



Sentry: A proposed software platform for analysis of radionuclide data sets

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Advance Radioxenon Analysis Needs

- ▶ To better discriminate underground nuclear explosions from routine nuclear power and medical isotope processes the IDC and the International Noble Gas Experiment (INGE) working group have identified several advanced radioxenon data analysis needs
- ▶ For beta-gamma analysis
 - Improvements to the Stockholm equations
 - Alternative spectral fitting techniques
 - Development of standard spectra methods
 - Incorporation of silicon detectors
 - Use of preliminary files for routine automatic analysis
 - Silicon detector beta-gamma analysis
 - Memory free cells
- ▶ For HPGe
 - More robust radioxenon metastable analysis
 - Use of other spectral data to track and update efficiency, resolution, and energy
- ▶ Radioxenon data sets independent of detector type
 - Uncertainty budget determination
 - Long term tracking of critical parameters and uncertainties
 - Better use of the QA/QC data sets



Sentry: Goals

- ▶ **Goal:** Sentry is envisioned as a radioxenon data analysis software platform that can incorporate new data analysis methods
 - Specifically, Sentry will provide radioxenon data analysis tools that
 - Incorporate the expertise developed over the past 20 years by experts: IDC, NDC, International Noble Gas Experiment (INGE), RN working group, other
 - Be flexible to future IDC and NDC needs
 - Provide a common programming platform for developers
 - Maintain a consistent data analysis experience for IDC and NDC analysts

Sentry Platform Description

Description: The Sentry platform will:

- Utilize data analysis using a number of different computing languages and already existing analysis packages
- Provide a common software development toolset for development of new analysis modules
- Utilize the Red-Hat 6.0 operating system for compatibility with the IDC and NDC-in-a-Box
- Be a web-based software platform, which has the advantage of:
 - Being installed in one place, but used by many across a network
 - Only needing to upgrade the code on a single server
 - Data being managed by the server, users don't need database credentials
 - Taking advantage of performance optimizations of web browser, such as plotting charts and maps, etc.



Learn more...

RN Data Analysis

[Sentry](#)

[Sentry Modules](#)

[Future Sentry Modules](#)

[Publications](#)

Radionuclide Data Analysis Software

As part of a world-wide treaty monitoring network for detecting nuclear explosions the IMS at the CTBTO deployed and maintains a network of particulate and radionuclide air sampling systems. The IDC at the CTBTO in Vienna receives the data and analysis it for the tell-tale signs of a nuclear explosion. These radionuclide (RN) data sets are critical for IDC analysts to determine whether a sample is from a nuclear explosion or some other source, such as a nuclear reactor or a medical isotope production facility. All of these systems have a common need for robust data analysis routines and results integration. PNNL has developed two web-based modules to help with the monitoring mission of the IMS and IDC and is proposing further software modules under the name Sentry to augment and enhance the critical data analysis mission of the IDC as well as individual Nuclear Analysis Data Centers (NDC).

Contacts

More information:

[✉ Justin McIntyre](#)

- ▶ Website for distribution of Sentry general purpose tools
 - <http://rn-data-analysisdev.pnl.gov/>

Example #1: web-based BGSim module

Configure Sample

T_0

Library	Atoms	mBq/m ³
Xe135	0	0 ± 0.0
Xe133	10000	1.0240 ± 0.00020
Xe133m	0	0 ± 0.0
Xe131m	0	0 ± 0.0

T_0

2015-01-01 00:00

Collection

Collection Start: 2015-01-01 01:00

Collection Stop: 2015-01-01 13:00

ccXe: 1.3

Acquisition

Library	Decays	Observed
Xe135	0 ± 0.0	0 ± 0.0
Xe133	526.61 ± 0.33	526.61 ± 0.33
Xe133m	0 ± 0.0	0 ± 0.0
Xe131m	0 ± 0.0	0 ± 0.0

Acquisition Start: 2015-01-01 20:00

Acquisition Stop: 2015-01-02 07:00

Live Time %: 100

Background/Minute: 0.24

Beta Gamma Sim

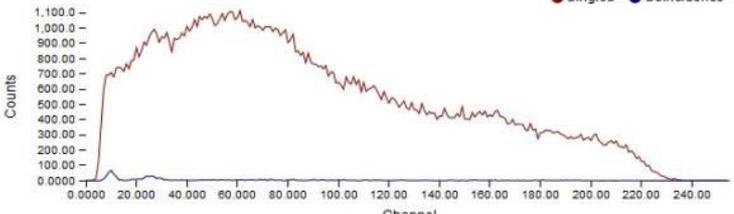
- Configure
 - Load Reference
 - Detector
 - Sample
- Results
 - Regenerate
- Download as
 - BGSIM1424725033717
 - simulated



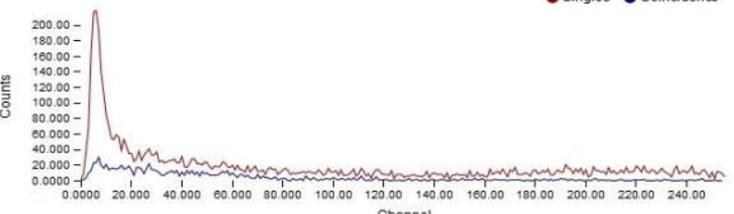
T_0	Collection	Acquisition
Jan-01-2015 00:00:00	Jan-01-2015 01:00:00	Jan-01-2015 13:00:00
Jan-01-2015 20:00:00	Jan-02-2015 07:00:00	

Library	Atoms	mBq/m ³
Xe135	0	0
Xe133	10000	1.0240
Xe133m	0	0
Xe131m	0	0

Gamma



Beta



► BGSim: produce realistic beta-gamma files for testing and training purposes

Example #2: web-based BGView module



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Sample

Load File

Detector Background

Load File

Sample Overview

Site Code	TST00	Acquisition Start	Jan-01-2015		Xe131M	14.9 ± 1.2 mBq
Detector Code	TST00_001		20:00:00 UTC		Xe133M	39.5 ± 1.9 mBq
Measurement ID	TST00_001-XXXXXXXXXXXXXXXXXX	Acquisition Stop	Jan-02-2015		Xe133_30	36.6 ± 2.8 mBq
			07:00:00 UTC		Xe133_80	-22.8 ± 2.1 mBq
Detector Measurement ID	0	Acquisition Duration	11 Hours		Xe133_8030	-0.62 ± 1.7 mBq
Type	SAMPLEPHD	Acquisition Live Duration	11 Hours (100%)		Xe133_80EX	-4.5 ± 1.9 mBq
Qualifier	FULL				Xe133_EX	53.1 ± 3.8 mBq
					Xe135	6.0 ± 3.3 mBq

Background Overview

Site Code	MRV01	Acquisition Start	Nov-15-2010		
Detector Code	MRV01-xy0		20:05:53 UTC		
Measurement ID	MRV01-xy0-2010/11/15-20:05:53	Acquisition Stop	Nov-18-2010		
			00:31:59 UTC		
Type	DETBKPHD	Acquisition Duration	2 Days, 4 Hours, 26 Minutes, 6 Seconds		
Qualifier	FULL	Acquisition Live Duration	2 Days, 4 Hours, 17 Minutes, 20 Seconds (99.721%)		

- ### Viewer Tool
- Overview
 - Graphs
 - Raw Files
 - Metadata
 - Energy Calibration
 - Regions of Interest
 - Efficiencies
 - Activity Timeline

▶ BGView: display beta-gamma files

CTBTO SnT2017

■ Available on website



Potential Future Modules

- ▶ State-of-health viewer recently provided to the IMS to monitor radioxenon system performance
- ▶ Advanced spectroscopy analysis of Beta-Gamma and Gamma spectroscopy
- ▶ Analysis techniques to quantify non-standard radioxenon isotopes
- ▶ Time series analysis of the preliminary data sets for better sensitivity
- ▶ Different analysis methods for new radiation detector types
- ▶ Trend analysis of existing or new state-of-health parameters or combinations of these same parameters such as:
 - Beta-Gamma, Beta and Gamma backgrounds rates
 - Ratios of isotopes measured by particulate stations
- ▶ Webgrape improvements
 - Advanced atmospheric plume model display
 - Analysis modules that include dilution and washout effects for multiple station locations

Summary

- ▶ Sentry is envisioned as a radioxenon data analysis platform that seeks to provide:
 - IDC and National Data Centers with updated radioxenon data analysis, advanced tools, and enhance the workflow of RN data analysts
 - Incorporation of best practices learned from over 20 years of IMS operations
 - Expert community-driven development and vetting of new analysis methods

- ▶ Seeking coauthors for a technical review paper to cover improvements for analysis of radioxenon datasets
 - Contact justin.mcintyre@pnnl.gov