stuk

MiniPANDA

A detector for measurement of environmental samples

Overview

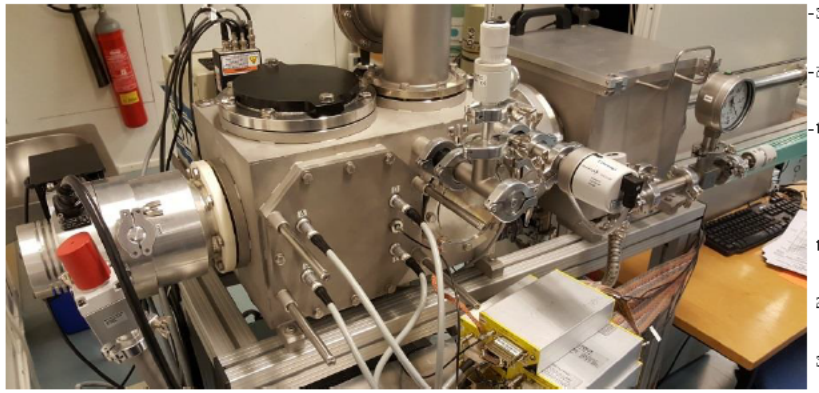
- RADICAL (RAdiation Detection In Coincidence And List mode) project is an umbrella project for continuation of earlier research done at STUK
- Collaboration between STUK and University of Jyväskylä
- Project is divided into several work packages. MiniPANDA detector system is part of RADICAL

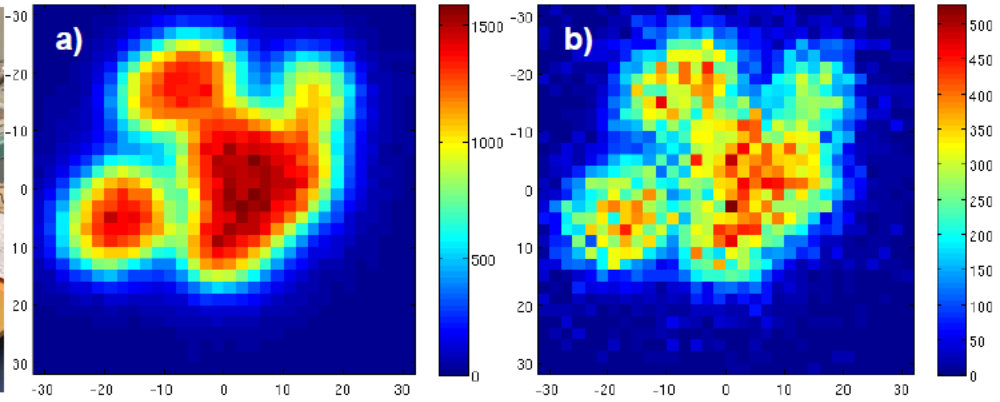
RADICAL WP1

- List mode data-acquisition – record the time and energy of every interaction recorded by the detectors.
- Data selection and analysis methods for list mode data
- Integration of IEC 63047 standard for list mode data
- Integration into STUK data management systems

RADICAL WP2

- PANDA detector system at University of Jyväskylä
- Two part vacuum system for loading samples without having to do full vacuum cycle
- Position sensitive alpha-gamma and beta-gamma coincidence measurement in Measurement position 1
- Conversion electron and x-ray detection with silicon drift detector in Measurement position 2





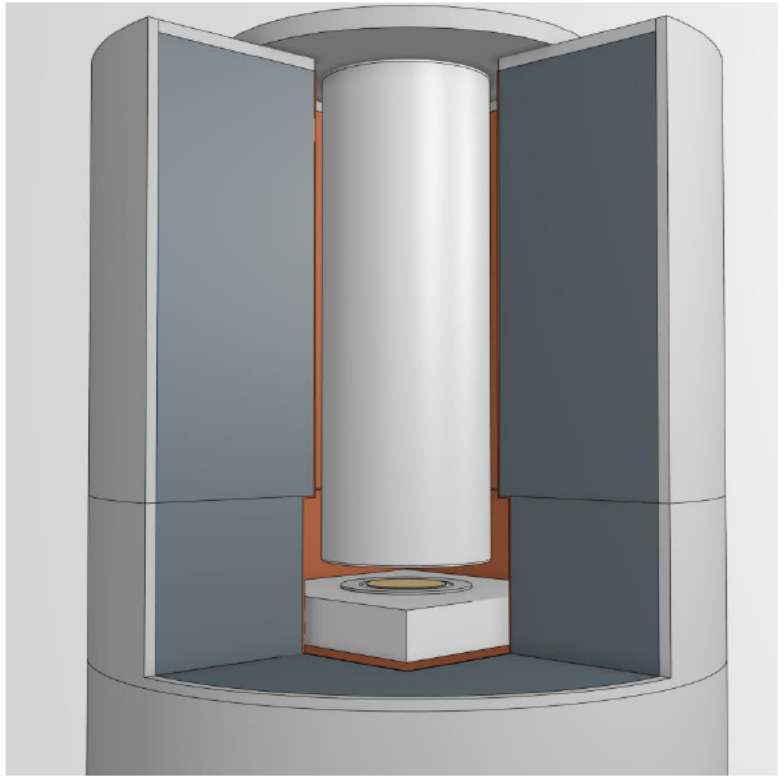
RADICAL WP3

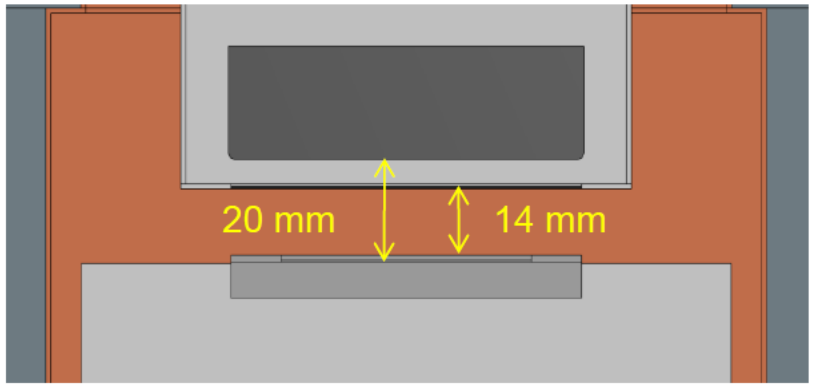
- Increase the sensitivity of detector systems in STUK
- Integration of multi-detector systems and list mode data acquisition into Gamma laboratory workflow
- To be integrated into STUK data management system.
- Compton suppression system
- MiniPanda system for alpha-gamma coincidence

[MiniPANDA, Timo Hildén]

MiniPANDA

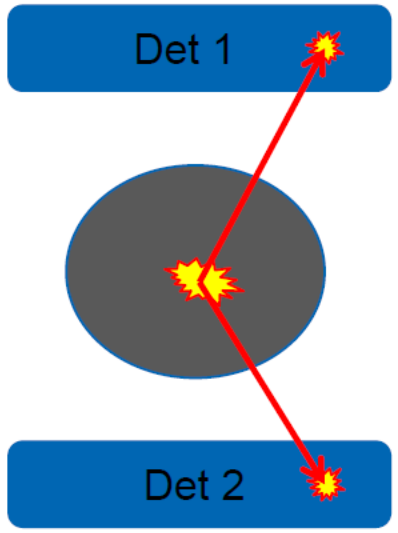
- Reviving an existing detector system originally put together 10 years ago
- Copper lined compact lead castle
- Passivated Implanted Planar Silicon (PIPS) detector for detecting alpha particles
  - 50 mm diameter
  - 300 µm thick
- High purity germanium detector
  - 70 mm diameter
  - 14 mm gap for sample
  - Close geometry - 20 mm between germanium crystal and the PIPS





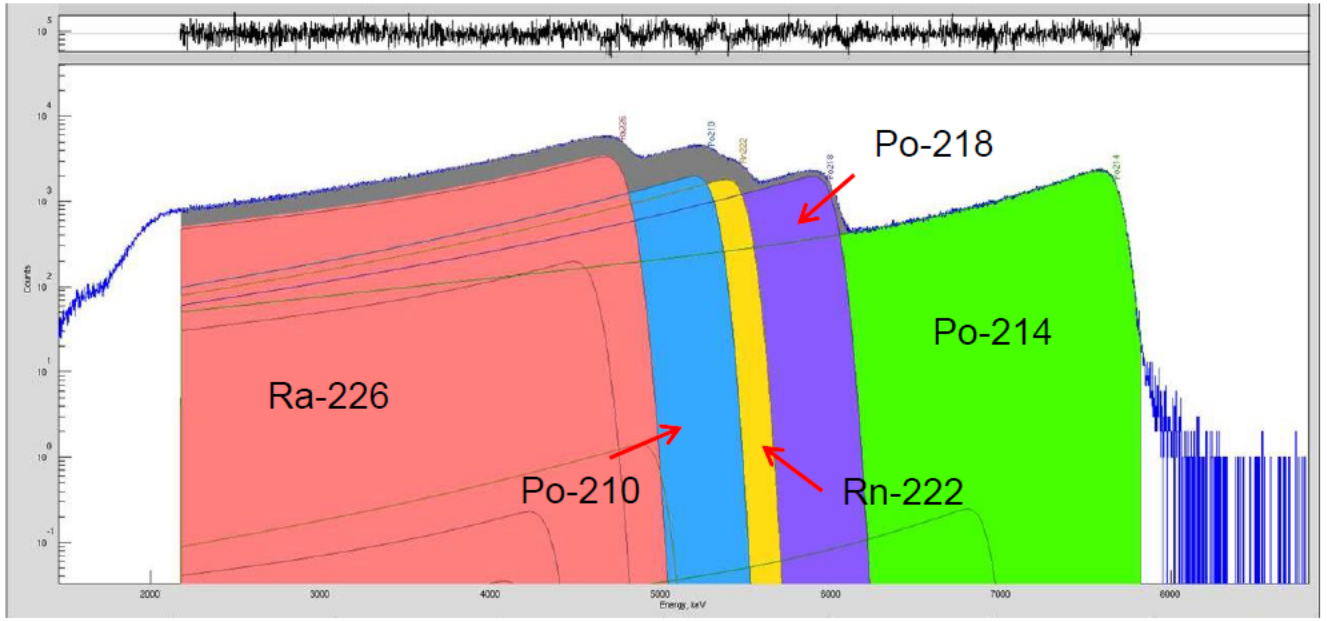
List mode readout

- Digital MCA with integrated high- and low voltage systems.
- Spectra can be generated from the time-stamped data online or in post production
- Access to time dependent behavior of the measurement system that would have been invisible under normal histogram recording.



- The detectors are running with a synchronized clock so that [anti]coincident events can be selected from the data.
- Signal in both detectors within a short time window – both come from the same event
- It is possible to select between events that are [anti]coincident or fall within a specific energy window in another detector

Alpha measurement

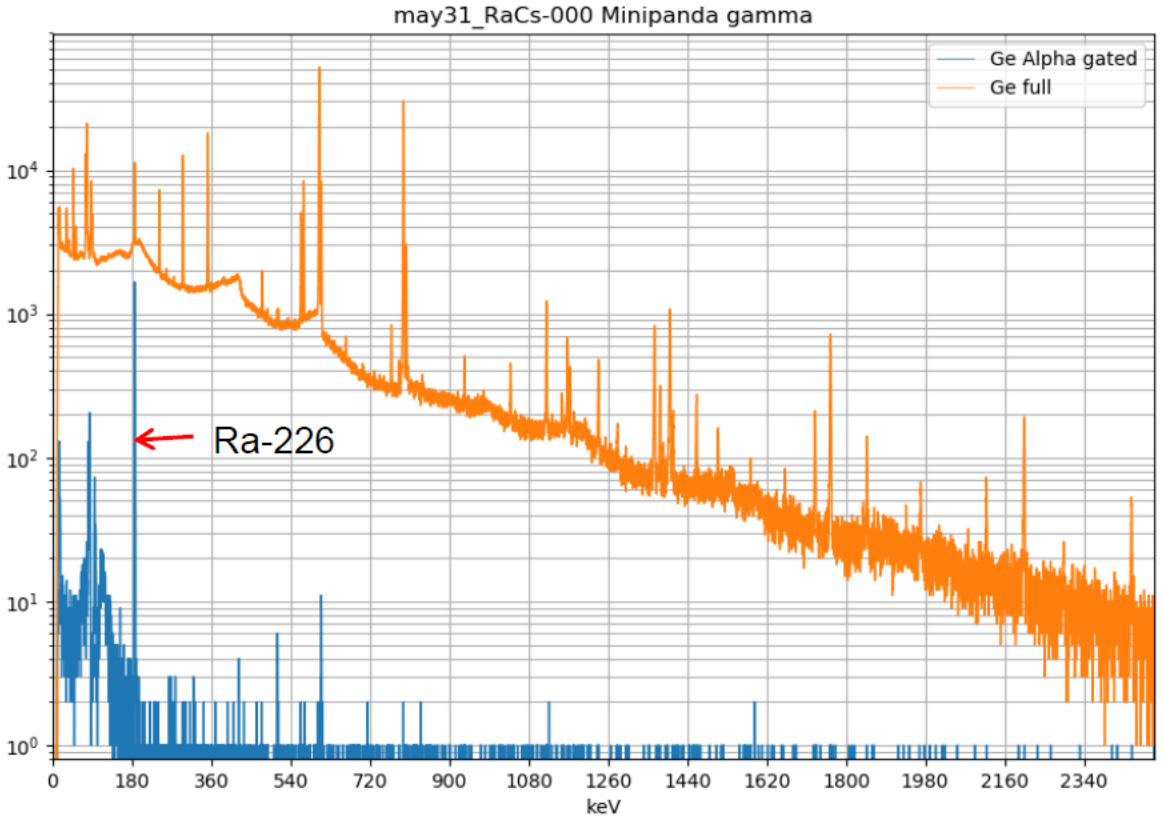


- Alpha particles ionize strongly - efficient detection, but easily absorbed by intervening material
- Controlled sample geometry
- For many nuclides more sensitive than gamma measurement

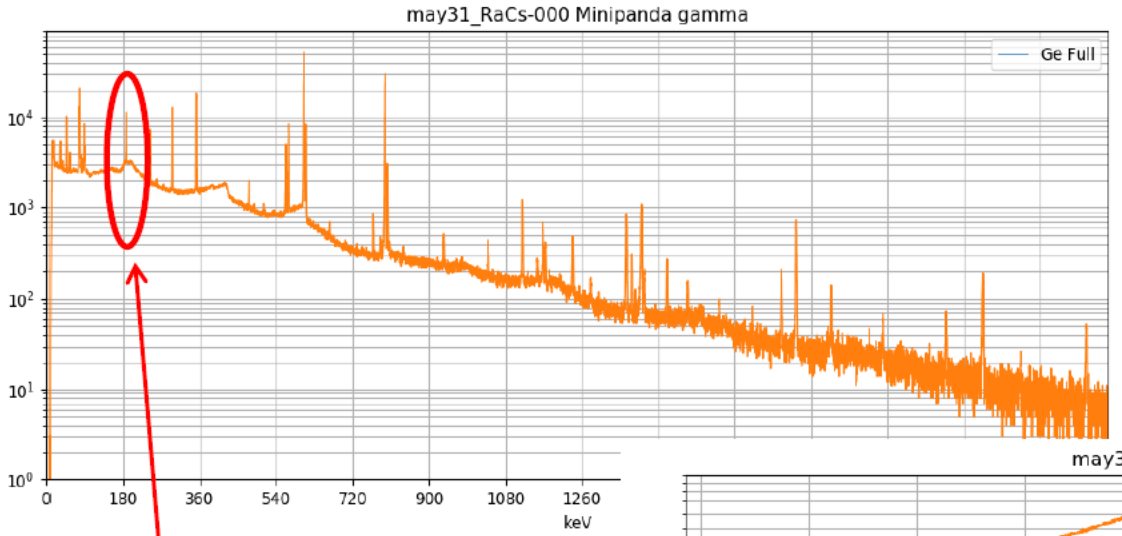
Alpha-gamma coincidence

– Only record gamma energies from events with coincident alpha signal

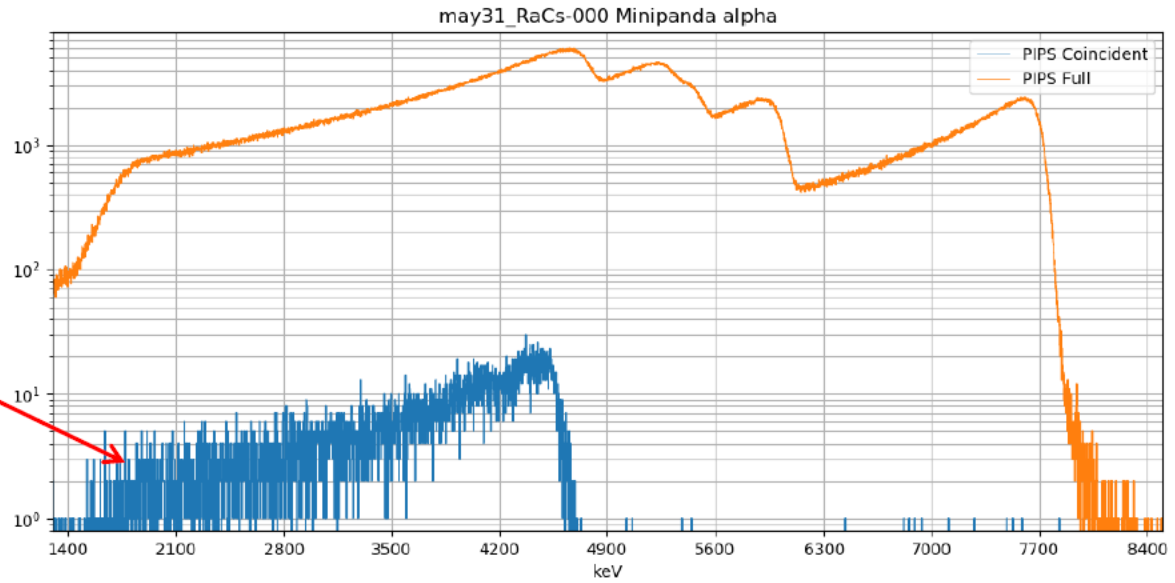
– Efficiently filter away the gamma background by demanding alpha coincidence, increasing detection efficiency



Alpha-gamma coincidence



- Filter alpha spectrum with known gamma peak
- Possible to pick out nuclides / branches from the alpha spectrum



Alpha spectrum gated by Ra-226 186 keV peak. Intensity of the gamma peak is ~3.5 %

Purpose

- Objective is to produce a new tool and workflow for the analysts in the Gamma laboratory of STUK
- Ability to make fast alpha-gamma measurement on samples that have been classified as suspicious in the routine gamma analysis
- Especially suitable for air filter and swipe samples but any thin sample will do
- Radiation safety monitoring
- Emergency preparedness

To do

- Final electronics yet to be acquired. Selection of the manufacturer and the device is close to completion, however, and readout software is in development.
- Full integration with the STUK data management system, including database connections, control interface
- Adoption of IEC 63047
- Designing the workflow
- Validation of the final setup with well-known sources and tests with various environmental samples