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T3.1-375





PUTTING AN END TO NUCLEAR EXPLOSIONS





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The SAUNA Q_B – array is the next step in remote sensing of activities involving nuclear fission that can improve.

Detection capability by decreasing average source-receptor distance and increasing coverage.

Location capability by increasing number of detecting sensors.

Categorization capability by increase the number of samples.

... at the same cost as a single state-of the art system like SAUNA III



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The Swedish xenon array (units connected by green lines) shown together with nearby MS radioxenon stations (white lines).



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The array consists of five fully automatic Q_B - units

- Collection time: 12 h
- 1.2 1.4 ml stable xenon in cell/sample
- Process time 3 h (coll. stop > sample in detector)
- Detector measurement time: 10.5h
- 5 day detector background
- Memory free beta cells
- No gas background used
- Same detector as SAUNA III
- 4 cm lead shield (SAUNA III has 7.5 cm)
- Automatic drift correction

Detector background gamma coincidence spectrum for a Q detector (blue) vs. a SAUNA II (orange) and SAUNA III detector (green).

- Weight 370 kg
- Transported in one piece
- Power consumption
- < 1.5 kW (max)</p>
- < 0.9 kW (mean)</p>
- N₂ consumption: < 200 l/day
- Calibrated at factory
- Simple installation





A Q_B - unit and its detector









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- All five Q_B:s installed and running since May 5, 2021
- One unit will later be moved from Uppsala to Kiruna in the north of Sweden.









Installation of the first Q_B - unit in Hagfors, Sweden, in November 2020.





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Operational experience



Date







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Example of the Q_B – array and SAUNA III detecting the same xenon plume

- A 2.5-day wide plume of ¹³³Xe hit Sweden in the middle of may 2021.
- All five $Q_{B^{-}}$ units in the array were affected, as well as the FOI SAUNA III in Stockholm.
- A Bayesian location analysis* was performed on the two data sets (19 Q_B – samples and 11 SAUNA III - samples), assuming a continuous source.
- The area of the resulting source location probability distribution is considerable smaller for the Q_B- array.



SAUNA III



Continuous source Bayesian PDF



Continuous source Bayesian PDF



*A. Ringbom and A. Axelsson, Poster at SnT2015, T1.3-P1.

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Conclusions

- The worlds first radioxenon system designed using an array concept has been installed in Sweden and is up and running since the beginning of May, 2021.
- The array consists of five Q_B units, which each has a capability comparable to the SAUNA II
 – systems currently installed in the IMS, but to a much lower cost.
- The data communication solution is based on mirrored databases, enabling constant access to all system data at the data center, remote control, and remote software upgrades.
- First data indicates that the array can provide a location capability superior to what has been achieved until now with state-of-the art radioxenon systems.

