RMCC -2015
CANBERRA Latest developments

Daniel Obrecht
International Sales Manager

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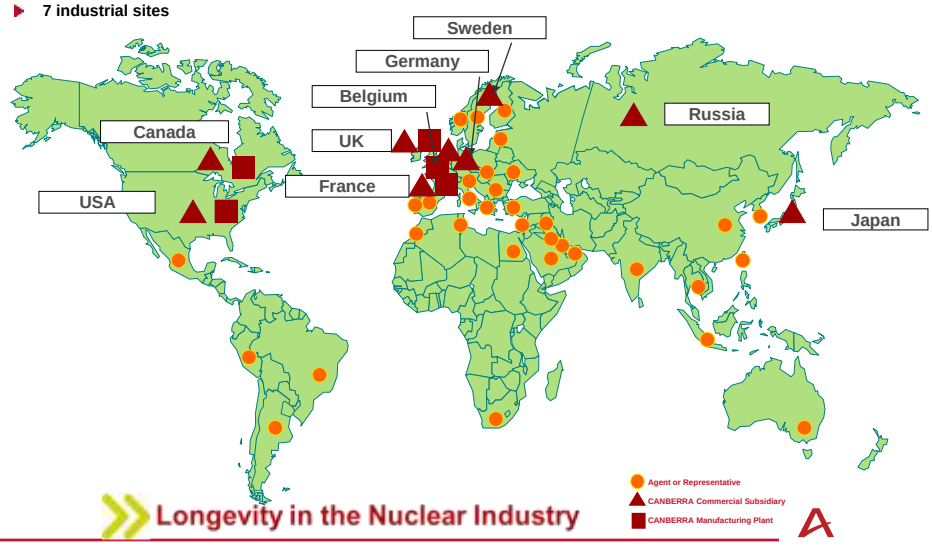
CANBERRA Worldwide Presence

- 50 years in business
- Over 1,000 employees
- 7 industrial sites



Longevity in the Nuclear Industry

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How to find them??

- **www.canberra.com:**
  - **ABOUT**
    - Worldwide offices per region

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Contrary to the Appearances, All Ge Detectors Are Not Created Equal!

CANBERRA offers the widest choice of HPGe-detector types, enabling you to find the best match between detector size, aspect ratio, energy window and performance for YOUR application.

CANBERRA allows you to choose the detector geometry that best fits your application.

Tell us about your application !

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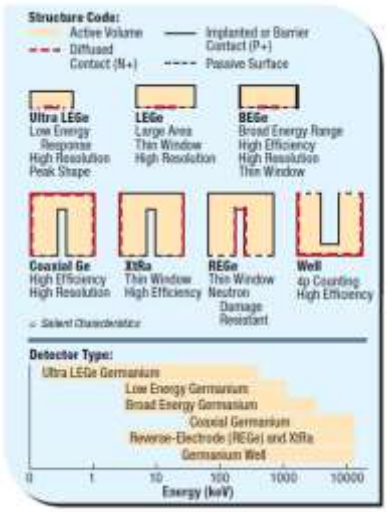
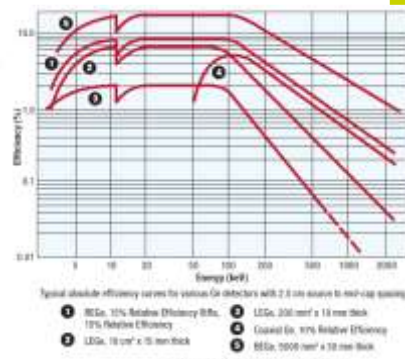
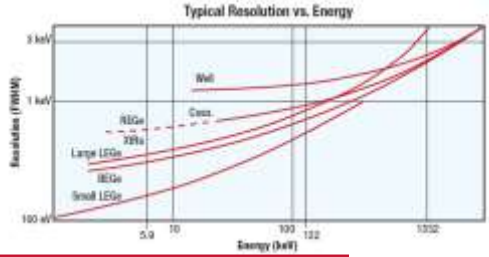
CANBERRA Standard Germanium Detector Types







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Detector parameters: Building blocks to optimize…

- **Detector Diode…**
  - **Nature of outer contact:**
    - Li-diffusion:
      - traditional outer contact for p-type detectors.
      - Thickness may grow in time from 0.3mm to 1.5mm. Prevents spectroscopy below 40 keV.
    - CANBERRA's proprietary Xtra contact: used for CANBERRA's XtRa and BEGe detectors.
      - May replace Li-diffusion on front window side of p-type detectors.
      - Thickness stable around 0.3µm. Allows spectroscopy down to 3 keV.
    - Boron implantation:
      - Outer contact on n-type detectors.
      - Thickness stable around 0.3 µm, allowing spectroscopy down to 3 keV.
        - Remark: very thin contact possible for spectroscopy down to a few 100 eV.
  - **Finishing diode:**
    - Bulletized vs. non-bulletized
    - From long and skinny to short and wide
      - Determines the detection efficiency in real counting situations…

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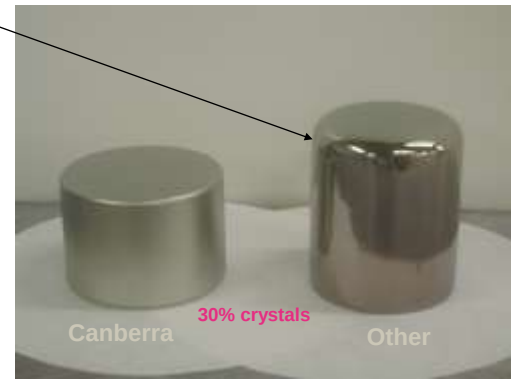
Bulletizing vs. non-bulletizing
Long and skinny vs. shorter and wider

- **Bulletizing creates serious efficiency drop in close geometries**
  - **90% of all Lab geometries are close geometries**
  - **Relative efficiency is at 25cm and unaffected by bulletization**
    - – so relative efficiency isn't a good measure of laboratory efficiency.



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Performance of a 70% bulletized n-type vs. a 50% thin window (XtRa) p-type detector

Energy keV	Net count rate (cps) 70% n-type	Net count rate (cps) 50% XtRa	Background (cps) 70% n-type	Background (cps) 50% XtRa	FWHM (keV) 70% n-type	FWHM (keV) 50% XtRa	MDA : improvement with 50% XtRa over 70% n-type
59	16.3	18.9	2.06	1.81	1.04	0.82	0.72
88	16.3	18.6	0.82	0.65			
122	16.2	17.5	1.10	0.77			
165	11.7	13.1	1.08	0.79			
392	6.84	7.42	0.74	0.56			
514	5.45	5.87	0.78	0.34			
662	4.63	4.89	0.61	0.46	1.63	1.34	0.75
898	3.24	3.33	0.56	0.45			
1173	2.63	2.66	0.33	0.26			
1333	2.38	2.36	0.16	0.14	2.23	1.80	0.85
1836	1.87	1.83	0.11	0.06			

Source: disk source near the detector window

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Use ISOCS to optimize detector-source geometry

Counting efficiency can be increased by 25% or more by optimizing the sample container geometry.

Therefore, can either reduce the MDA by 25% or reduce the counting time by around 40% of typical values.

See a.o. the paper presented by Frazier Bronson, Ram Venkataraman, and Brian Young. Copies are available upon request. Paper Title: "Optimum Size and Shape of Laboratory Samples for Gamma Spectroscopy with Various Size and Shape Ge Detectors"

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CANBERRA's modern solutions for electrical cooling

CP-5

Cryo- Cycle

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Cryo-Pulse 5

- **To gain time**
  - LN2 free
  - Low power consumption (UPS !)
  - No resolution degradation
  - Fast start up (3-6 hrs)
- **To save money**
  - No LN2 related risks and costs
  - Quick and easy installation
- **Freedom in operation**
  - No flex lines or gas connectors
  - Small footprint and weight
  - Compatible with nearly any front end
- **Safe and quiet**
  - No LN2, no flamable gas.
  - Low audible noise (< 60dB)

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Cryo-Cycle

- **To save money**
  - Refill once in 1 – 2 years
  - No oil filters, no metal to metal wear.
- **To gain time**
  - Few refills.
  - Runs on LN2 in case of power failure
- **Freedom of operation**
  - Same footprint as standard dewar
  - Accepts dipsticks and exists now in integal version.
- **Where safety counts**
  - Nitrogen gas refill possible
  - Cooling gas is He

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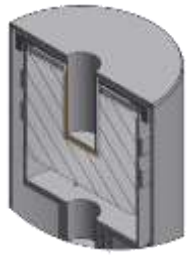
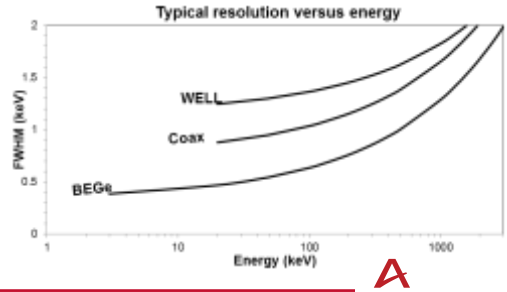


First some history: Traditional Germanium Well Detectors

- 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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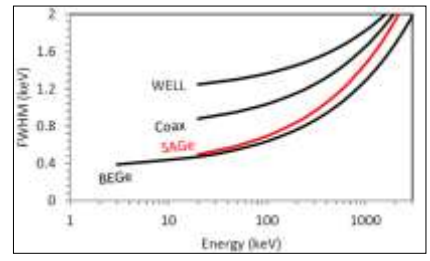
SAGe Well: Geometry and Advantages

- 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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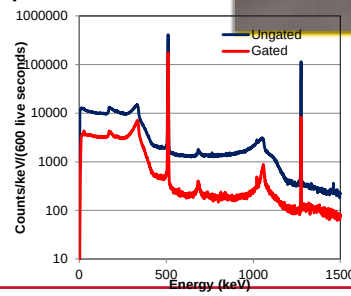
Sample Changers

- **Versatile setup:**
  - **Conveyor accommodates to lab's needs,**
  - **Various shielding possible,**
  - **Standard manual coutnting operation**
  - **Cosmic Veto option available**



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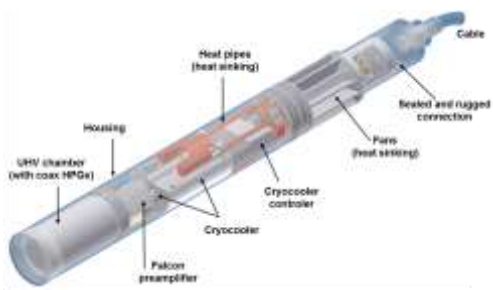
Special Probes



Sealed Probe

Airborne

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Colibri Specifics

- **Colibri is…**
  - **A Hand-Held Health Physics Communication ALARA Platform**
- **Colibri features:**
  - **Dose-rate equivalent Survey (internal detector: VLD or TTC)**
  - **Contamination survey with external probes**
  - **Data-logging with**
    - External Barcode
    - External RFID
    - Internal GPS
  - **Scaler-timer**
  - **Communicator**
    - USB
      - Computer connection via web server
    - Bluetooth
      - Wireless probe via CSP-COM-BT
      - Headset
      - Barcode and/or RFID reader
      - Web server
  - **ALARA tools**
    - Always measures worker's location dose-rate while surveying, frisking, monitoring
  - **Hand-held Host system for up to 8 probes**
    - 7 via BT
    - 1 via cable
  - **It is waterproof**
  - **Is Color touch screen with easy keypad field control**
- **Powerful sound for alarms and chirper**

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Colibri And Traceability

No more logbooks !

measurement is associated with GPS coordinates

Barcode : measurement is associated with barcode reader

-> localization

- ***Measurement can now be associated to :***
  - ***User : WHO ?***
  - ***Probe that was used to take the measurement : HOW ?***
  - ***Date stamp : Date and Time of measurement : WHEN ?***
  - ***Location (GPS, Barcode, RFID, …) : WHERE ?***
- ***Measurement can be centralized immediately without paperwork – real time becomes a fact!***

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Colibri
Acquisition, display, Alarm

- ***Large touch screen backed up with keyboard***
- ***Internal TTC or VLD detector***
- ***Simultaneous display :***
  - ***Internal dose rate + Internal dose***
  - ***External (depending on probe) + Internal Dose-rate***
    - *Dose rate*
    - *Combined or Separate discriminator channel*
- ***Probe connection***
  - ***Cable: single input***
  - ***Wireless - Bluetooth: multiple inputs***
- ***Alarm : Visual, sound and vibration***

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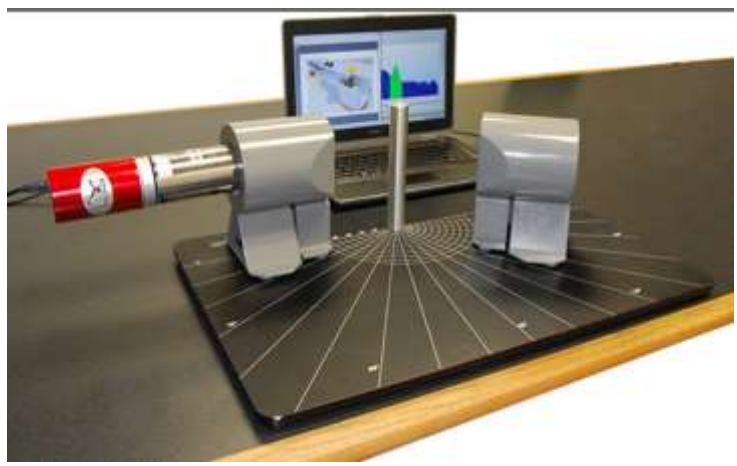
LABKIT-BASIC

For experiments 1-5



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LABKIT-BASIC

LABKIT-TABLE

LABKIT-ABS

LABKIT-SR-CS137

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Expanded Descriptions for reference: Using LABKIT-Basic

- **EXP 1: GAMMA-RAY DETECTION WITH SCINTILLATORS**

  In this introduction to gamma ray detection, students will identify photoelectric scattering, Compton scattering, and pair production in a spectrum and perform an energy calibration using known reference sources.

- **EXP 2: COUNTING STATISTICS AND ERROR PREDICATION**

  Students will perform a series of background and gamma ray measurements with a Nal detector and apply statistical principles to these measurements.

- **EXP 3: GAMMA-RAY ABSORPTION IN MATTER (BASIC)**

  Students will measure the effective attenuation of a set of materials with varying densities and cross sections.

- **EXP 4: COMPTON SCATTERING**

  Using the Compton Scattering table developed especially for this exercise, the principle of Compton scattering and the dependence on angular variation is demonstrated.

- **EXP 5: HALF-LIFE MEASUREMENT**

  Students calculate the half-life of a short-lived nuclide using multi-channel scaling acquisition.

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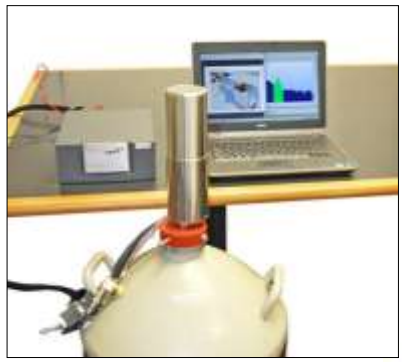
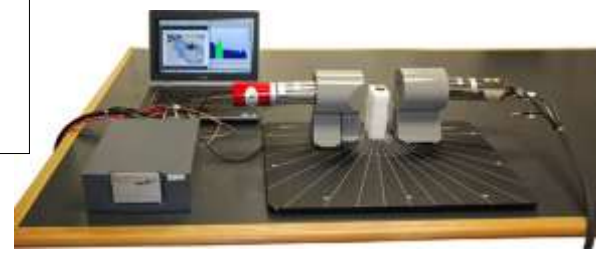
LABKIT-ADVANCED

Combine with LABKIT-Basic
for experiments 6-12





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LABKIT-ADVANCED

LABKIT-SRCEHLDR

LABKIT-NAICOLL

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Expanded Descriptions for reference: Using LABKIT-Basic + LABKIT-Advanced

- **Exp 6: Signal Processing with Digital Signal Electronics**

  Using the built-in Digital Signal Oscilloscope feature of the LYNX MCA, students observe the effects of changing signal processing parameters using several different acquisition modes.

- **Exp 7: High-Resolution Gamma-Ray Spectroscopy with HPGe detectors**

  Semiconductor gamma-ray detection is introduced and students compare HPGe resolution to NaI detector resolution.

- **Exp 8: Gamma-Ray Efficiency Calibration**

  Using both a NaI detector and an HPGe detector, the concept of detection efficiency is explored.

- **Exp 9: Gamma-Ray Coincidence Counting Techniques**

  Counting with multiple detectors correlated in time can yield incredible information about fundamental nuclear structures. In this experiment, students learn these techniques by acquiring and interpreting time-stamped list mode data for synchronized detectors.

- **Exp 10: Positron Annihilation**

  By using coincidence counting techniques and the Angular Correlation table, students explore the geometrical behavior of positron annihilation events.

- **Exp 11: Mathematical Efficiency Calibration**

  Mathematical modeling is increasing used instead of source based efficiency calibration for cost, flexibility, and safety. In this experiment, students generate efficiency calibrations using Canberra's LabSOCS efficiency calibration software and compare against traditional source based calibrations.

- **Exp 12: True Coincidence Summing**

  Students observe true coincidence summing and quantify the effect on observed count rate using LabSOCS mathematical efficiency software.

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