NKS seminar on nuclear forensics in Nordic countries

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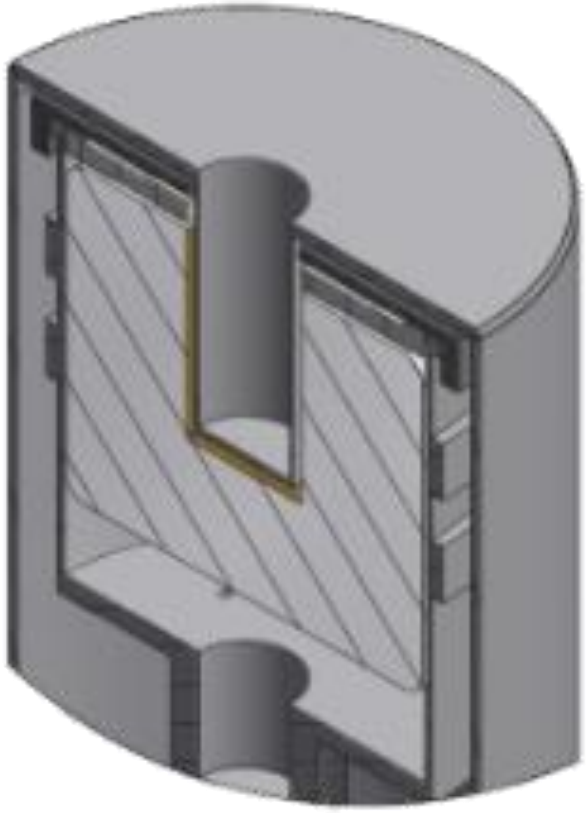
SAGe Well Detector Overview

- SAGe™ Well – A revolutionary new detector geometry



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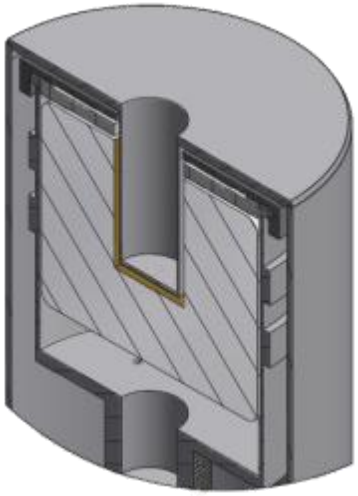
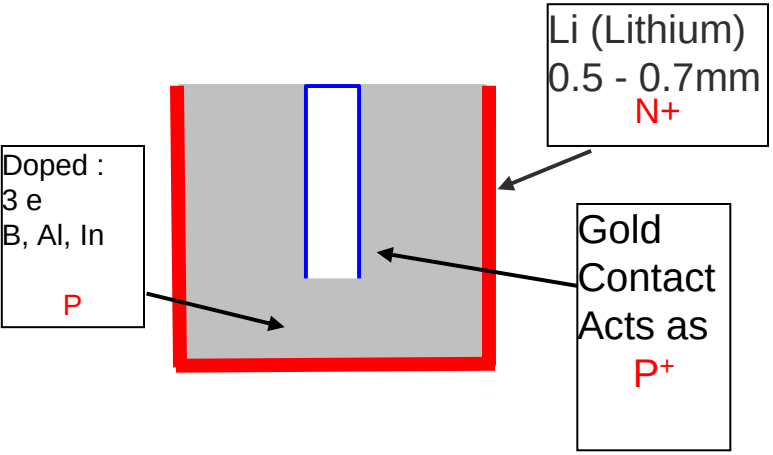
First some history: Traditional Germanium Well Detectors





P-type Turned Upside-down

- Spectroscopy from 20 keV up to 10 MeV
- Disadvantages of traditional Well detectors
  - Limited to small sample volumes
    - Diameter: 11 -15 mm
  - No Coincidence Summing Correction
  - Poor resolution
  - **Only good for in-well counting**
  - LN_2 cooling only

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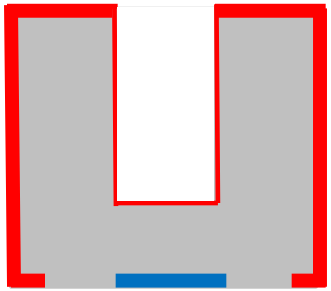
What is the SAGe Well Detector ?

- SAGe Well = Small Anode Germanium Well
  - Small area contact with short signal lead (like a BEGe)
  - Very low device capacitance=> Good Resolution
  - Maintains energy sensitivity down to 20 keV
    - Requires Thin Li-Contact



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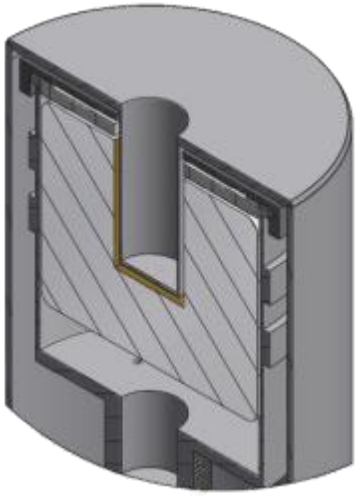
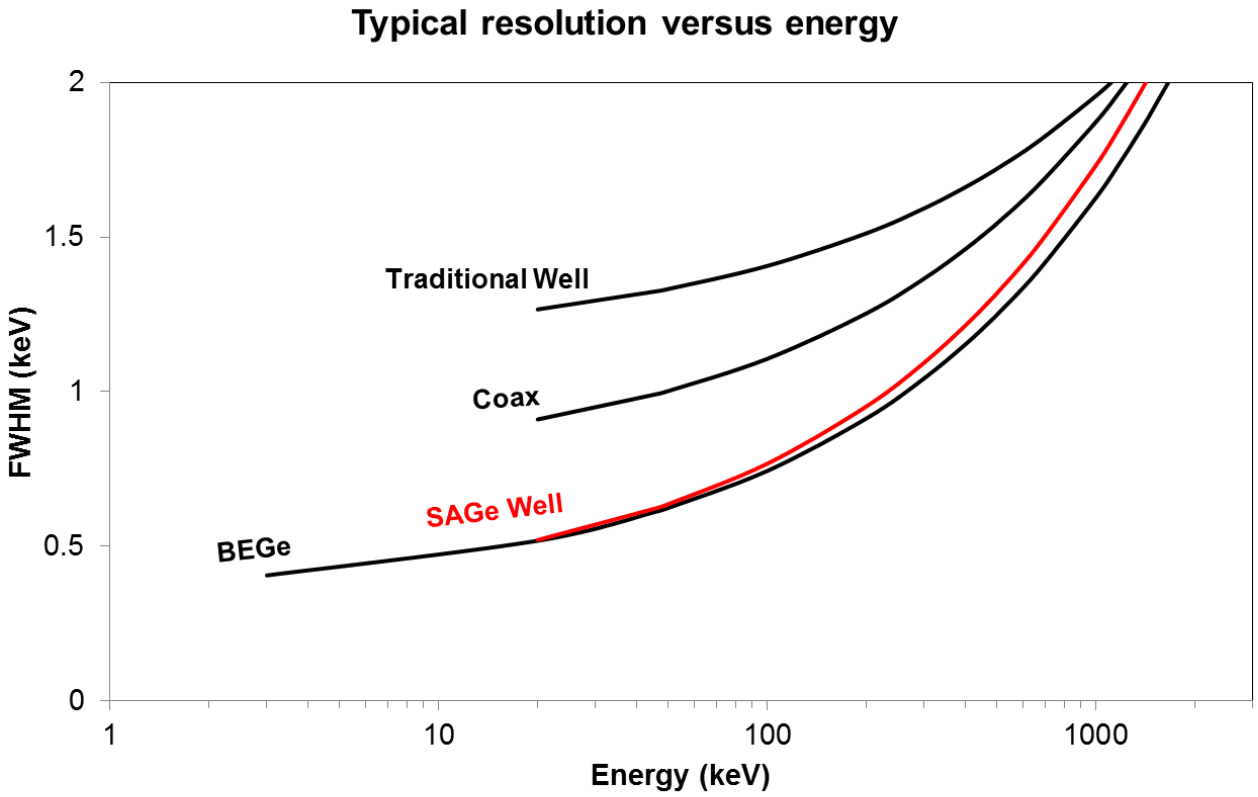


The SAGe Well Detectors



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SAGe Well: Features and Benefits

- Feature
  - Well Detector Geometry
- Benefits
  - Near 4π counting geometry for a source placed inside the well.
  - High counting efficiency resulting in lower detection limits and shorter counting times for small samples.

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SAGe Well: Features and Benefits

- Feature
  - Small Anode Contact
- Benefits
  - Low capacitance detector provides excellent low-energy resolution
  - Compatible with electric coolers
  - Excellent performance for wells and non-well sample geometries (industry first)
  - Better nuclide identification
  - Significant reduction in counting times

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SAGe Well: Features and Benefits

- Feature
  - Larger 28mm diameter well diameter possible without degrading resolution.
- Benefits
  - 24cc sample provides a practical measurement solution for wide range of samples (traditional well holds ~8cc).
  - Excellent match for sediment samples.
  - For small samples, SAGe Well provides extremely low MDA values compared to Coax or BEGe geometries.

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SAGe Well: Features and Benefits

- Feature
  - Low Energy (20 keV) Contact inside the Well
- Benefits
  - Important for some important radionuclides such as Pb-210.

Is thin Li-diffused contact
Requires cooling to remain thin

SAGe Well: Features and Benefits

- Feature
  - Patented ISOCS Characterization both in and outside of the well.
- Benefits
  - ISOCS/LabSOCS Mathematical Efficiency calibration, allowing for full efficiency calibrations without costly sources
  - Flexibility to calibrate for a large range of geometries
  - Capability to correct for the effects of Cascade Summing

Applications

- SAGe Well detectors Introduces the “universal detector” concept

1. Dramatic 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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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
GSW275 L	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

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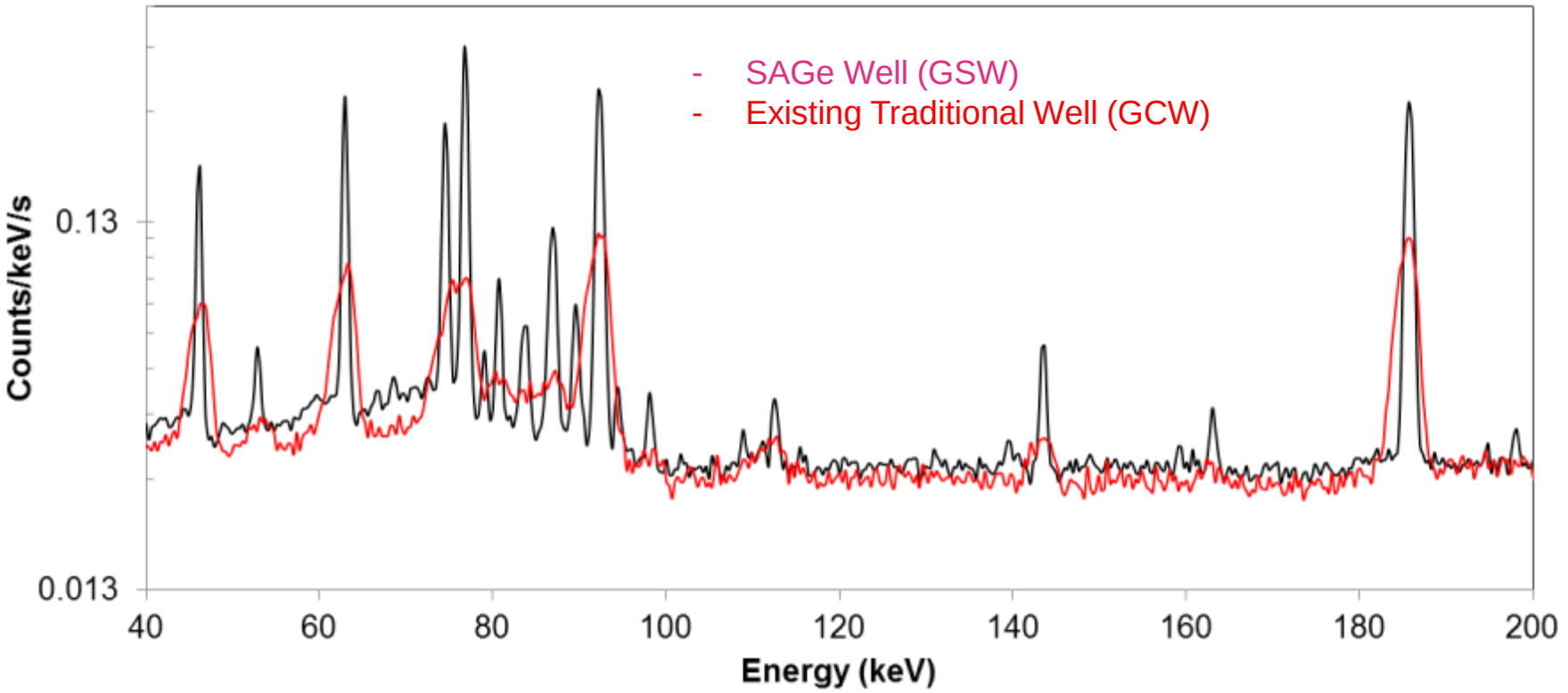
SAGe Well Resolution Creates New Possibilities



Low energy resolution comparison for a 275 cc SAGe Well to a 260 cc Traditional Well Detector, both with a 28 mm diameter usable well

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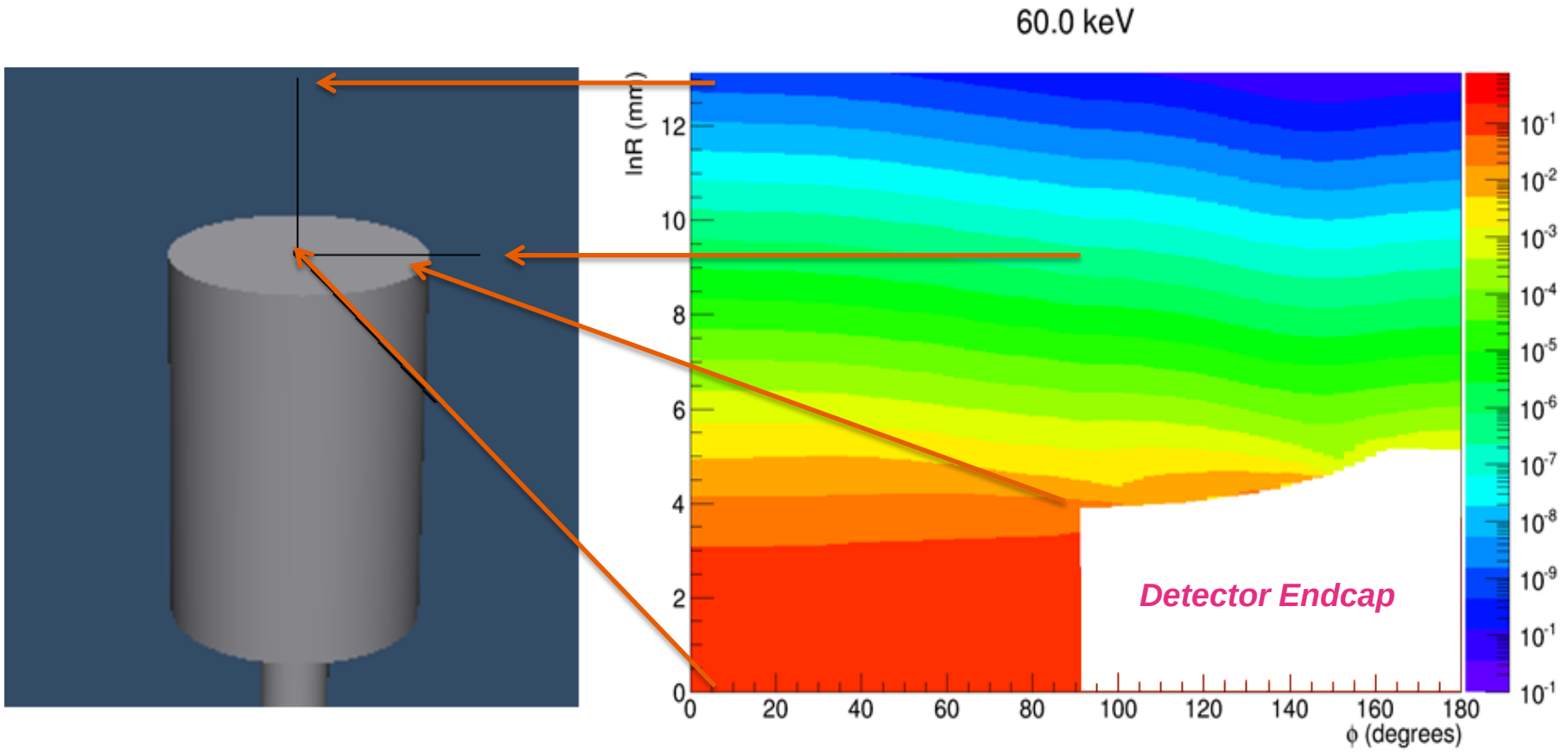
ISOCS Detector Characterization: Standard Detector



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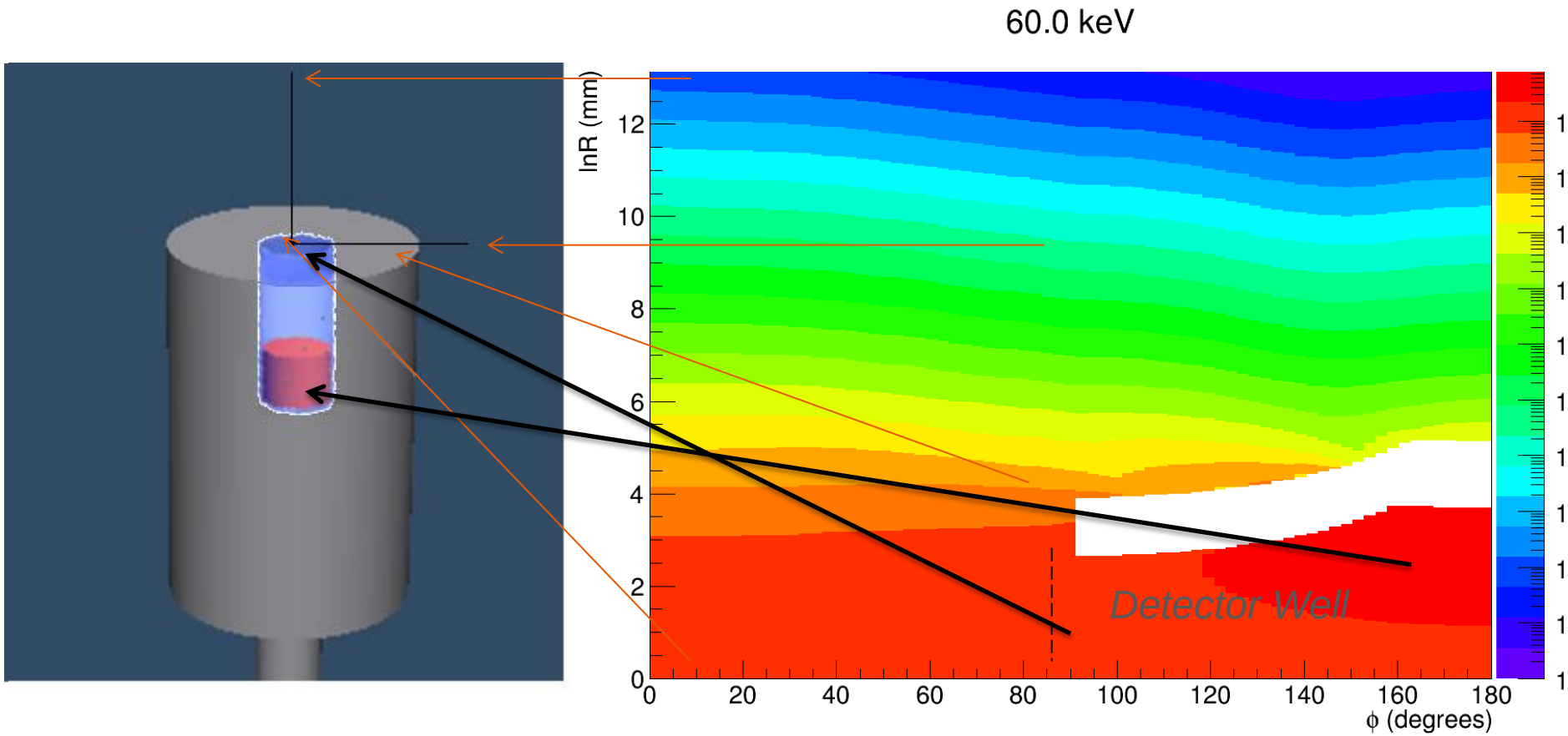
ISOCS Detector Characterization: SAGe Well Detector



Some of the highest efficiency is located in the well of the detector

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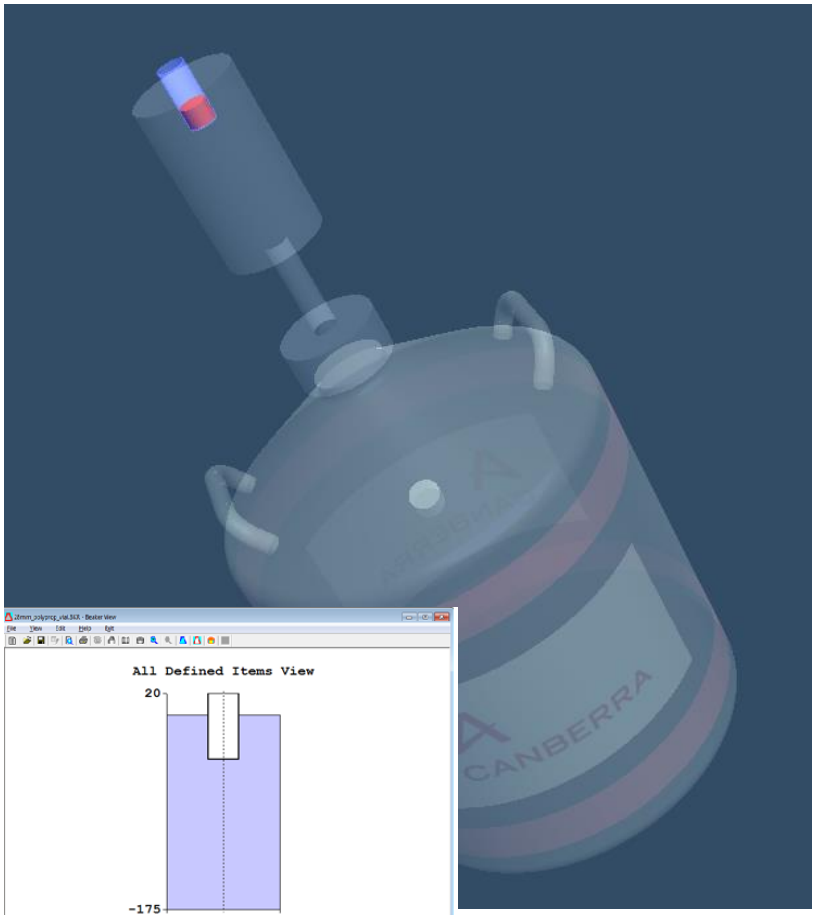
Eff Calibrations and Coinc.Sum. Corrections for Well Detector Geometries

- **Detector Characterization & PAR file modified to support samples in the well**
- **To create samples inside the well:**
  - **Use the Complex beaker template and the Beaker Editor for inside the well**
- **To create samples outside the well:**
  - **Use any of the existing templates for samples outside the well**
- **Applications:**
  - **Efficiency Calibration (LabSOCS)**
  - **Cascade Summing Correction (Total Efficiencies**



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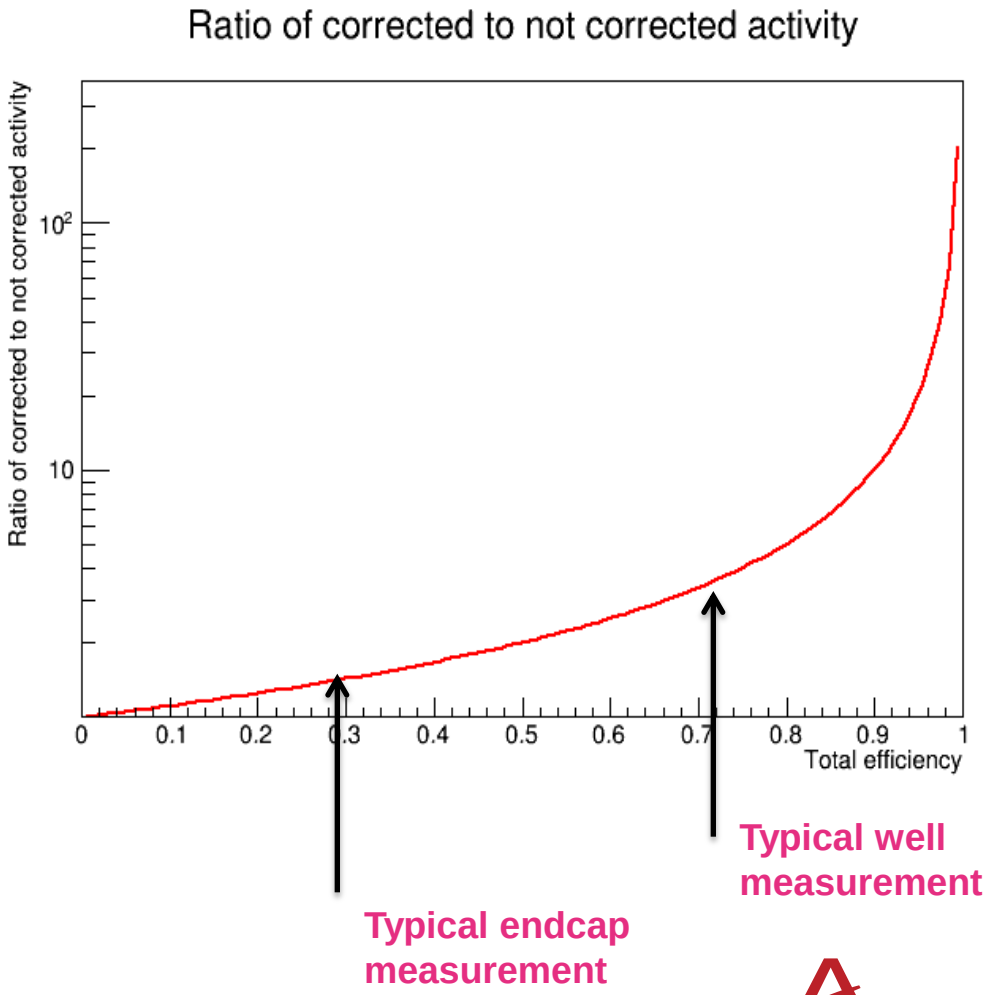
True coincidence summing: Well Detector Measurements

- Generally speaking, the effe
  Total Efficiency
- In the well of a detector, tot
- Consequently, cascade sur
  significant for well detector



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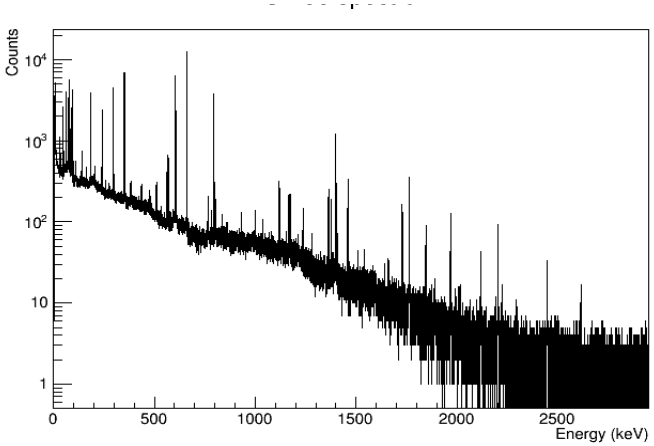
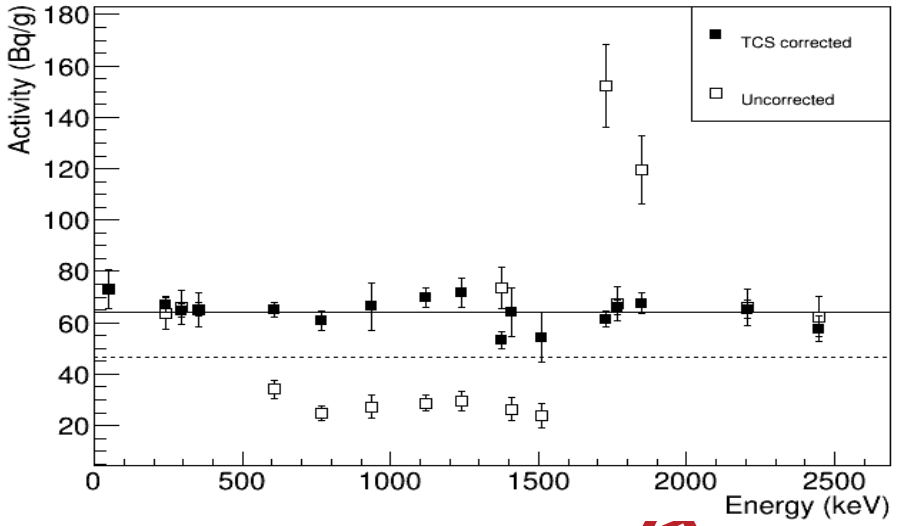
Effect of Cascade Summing Correction Case Study: U-238 Sample

- Real sample measured in the well
- Contains U-238 daughters in equilibrium
- All lines have the same activity
- 20 minute count time
- Efficiency calibrated with ISOCS

- Open squares: Activity not corrected for cascade summing
- Filled squares: Activity with cascade summing correction performed
- 30% Weighted mean difference in results





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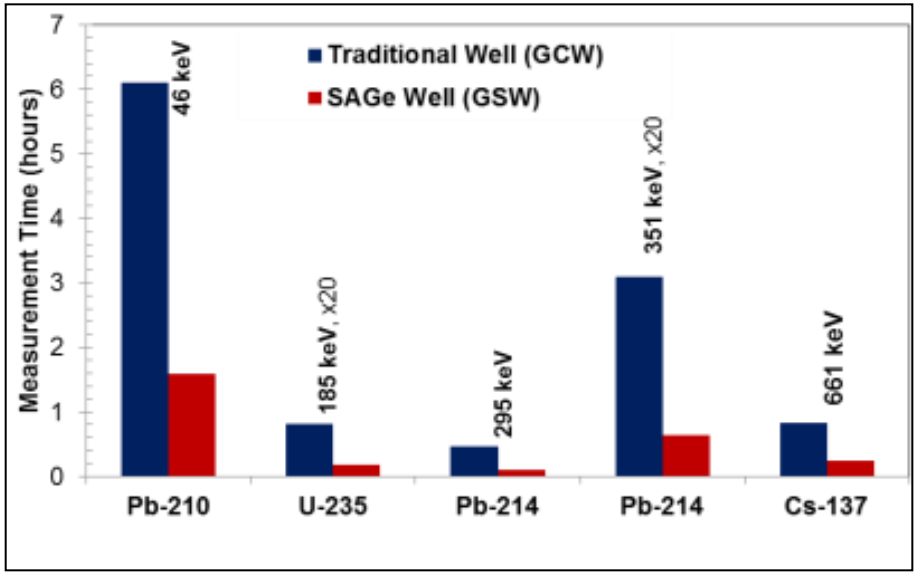
Improving existing well applications
Case study: Pb-210 dating

- 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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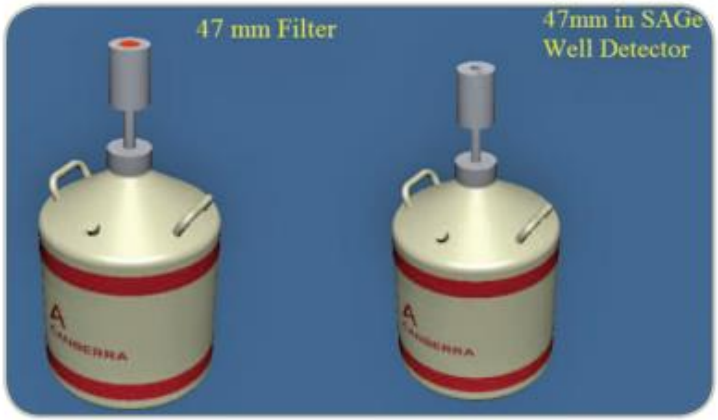
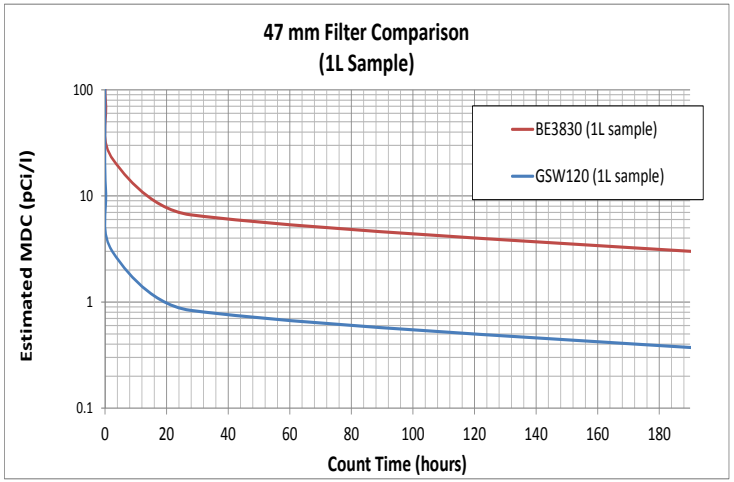
New Well Applications
Case study: Radium in drinking water

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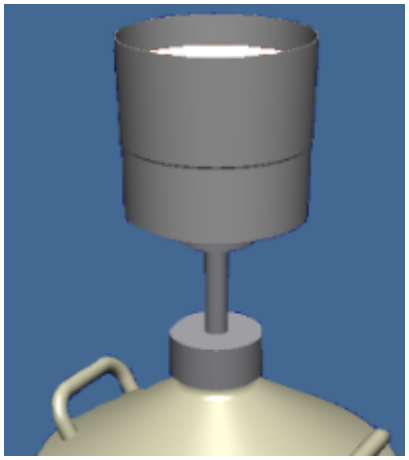
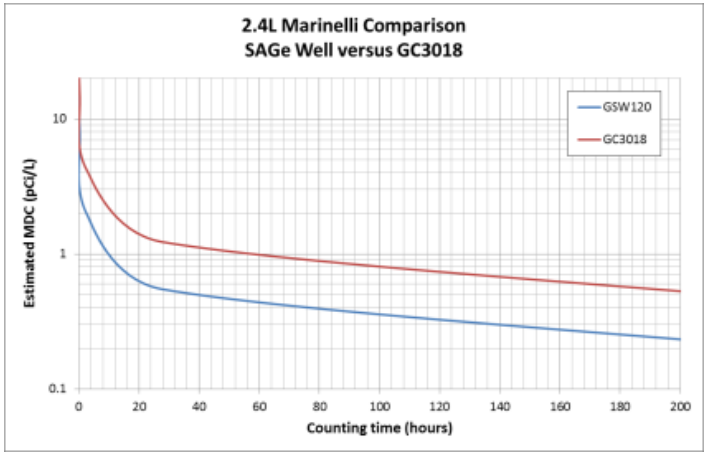
Using SAGe Well For Large Samples
Case study: Radioiodine in Milk

- 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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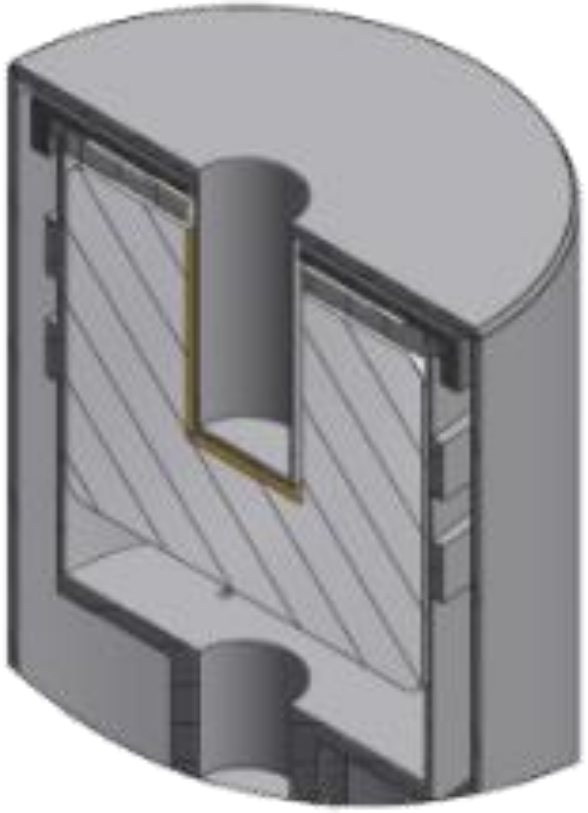
Thank You.

- SAGe™ Well – A revolutionary new detector geometry

Question? Comments?



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