Sampling
Uninterrupted sampling of atmospheric xenon is performed using charcoal beds at ambient temperature. Moisture and carbon dioxide is removed from the air using membrane dryers and molecular sieves.

Processing and quantification
Sample preparation including radon separation is performed by preparative gas chromatography. The xenon volume is quantified using a thermal conductivity detector.

Detection
The xenon activity is measured using a beta-gamma coincidence technique recording the energy of the electrons and gamma rays produced in the decay of $^{133}$Xe, $^{135}$Xe, $^{131m}$Xe, and $^{133m}$Xe. The coincidence technique reduces the ambient background and the recording of the beta energy allows for high sensitivity measurements of the metastable states.

SAUNA SYSTEMS
Instruments for detecting nuclear explosions from low levels of radioactive xenon in the atmosphere
Helena Berglund, Scienta Sauna Systems AB, Uppsala, Sweden

Continuous monitoring
SAUNA II
- A fully automatic system for continuous monitoring
- SAUNA II is based on a non-cryogenic sampling technique followed by preparative gas chromatography and a high sensitivity beta-gamma detection system
- Data is reported every 12 hours
- A state-of-health monitoring system that alerts on deviations from normal

Laboratory analysis
SAUNA II Laboratory System, Extended Laboratory System, and Base Camp System
- Analysis of archive gas samples
- High transfer efficiency, >95%
- Activity measurement of $^{133m}$Xe, $^{133m}$Xe, $^{131m}$Xe, and $^{135}$Xe, using a beta-gamma coincidence detector with the high sensitivity of the SAUNA II detector system
- Extended Laboratory System: Possibility to also process and analyse samples collected with the Mobile Sampling Unit and an increased radon separation factor
- Base Camp System: Addition of the SAUNA II state-of-health monitoring system allowing for a more automatic analysis process

Transportable xenon laboratory
TXL, Transportable Xenon Laboratory, technical solution developed by PNNL (Pacific Northwest National Laboratory) in 2009
A transportable SAUNA II system
- A container solution for a transportable SAUNA laboratory
- Complete solution for deployment worldwide
- All infrastructure integrated
- Fast start up for continuous monitoring

New developments
- New detector electronics
  - Software controlled digital readout electronics and detector settings
  - Real time and live time measurements
- Coated beta cells
  - $\text{Al}_2\text{O}_3$ layer to reduce gas diffusion into beta cell material. Minimizes memory effect
- Extended sample archive
  - Covering 7 days of sampling and makes identification and shipping of samples easy
- Data acquisition software
  - Intuitive and user friendly
- New detector electronics
  - Software controlled digital readout electronics and detector settings
  - Real time and live time measurements
  - Coated beta cells
  - $\text{Al}_2\text{O}_3$ layer to reduce gas diffusion into beta cell material. Minimizes memory effect

In-field sampling
SAUNA II Mobile Sampling Unit
- A mobile unit for in-field sampling
- Processing and analysis at a base camp laboratory
- Atmospheric or sub-soil samples
- Continuous or single sampling
- Short set-up time, 20 min
- Modules mounted in boxes easy to carry

SAUNA network
Service and support
- Preventive maintenance
- Emergency repair
- Telephone support
- Remote dignosing
- Training

www.saunasystems.se