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SAGe Well Detector

GammaSpec 2016

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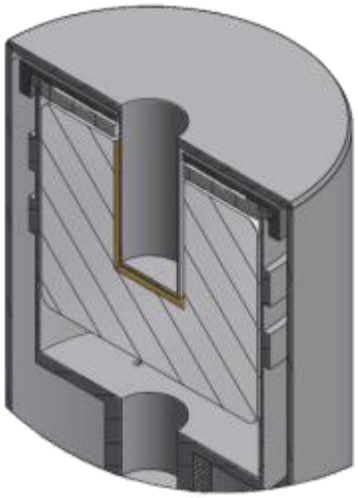
Outline

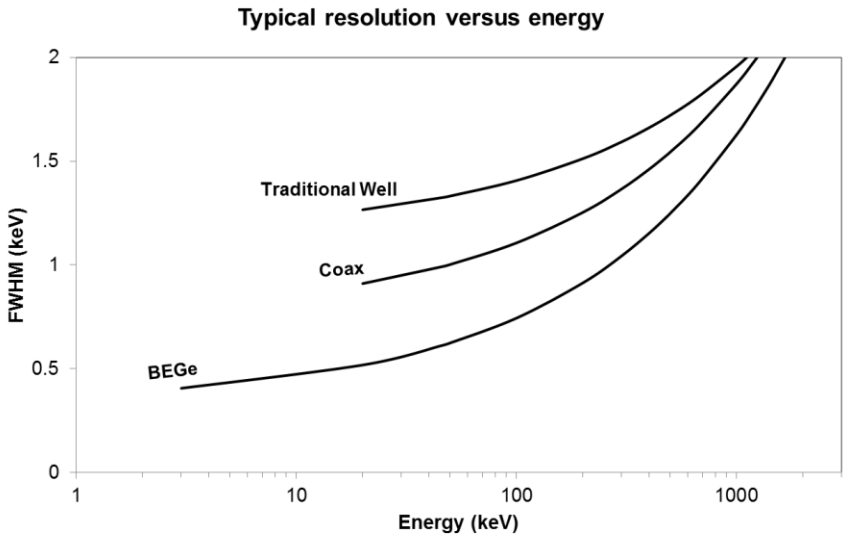
- What is a “SAGe Well Detector”
  - Features and advantages
- Application benefits
- Models and configurations
  - Performance specifications
  - Available options
- Care and maintenance
- Conclusion



First some history: Traditional Germanium Well Detectors

- Spectroscopy from 20 keV up to 10 MeV
- Near 4π counting geometry for a source placed inside the well
- High counting efficiency resulting in lower detection limits and shorter counting times to achieve a given detection limit

- Typical Applications
  - Oceanography
  - Geology
  - Life Science
  - Environmental samples
- Disadvantages of traditional Well detectors
  - Small sample volumes
  - No Coincidence Summing Correction
  - Poor resolution
  - Only good for in-well counting
  - LN_2 cooling only



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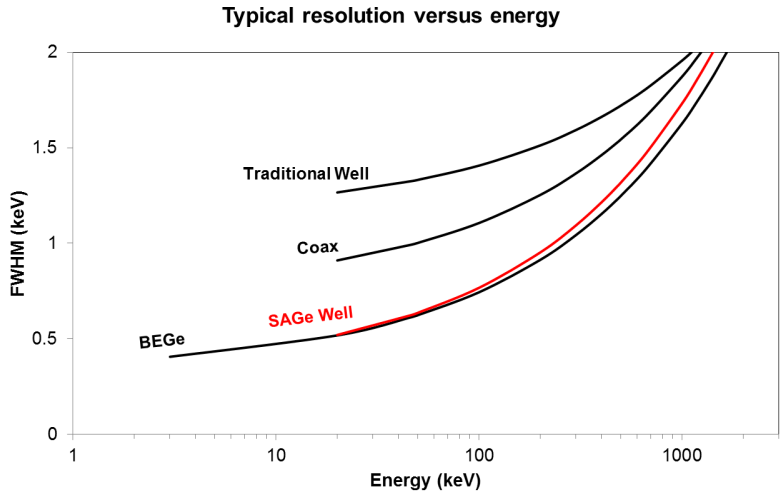
SAGe Well: Geometry and Advantages

- SAGe = Small Anode Germanium
  - Small area contact with short signal lead (like a BEGe)
  - Very low device capacitance
  - Maintains energy sensitivity down to 20 keV
- Advantages:
  - Low noise provides excellent low-energy resolution
  - Larger well diameters possible without degrading resolution
  - Compatible with electric coolers
  - Excellent performance for well and non-well sample geometries
- LabSOCS and Cascade Summing Correction
- Addresses major drawbacks of traditional Well detectors:
  - Significant reduction in counting times
  - Expanded field of application



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Application benefits

- Small Anode Germanium (SAGe) Well detectors
  - Innovative detector geometry addresses the drawbacks of traditional Well detectors
  - Introduces the “universal detector” concept

1. Step-change improvement in count time due to resolution performance
2. Significantly reduce count time with in-well counting
3. Count samples outside the well with similar or better performance than with coaxial detectors

Sample vial in the well

Bottle sample on end cap

Marinelli sample

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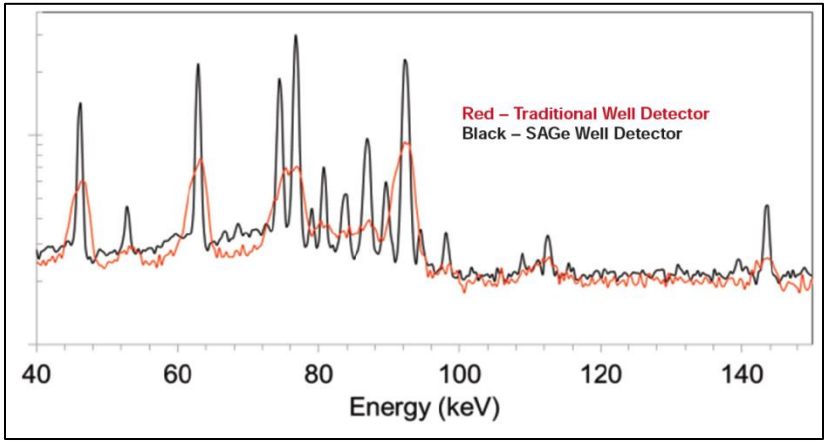
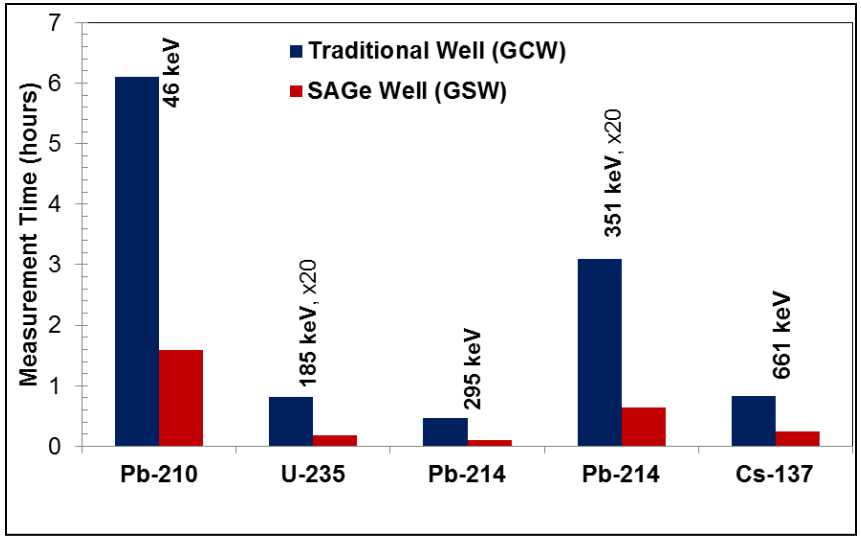
Improving existing well applications
Case study: Pb-210 dating

- Count time to MDA is calculated for SAGe Well GSW275L and compared with a Traditional Well detector
- Both detectors have a 28 mm diameter well (custom made GCW)
- Sediment sample in a vial 37 mm fill height
- **Factor 4 improvement in counting time for Pb-210**





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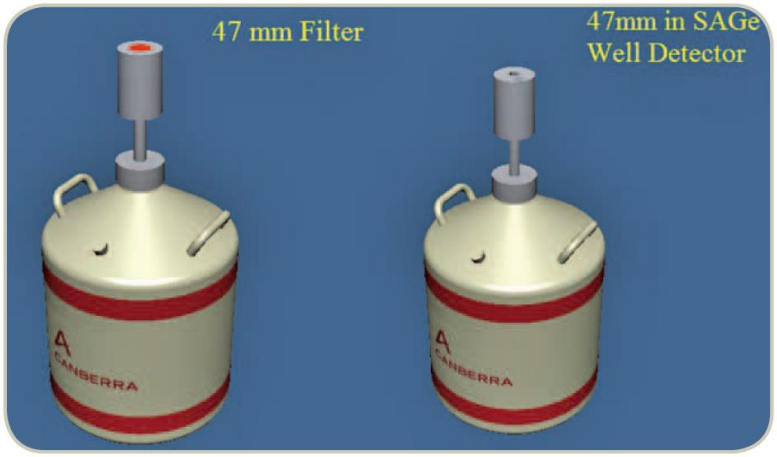
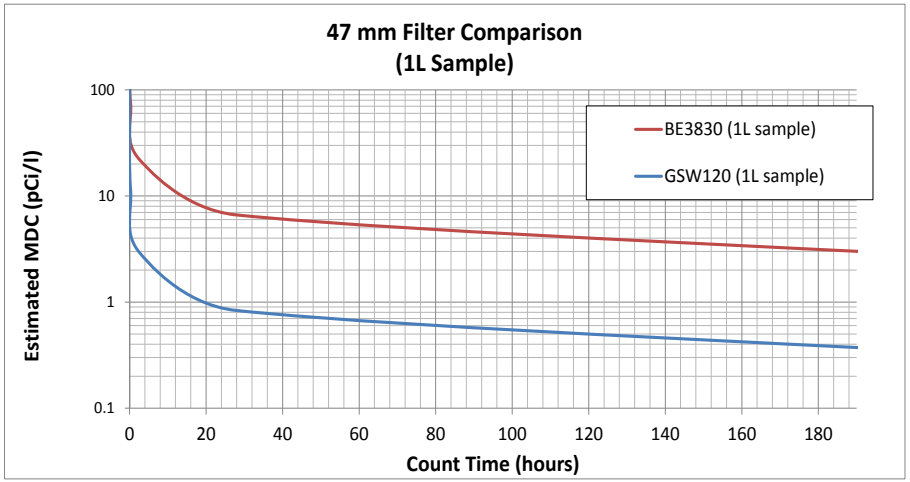
New Well Applications
Case study: Radium in drinking water

- Radium precipitation on filter paper
- EPA approved method developed by Georgia Tech Research Institute in 2002
- Evaluated scenarios:
  - 47 mm filter on 3800 mm^2 Broad Energy Germanium (BE3830)
  - Precipitate centrifuged in test vial and measured inside the well of 120 cc SAGe Well (GSW120)
- Detectors have comparable energy resolution, SAGe Well provides superior absolute efficiency
- SAGe Well realizes factor 8 improvement in MDC resulting in 50 times shorter count time
- Significant improvement in laboratory productivity





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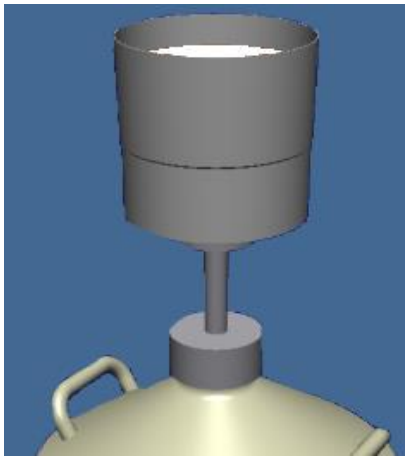
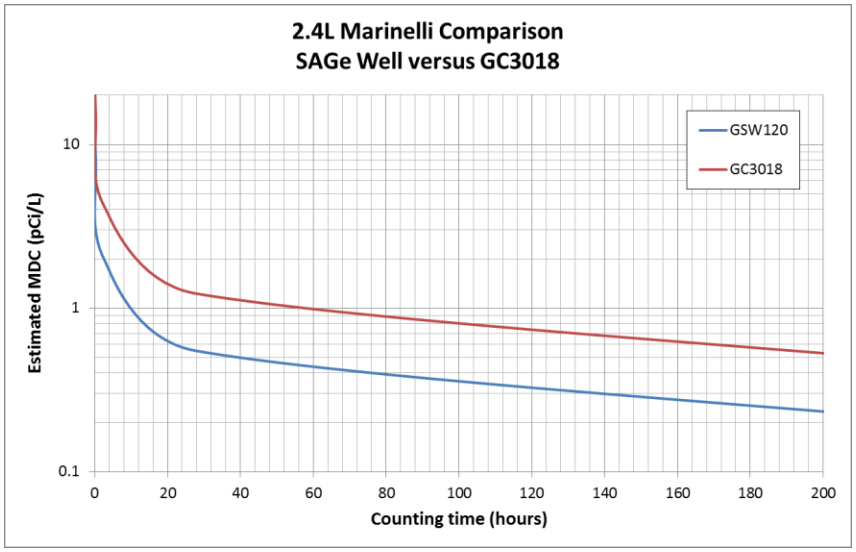
Using SAGe Well For Large Samples
Case study: Radioiodine in Milk

- Evaluated scenarios: 2.4 liter Marinelli beaker on:
  - 30% rel. eff. P-type coaxial detector (GC3018)
  - 120 cc SAGe Well (GSW120) – 3.25” diameter endcap
- Both detectors have +/- same active volume
- SAGe Well realizes factor 2 improvement in MDC resulting in 5 times shorter count time
- Example is representative for numerous liquid samples best measured in a large beaker
- Demonstrates versatility of the SAGe Well detector





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Models and specifications

Model	Min. Active volume (cc)	Well diameter (mm)	Well depth (mm)	1332 keV FWHM (keV)	122 keV FWHM (keV)	End cap diam. (inch)
GSW120	120	16	40	2.2	0.75	3.25
GSW200	200	16	40	2.2	0.75	3.5
GSW300	300	16	40	2.2	0.75	4.25
GSW350	350	16	40	2.2	0.75	4.5
GSW425	425	16	40	2.2	0.75	4.5
GSW275L	275	28	40	2.2	0.75	4.25

- **6 different models ranging from 120 – 425 cc active volume**
  - **5 models with 16 mm diameter well (usable diameter in endcap)**
  - **1 model with 28 mm well**
- **Resolution performance specifications:**
  - **Independent of active volume or well diameter**
  - **Guaranteed with LN_2 or electrically cooled cryostats**
  - **Valid with digital MCA's only**
    - Because of specific requirements on trapezoidal shaping settings
- **Thin lithium contact inside well**
  - **Low energy transmission: > 5% at 20 keV**

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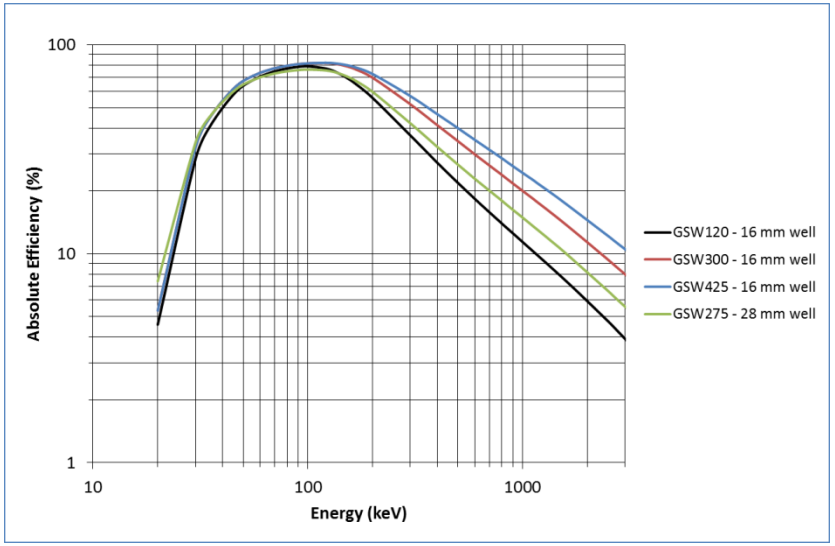
Models and specifications

- **Selecting the right SAGe Well Detector model:**
  - **Required absolute detector efficiency as function of energy**
    - Absolute eff. increases with active volume
    - Effect becomes more significant at higher energies
  - **Available sample volume/size**
    - 16 mm vs. 28 mm diameter
  - **Compatibility with Marinelli beakers**
    - Endcap diameter needs to be compatible with the well diameter of the beaker
  - **Budget vs. sample throughput due to count time**



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Available options

- **Cryostat configurations, electric coolers, shields and accessories**
  - **Same as any other Standard HPGe Detector model**
  - **Examples:**
    - Remote Detector Chamber (RDC) for backshielding
    - Ultra-Low Background (ULB) hardware
    - Electric coolers: CP5-PLUS or Cryo-Cycle II
    - …
- **ISOCS/LabSOCS characterization**
  - **Factory efficiency characterization for new or existing detectors**
    - For new detectors, needs to be included on the order
  - **Compatible with ISOCS/LabSOCS Efficiency Calibration Software**
  - **Provides an easy solution to perform Cascade Summing Correction (CSC)**
    - CSC usually a significant problem in well-type counting geometries because of the high absolute efficiency (sample is +/- completely surrounded by active detector material)
  - **Competitive solutions to CSC all involve Peak-to-Total calibrations, meaning additional measurement time, cost of sources and potential for error in the measurements and analysis**

Care and Maintenance

- Similar to any other HPGe Detector
- Need to keep cooled to LN_2 temperature and particularly avoid storage at elevated ambient temperature
  - Thin lithium contact inside the well is stable when the detector is cooled down
  - But thickness of this layer can increase at room temperature, reducing the low-energy sensitivity of the detector
- Time before low-energy sensitivity is impacted depends on conditions
  - Couple days is not a problem
  - Several weeks causes noticeable degradation and can impact the ISOCS characterization
  - Best shipped by air freight to minimize delays

Conclusion

- **SAGe Well is the most versatile detector ever:**
  - **Excellent energy resolution over 20 keV – 3 MeV (similar to a BEGe detector)**
  - **A larger well size (28 mm) without compromising resolution performance**
  - **An aspect ratio similar to coaxial detectors and compatible with Marinelli beakers and other large sample containers**
  - **Available with electrically cooled cryostat with same resolution performance**
- **LabSOCS and Cascade Summing Correction supported**
- **Major application benefits for both well and non-well sample geometries**
- **Use of digital electronics (MCA) is required**
- **Need to keep the detector cooled**

Now a lab manager doesn't have to choose between an HPGe detector for very small samples and one for more standard sized samples.

The SAGe Well detector does it all!!!

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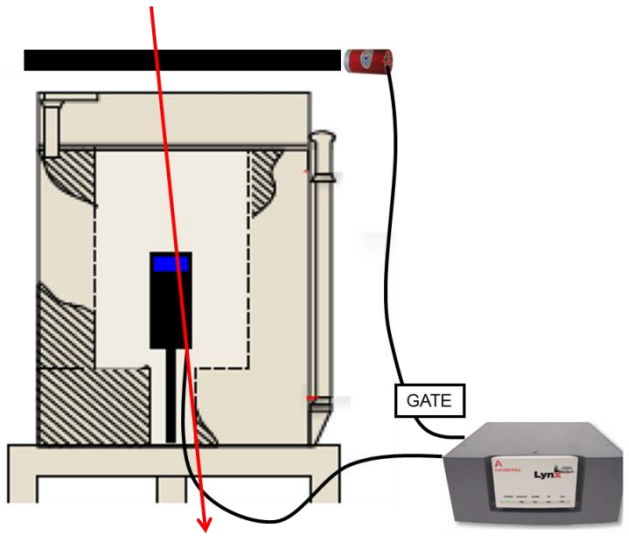
CANBERRA's Cosmic Veto System

CosmicGuard™



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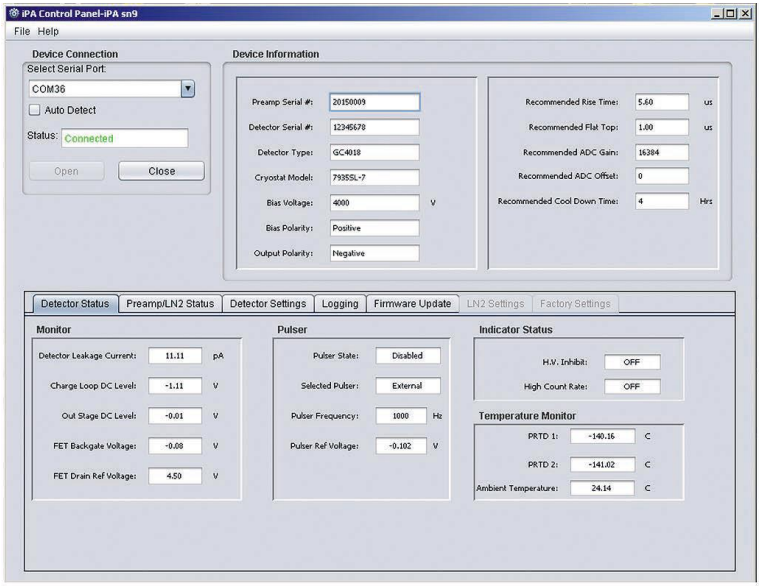
Look out for : New iPA

- **Intelligent Pre-Amp**
- **Digital setup of parameters (through Software)**
- **On Board Memory (USB) – Detector parameters, ISOXS Characterization, Service data...)**



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