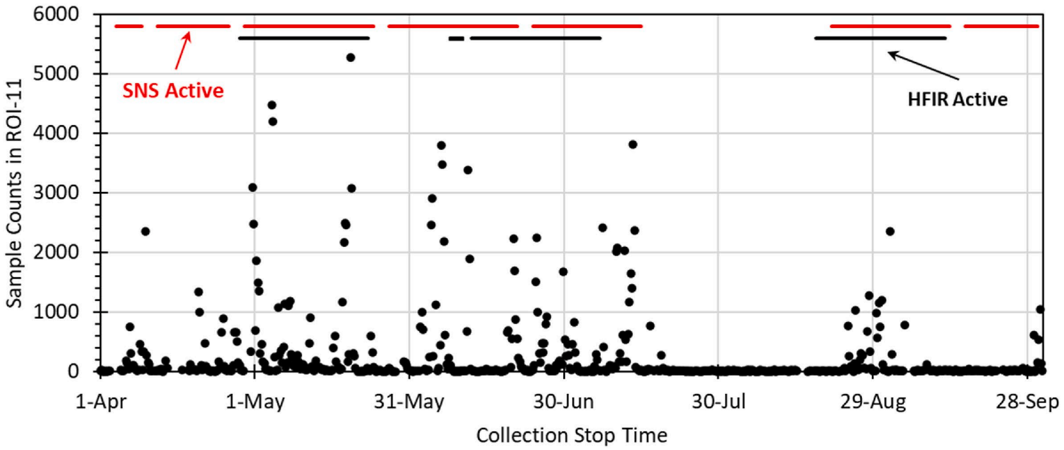
Introduction

- During the acceptance testing for Xenon International, non-traditional radioxenon isotopes were observed
- These signals were attributed to the Spallation Neutron Source, but could have partly been from HFIR
    - These aren't the only potential sources of non-traditional isotopes in the world







See Poster P2.4-215 for more information

Objectives

- With the network of radioxenon stations in the IMS, what is the potential impact of these potential sources on the measurement of traditional radioxenon isotopes

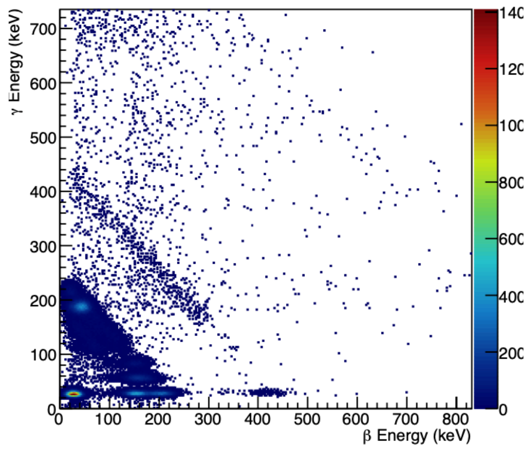
- Desire to combine all the source location and release information into a complete understanding of the impact of non-traditional isotopes

Locations of Reactors

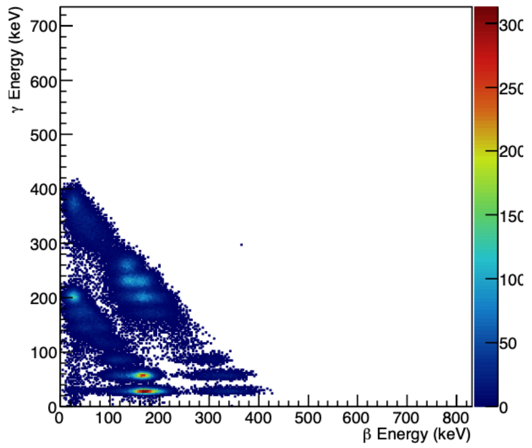
Methods and Data

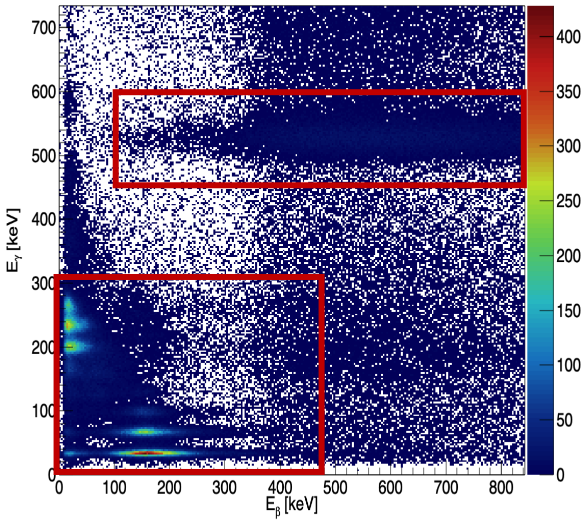
- Sources of Interest:
  - Spallation Neutron Source
  - High Flux Isotope Reactor
    - Xe-133 Release rate of ~0.53 GBq/day
  - Other Research Reactors
    - Fission isotopes
    - Air activation
  - Different types of power reactors

^{125}Xe Simulation



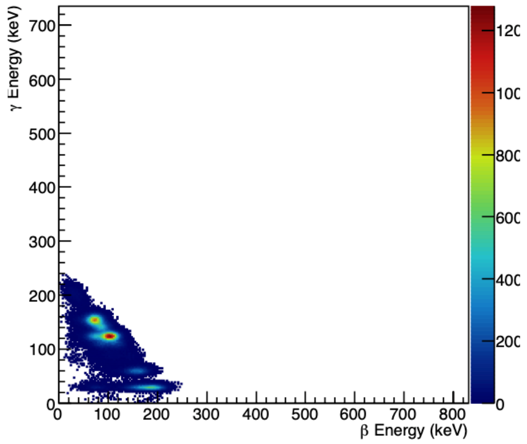
^{127}Xe Simulation





Measurement

^{129m}Xe Simulation



INTRODUCTION
OBJECTIVES
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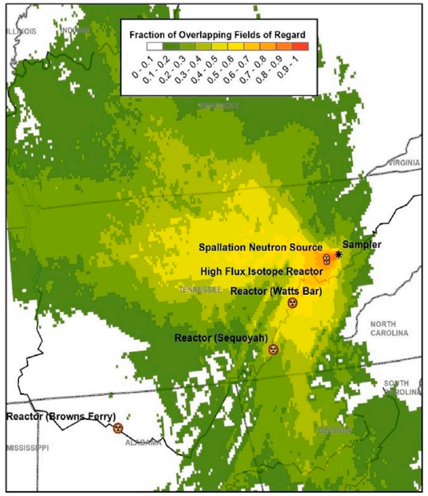
RESULTS
CONCLUSION

Results

- Both traditional and non-traditional xenon isotopes can be emitted from a single source
- A close station can see Xe-125 and Xe-133 for isotopic ratios
  - Further atmospheric transport will limit the Xe-125 observed
  - Xe-127 still shows enough to release activity to tag the source
- Sources close together have the potential to skew isotopic ratios
- Differing sources and abatement methods may alter the release isotopic ratios



Nuclide		Half-life (s)	Activity (Ci) shutdown year 40	Decay time Down 3.00E+01 m
Xe	119	3.48E+02	8.43E-01	2.34E-02
Xe	121	2.41E+03	1.27E+01	7.57E+00
Xe	122	7.24E+04	8.44E+00	8.29E+00
Xe	123	7.49E+03	2.46E+01	2.08E+01
Xe	125	6.08E+04	9.80E+01	9.65E+01
Xe	125*	5.70E+01	1.20E+01	3.75E-09
Xe	127	3.15E+06	1.08E+02	1.08E+02
Xe	127*	6.92E+01	2.12E+00	3.13E-08
Xe	129*	7.68E+05	6.17E+00	6.16E+00
Xe	131*	1.03E+06	4.43E+00	4.42E+00
Xe	133	4.53E+05	8.56E+00	8.55E+00
Xe	133*	1.89E+05	4.44E-01	4.42E-01
Xe	134*	2.90E-01	3.66E-02	6.33E-07
Xe	135	3.29E+04	3.00E+00	2.89E+00

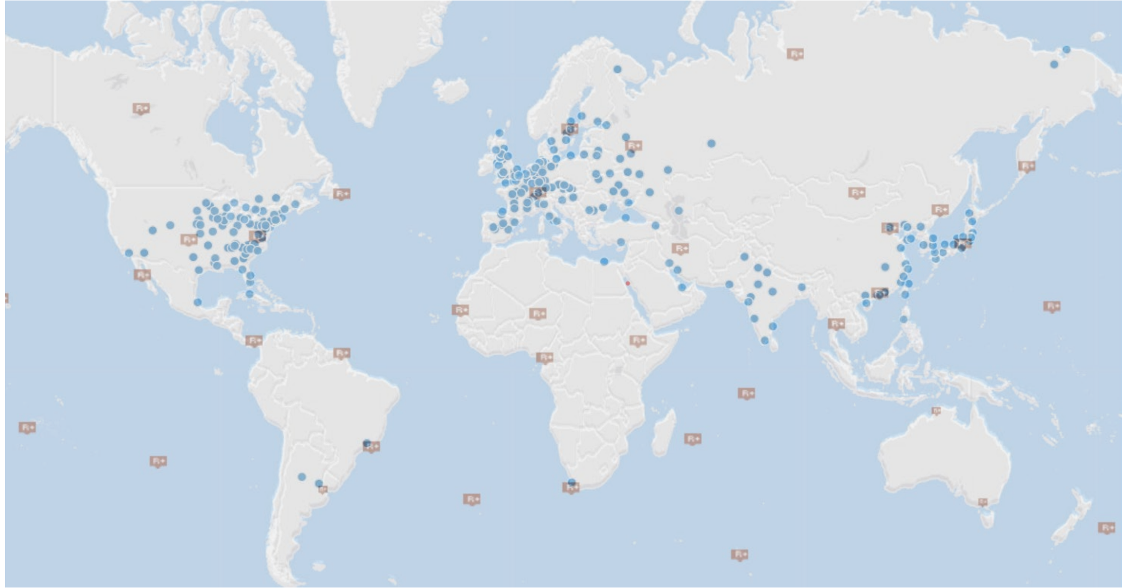
TABLE I. Calculated production rates for krypton and xenon isotopes of interest

Nuclide	Production rate (/cm3/s at 1 MW)		Ratio
	spallation	equilibrium	(equ./spal.)
Kr-77	1.117E+07	1.141E+07	1.02
Kr-79	2.120E+07	3.523E+07	1.66
Kr-85m	7.664E+06	2.133E+07	2.78
Kr-87	6.782E+06	1.270E+07	1.87
Kr-88	6.453E+06	1.053E+07	1.63
Xe-121	2.721E+06	3.291E+06	1.21
Xe-122	4.393E+06	7.008E+06	1.60
Xe-123	3.553E+06	9.080E+06	2.56
Xe-125	2.527E+06	1.752E+07	6.93
Xe-127	1.531E+06	2.508E+07	16.38

DeVore, Joe R, Lu, Wei, and Schwahn, Scott O. 2013. "NOBLE GAS PRODUCTION FROM MERCURY SPALLATION AT SNS". United States

Discussion

- With more sensitive radioxenon stations being implemented, there is potential for added impact from non-traditional isotopes.
- Need to evaluate the impact of these different signals on the network
  - How close does the source need to be to a station? (Xe-125)
  - How many stations might a strong source impact? (Xe-127)
- What is the impact of smaller isolated sources compared to medical isotope production facilities and nuclear reactors?



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