
CANBERRA

XXXL Solutions for specialty applications Or how to meet your high efficiency Gamma & X-ray detection requirements

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CANBERRA Lingolsheim Specialty Detectors

February 2009

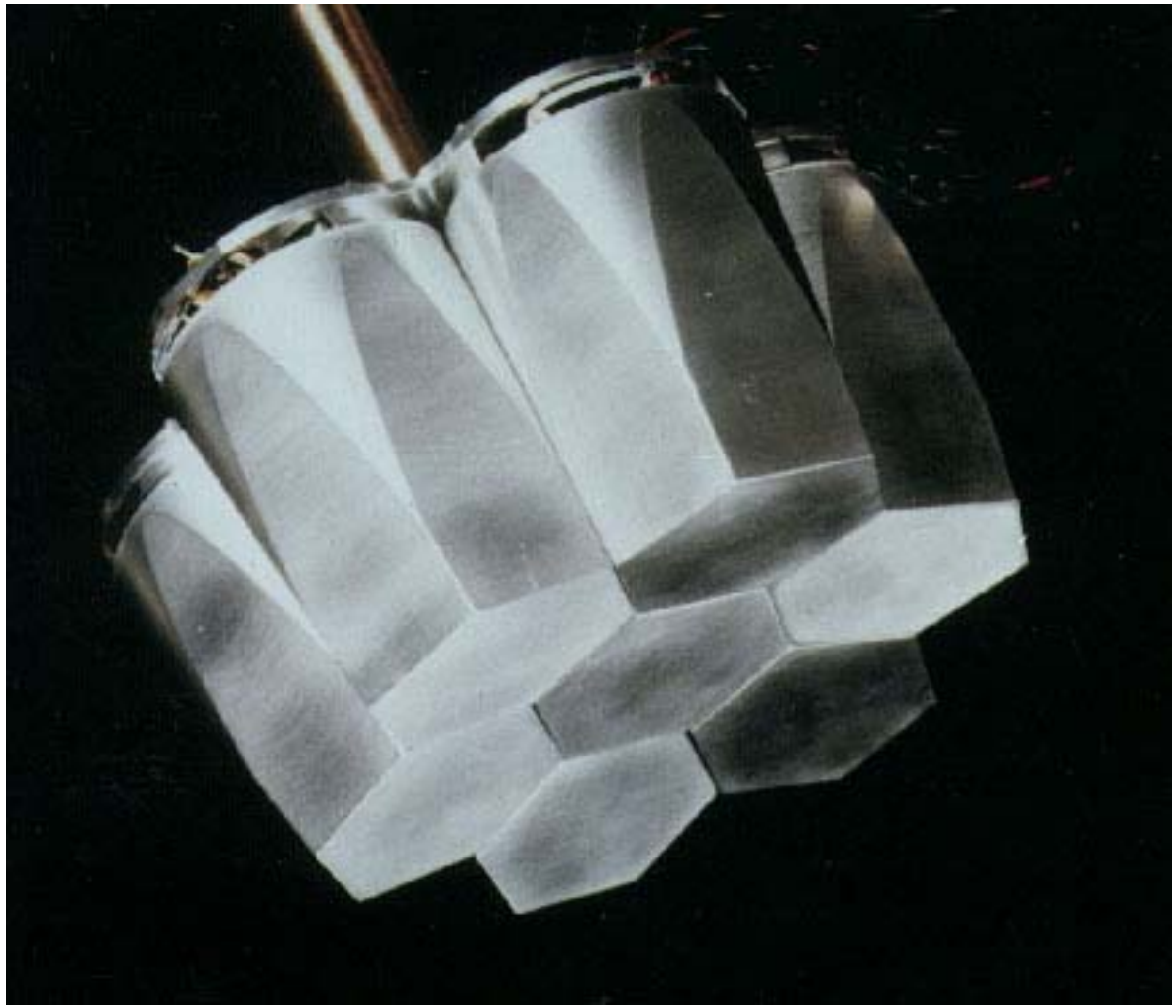
CANBERRA

Already built & successfully delivered XXXL solutions

The largest efficiency systems ever designed for Gamma & Xray detection

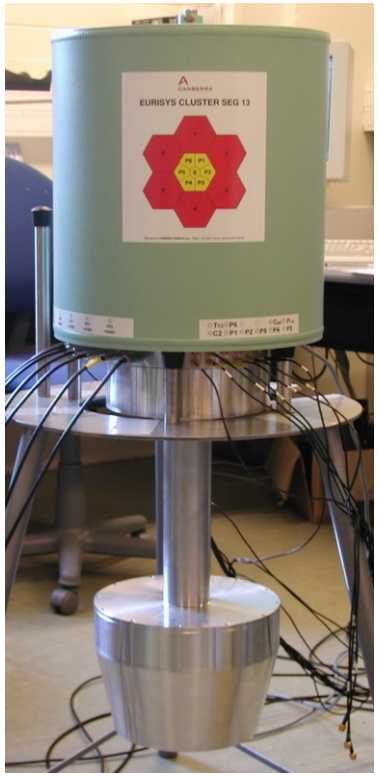
Large Array of Encapsulated Ge detectors

CLUSTER: 7 capsule system



Large Array of Encapsulated Ge detectors

7 capsule array with central segmented capsule



- **Up to 7 capsules mounted in a unique custom designed cryostat.**
- **Hexagonal shaped diodes & capsules to make a close packing.**
- **Add-back features possible with adequate electronics.**
- **LN2 cooled but electrical cooling also available.**
- **Segmentation available for Doppler correction if needed.**

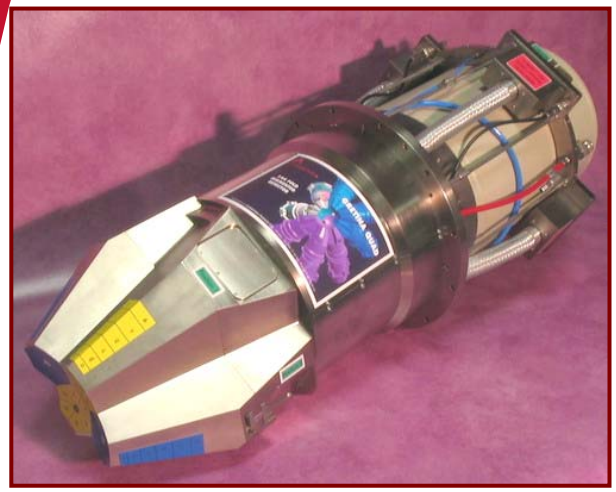
Application: nuclear physics or any application needing high stopping power for high energy gamma.

Close packing of Ge detectors new opportunities for versatile systems

GRETA Quad Detector

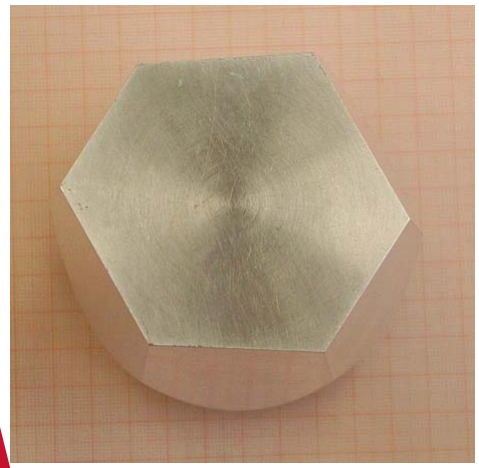
GRETA detector

GRETA Quad Detector

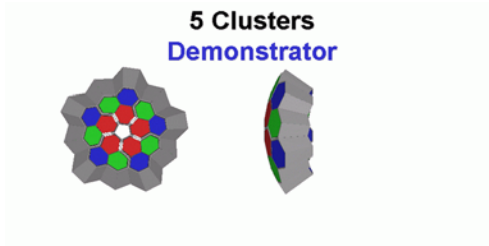


- The largest Ge array detector ever built for Nuclear physics world wide.
- 4 encapsulated Ge diodes with initial diameter 80mm & 90mm length.
- Irregular hexagonal shaped design to best accommodate the 4π detection ball.
- Each diode segmented in 36.
- 36 position information & full volume information available on charge sensitive preamplifiers for each diode. Total of 148 channels & 100% are working.

Irregular hexagonal shaped capsule



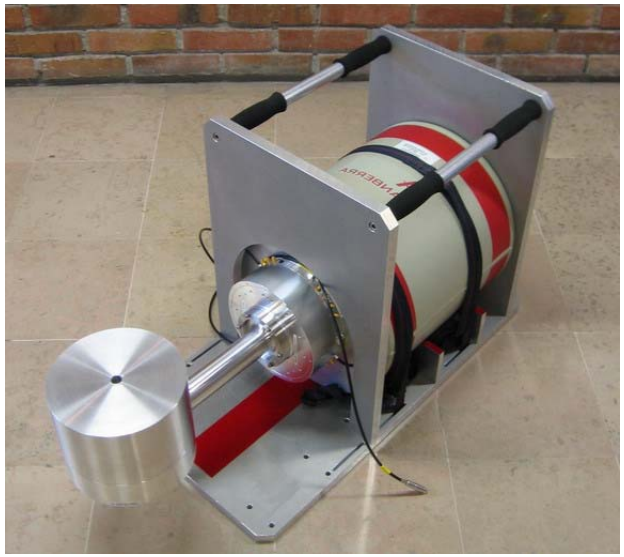
Application: Pure Ge shell for γ-ray spectroscopy with high granularity for Dopppler correction with γ-ray tracking in electrically segmented Ge crystals.

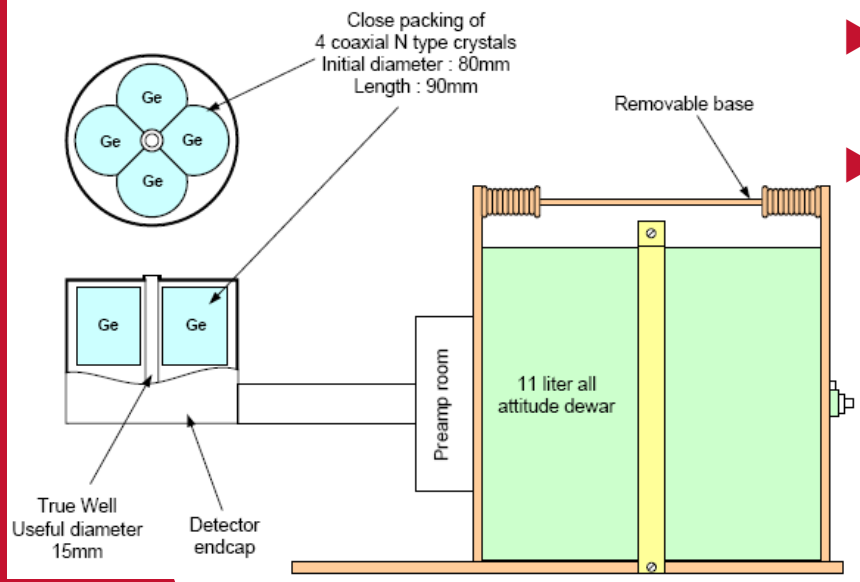


State of the art detectors for Nuclear Physics

CANBERRA True Well Type Clover 4x80x90

Clover 4x80x90TW





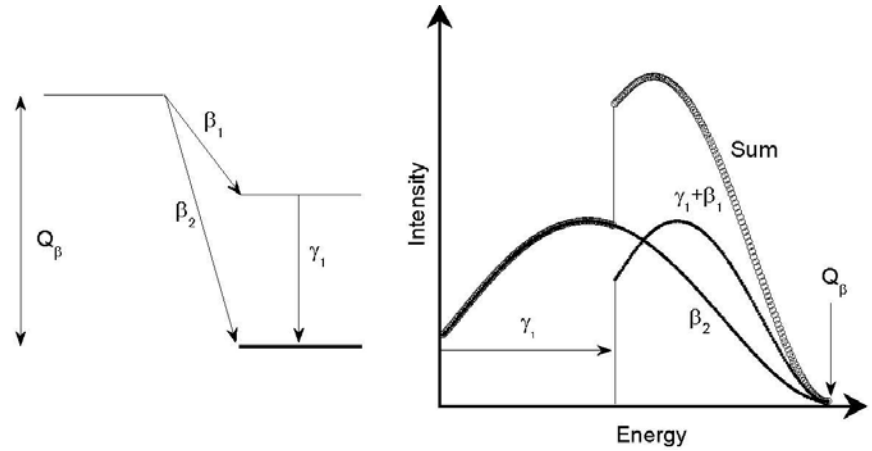
- Four N type crystals initial diameter 80mm length 90mm in a close packing array.
- About 10kg of Ge material. Other crystal sizes are available.
- 15mm true well diameter. Other sizes are available.
- Qβ measurement possible thanks to 0.4mm thick aluminium walls within the well.
- Remote cryostat configuration to ease the use of a veto surrounding detector.
- Typical add-back efficiency: 500% at 1.33MeV starting with 90% diodes.
- LN2 free operation possible by electrical coolers.

Application: high efficient spectroscopy in a 4π geometry (on short life time isotopes etc…).

The Largest Well Type detector ever built World Wide

CANBERRA True Well Type Clover 4x80x90

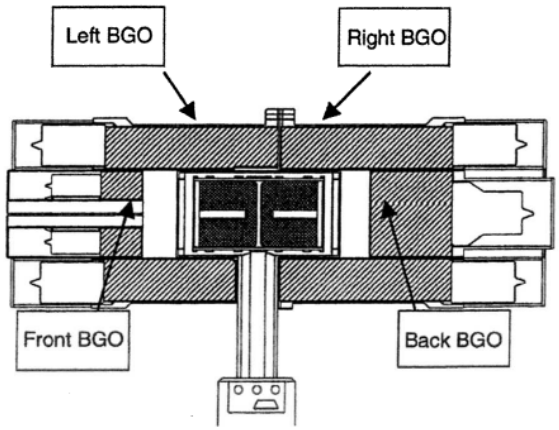
Concept of Qβ measurements using the total absorption.



Detector performances

CARACTERISTIQUES EN DETECTION DES 4 CRISTAUX/ *DETECTION CHARACTERISTICS* OF THE 4 CRYSTALS :				
CRISTAL / CRYSTAL :	1	2	3	4
NUMERO DE SERIE DU CRISTAL / CRYSTAL SERIAL NUMBER:	73981	74014	74011	73994
RESOLUTION MESUREE à 1,33MeV EN keV / *MEASURED RESOLUTION AT 1.33MeV IN keV:*	2.26	2.05	2.05	2.09
RÉSOLUTION MESURÉE à 122keV EN keV / *MEASURED RESOLUTION AT 122keV IN keV:*	1.20	1.09	1.06	1.18
EFFICACITÉ RELATIVE à 1,33MeV EN % / *RELATIVE EFFICIENCY AT 1.33MeV IN %:*	90	103	101	101
RAPPORT PIC SUR COMPTON / *PEAK TO COMPTON RATIO:*	62.7	81.6	77.0	66.3
LONGUEUR DU CRISTAL EN MM / *CRYSTAL LENGTH IN MM:*	90	90	90	90
SENSIBILITE DU PREAMPLIFICATEUR EN mV/MeV / *PREAMPLIFIER SENSITIVITY IN mV/MeV:*	201	204	205	208

CANBERRA TWIN DETECTORS



- High energy telescope combining two Ge crystals each diam 80mm – length 70mm.
- Total of 140mm of Ge material to get high stopping power for high energy applications.
- Close packing compatible anti-coincidence detectors (BGO).
- N type detectors for easy in-situ neutron damage annealing.
- LN2 free operation possible by electrical coolers.

Application: total gamma absorption cross section measurements for high energy gamma rays (140mm Ge absorption).

High resolution high energy photon telescope

CANBERRA TWIN DETECTORS

Detailled drawing of the twin detector

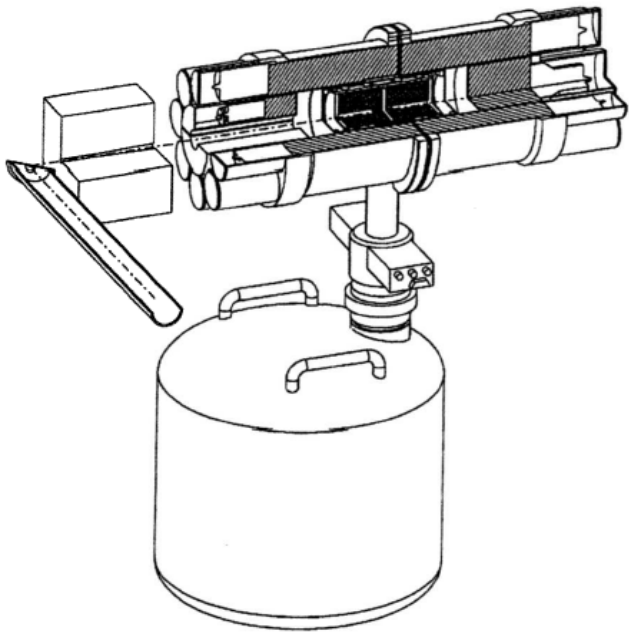
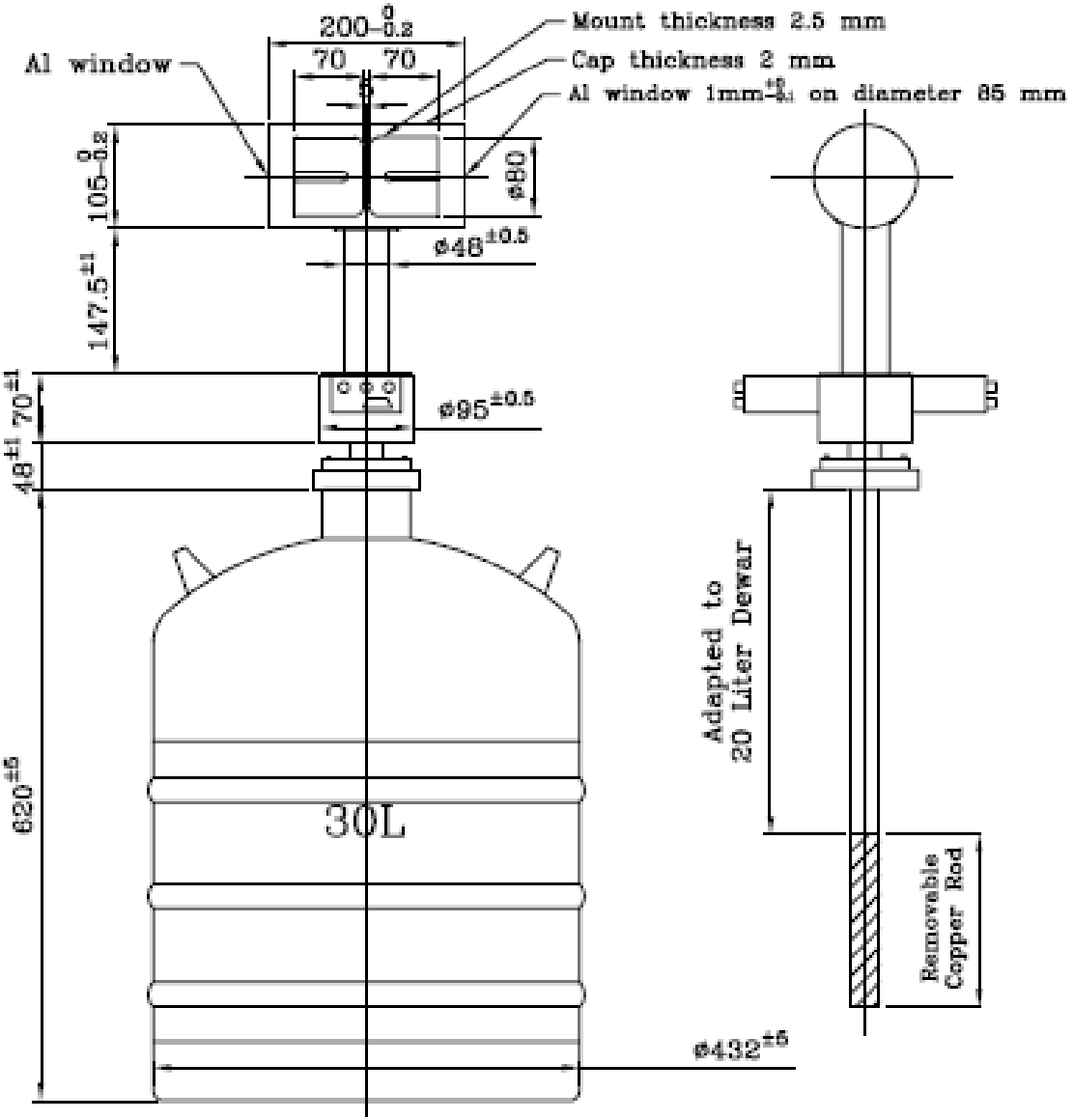


Fig. 3. Experimental setup.



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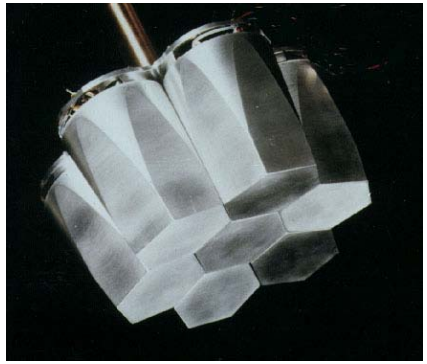
4π combinations: Clovers and Clusters

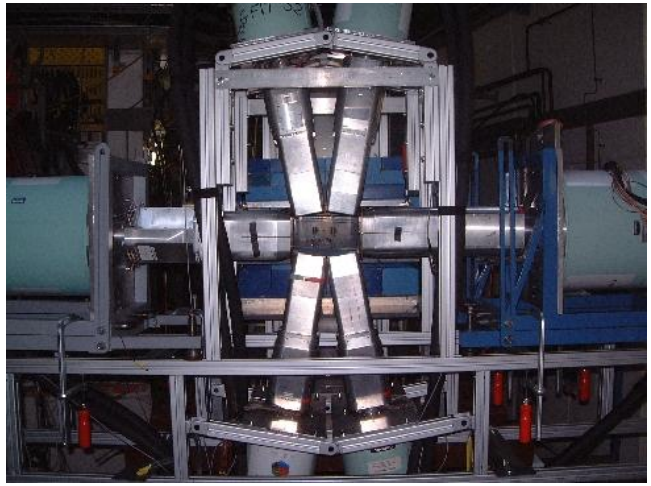


Cluster

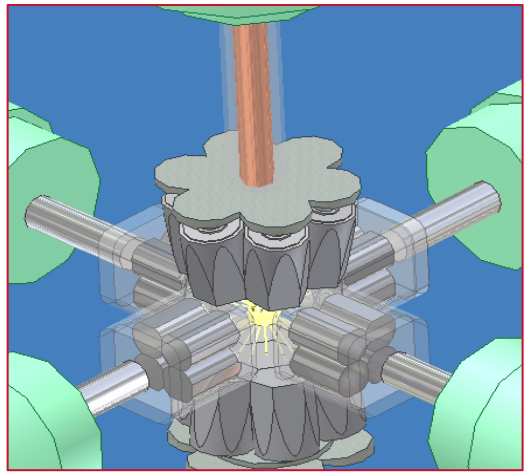
- **Full range of Clovers : four crystals diameter 50mm to 70mm length 60mm to 140mm each with or without segmentation.**
- **Arrays with Clovers only or composition with encapsulated Ge in clusters.**

Clover

6 Clovers



2 Clusters + 4 Clovers



Interesting combinations

Clover + cluster = adaptable geometries

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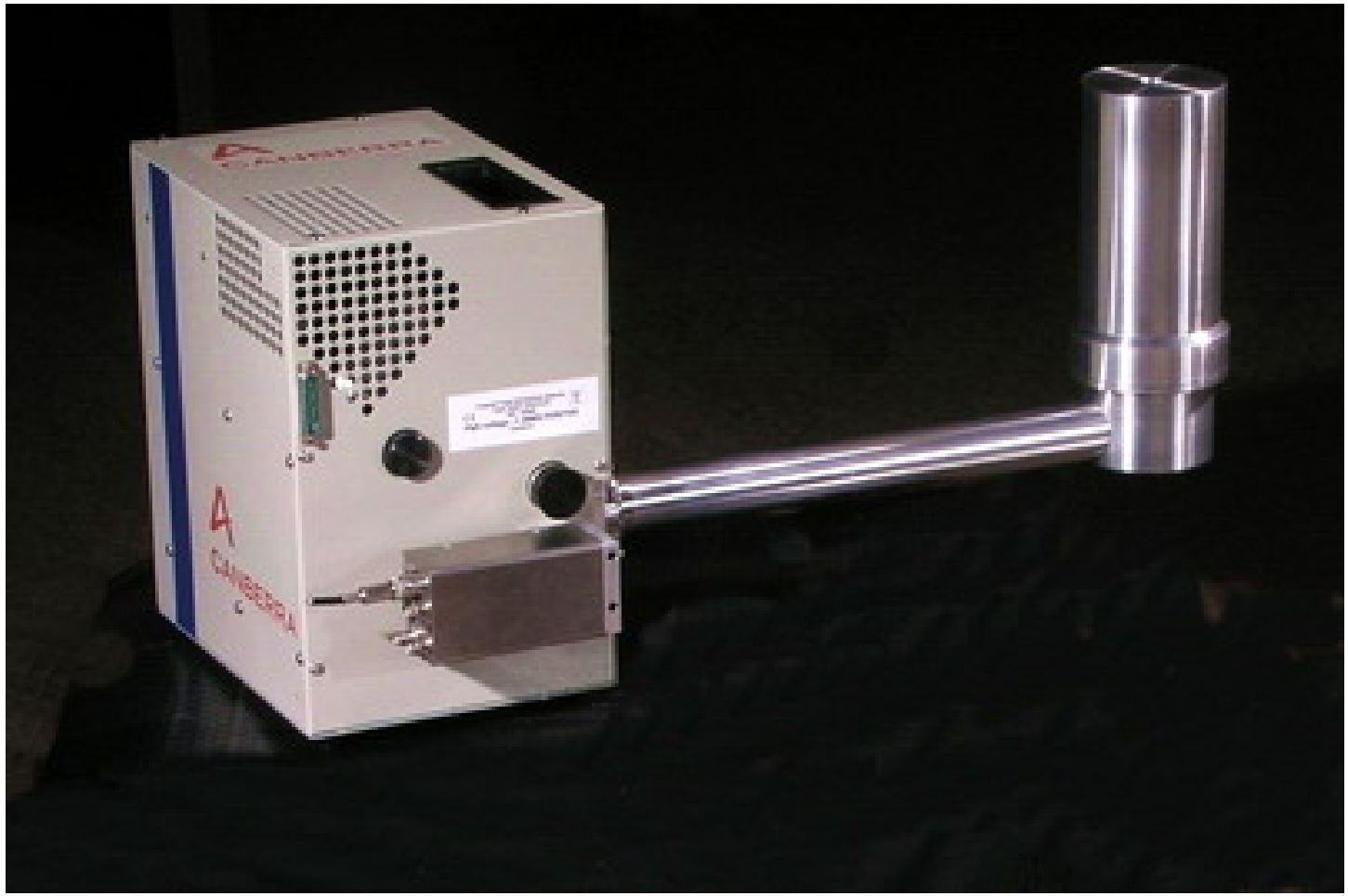
Best achievable ULB performances

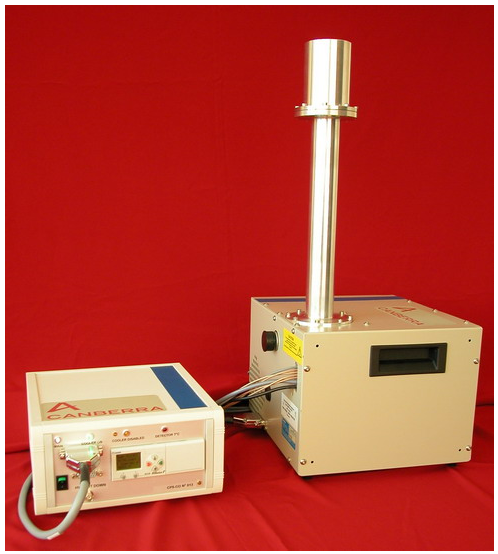
Typical electrical cooled ULB detector for Underground Labs



Best achievable ULB performances

J type BEGe 5030

Long neck ULB detector



- **Unique ULB performances as expected for underground labs: 0.11 counts per min between 20keV & 1.5MeV for a BEGe 5000mm² active area & 30mm thick in the Modane Underground Laboratory.**
- **Large sized coaxial Ge detectors available up to 910cc**
- **Highly selected material**
- **Custom designed system**
- **LN2 free operation possible by electrical coolers with unique features.**

High performances detectors for underground labs

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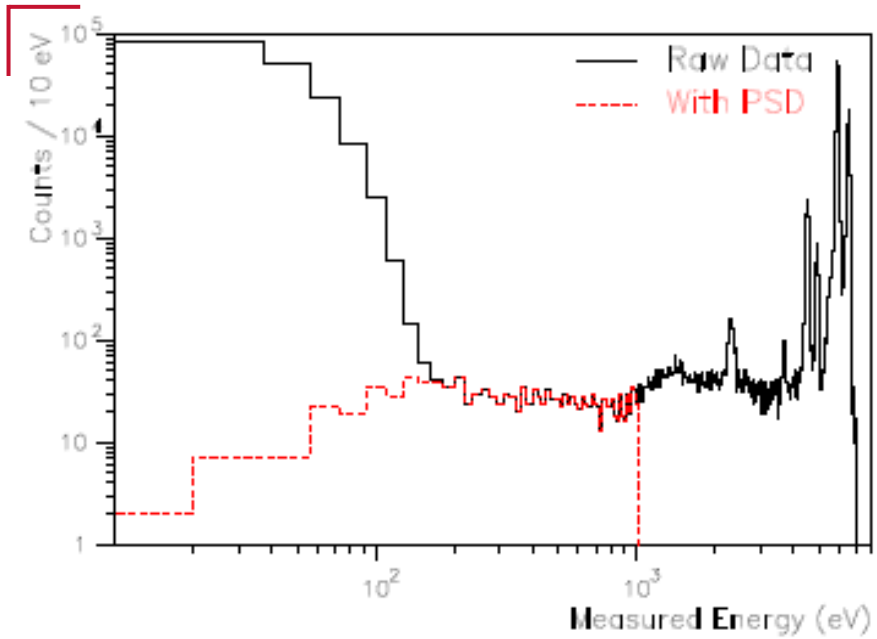
CANBERRA detectors for ultimate noise edges

Segmented ULB detector

New CANBERRA instrument to combine with Pulse Shape Discrimination to drop down noise edges as required by astroparticle & neutrino physics



CANBERRA detectors for ultimate noise edges

Modified electrode 50x50 ULB detector

- Modified-Electrode P type Point Contact Ge Detectors (PCD) in ULB cryostat.
- With high performances low energy threshold central contact.
- Best performances at low & high energies close to theoretical values.
- External AC coupled preamp for veto and spectrum cleaning.
- Several low capacitance Ge detectors with a 150eV FWHM with test pulser, already in use.

Application: New innovative tool in astroparticle & neutrino physics by direct interaction measurement within the Germanium detector. Double-beta decay, neutrino magnetic moment and WIMP searches.

Detector performances: FWHM Vs energy

TEST (pulser)	60 keV	122 keV	1.33MeV
150 eV	360 eV	500 eV	1.68 keV

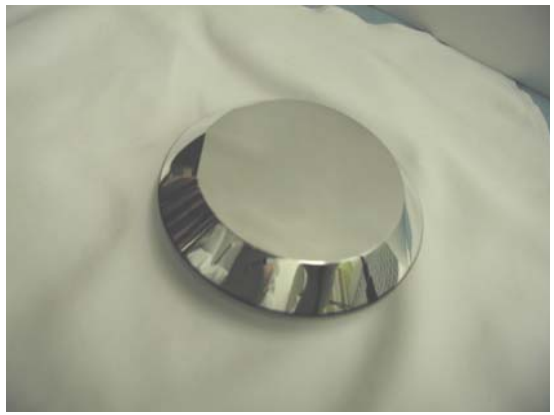
Unique coax Ge detector with 150eV FWHM resolution

Detectors for Bolometers

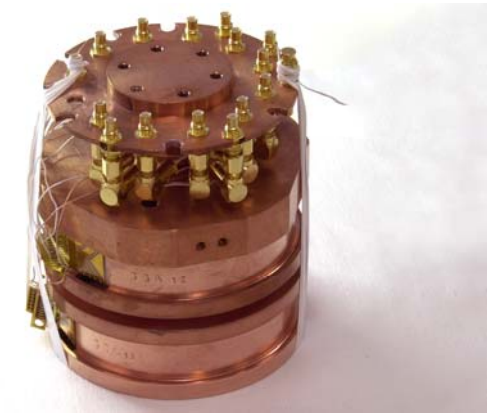
Edelweiss Experiment : Dark Matter search
using a 320g Ge detector with InterDigitised electrodes

Detectors for Bolometers

Germanium detector for EDELWEISS



1kg Ge detector stack for EDELWEISS

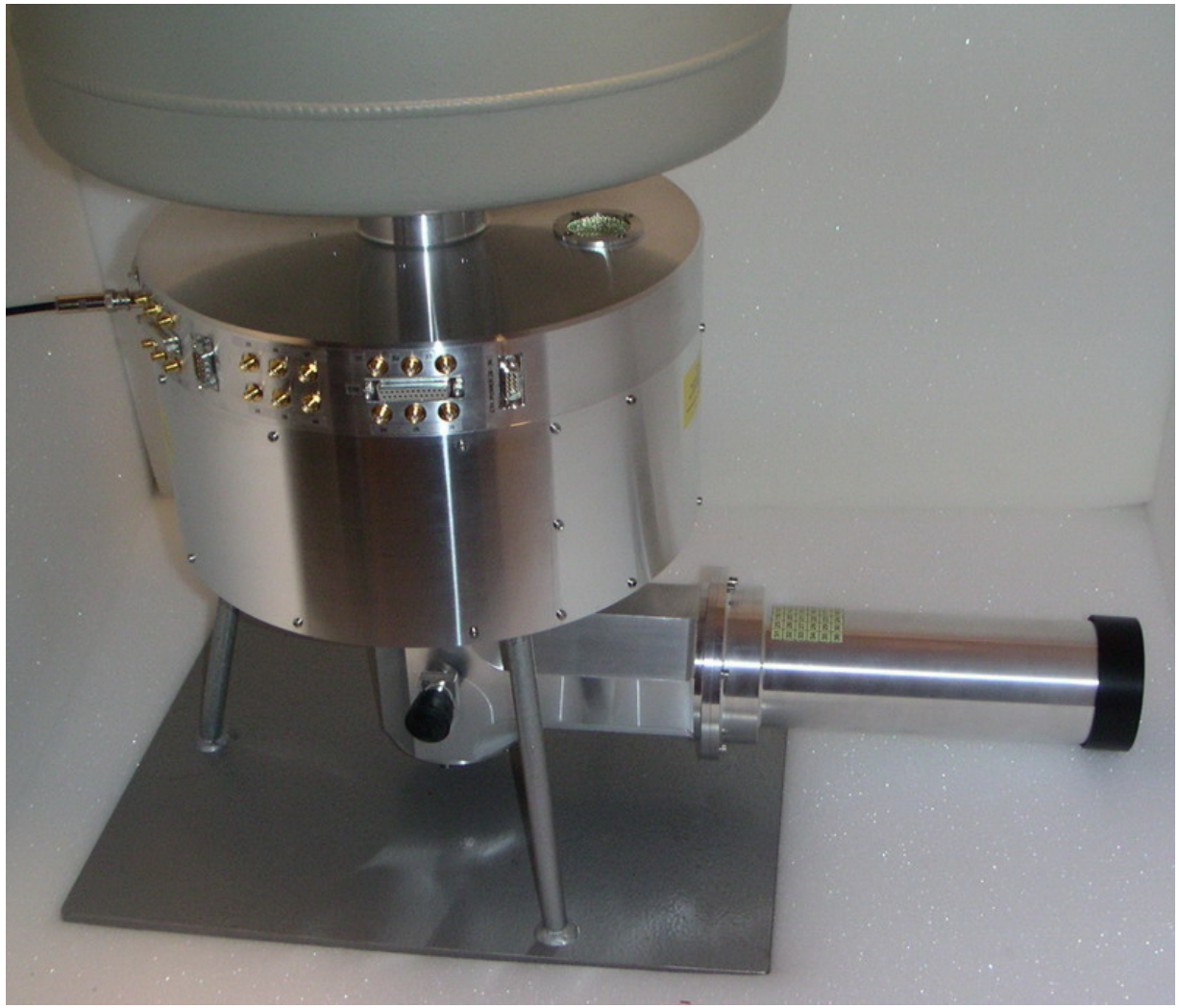


- **Dark matter search: heat and ionization at 10mK.**
- **Ultra Low Background environment in the underground Lab of Modane**
- **Energy and WIMPS interactions.**
- **Exploration of new structures of contacts for better discrimination of surface effects.**

Experiment with rare events using purest materials

4-100 Pixel detectors with ultimate performances.

CANBERRA 36 Pixel Detector Design



Pixel detectors with ultimate performances.

36 Pixel detector design

- **Monolithic pixel detector: different sizes & segmentation patterns are available.**
- **Several 100 pixel detectors already built & in operation for several years.**
- **High reliable CANBERRA proprietary segmentation technology.**
- **Best achievable area coverage : 100% of the entrance surface is active.**
- **FWHM average values on a 36 pixel detector with 55Fe source:**
  - **134eV @ 8µs**
  - **239eV @ 0.5µs**
- **Application : XANES, EXAFS.**

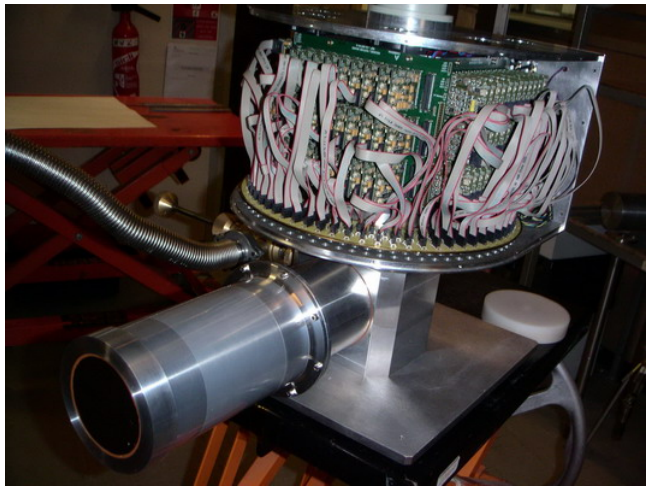
High efficiency & high resolution detector for Synchrotron

100 Pixel detector performances.

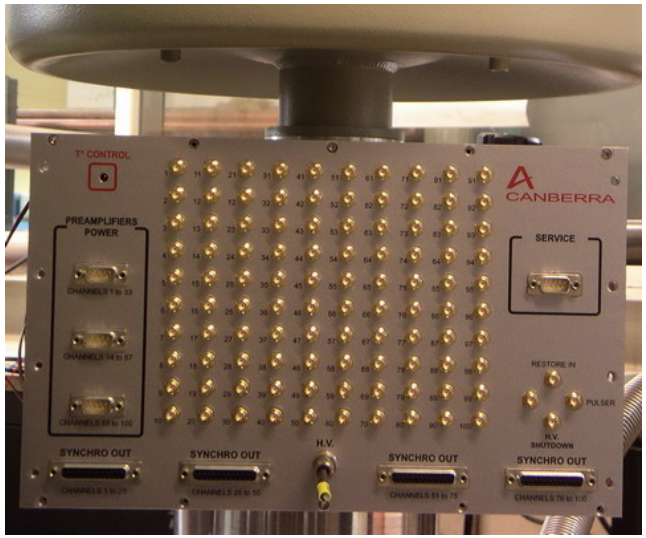
New 100 Pixel detector design.

100 Pixel detector performances.

Motherboard cards for preamplifiers



Patch panel



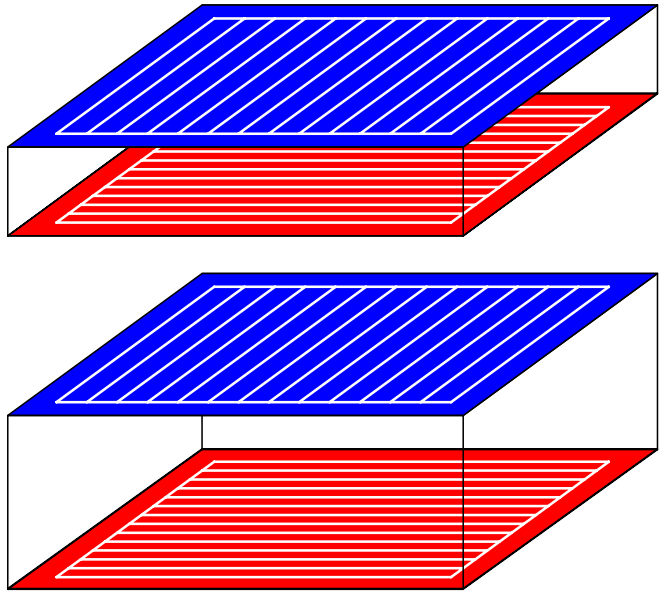
- **Best performances identical to multielement detectors but without area coverage compromise.**
- **New 100 Pixel detector design with preamplifier room orientation feasibility depending on room availability around the detector.**

Preliminary typical values for a 100 pixel detector

Gaussian shaping time	FWHM @ 5.9keV / 2kcps
8-12µs	140eV
1µs	190eV
0.5µs	220eV
0.25µs	250eV
0.125µs	300eV

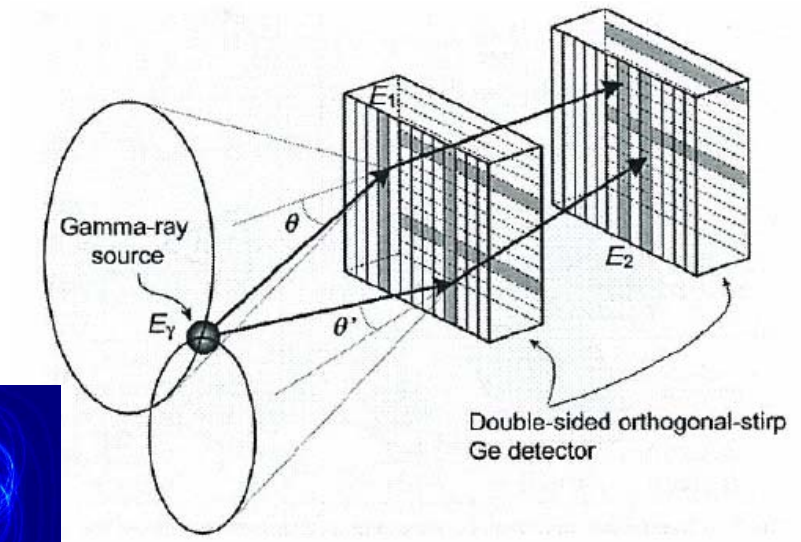
CANBERRA Strip detectors for photon imaging

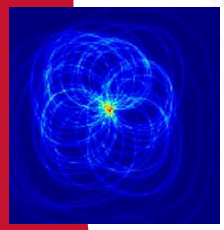
Telescope of two DSSD, each 13X & 13Y strips



CANBERRA Strip detectors

Compton Camera principle





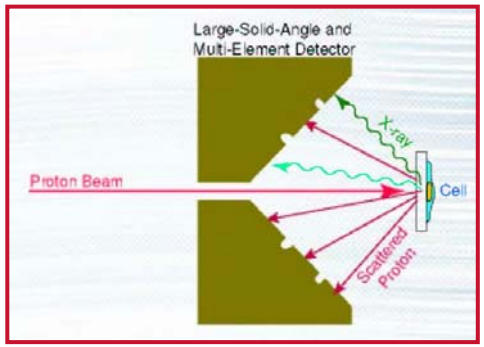
- Double Sided Strip detectors.
- Use of Ge or Si(Li) material depending on energy range.
- Telescope arrangements with two or more diodes are possible.
- Strip pitch or detector dimension on request.
- LN2 free operation possible by electrical coolers.
- FWHM @ 60keV : 1.5keV (mean value)
- FWHM @ 1.33MeV : 3.0keV (mean value).

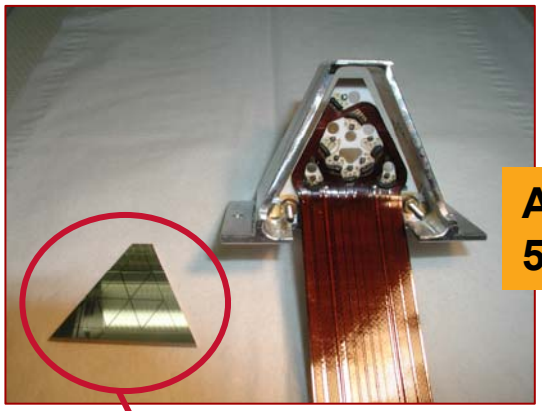
Application: Compton Camera for imaging medical or industrial need.

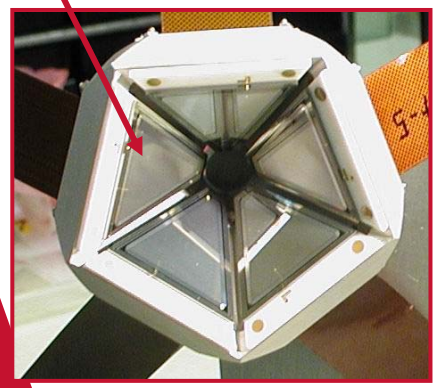
New solution for Compton Camera

High efficient 2π X-ray detection for material analysis

Large solid angle multi-element detector

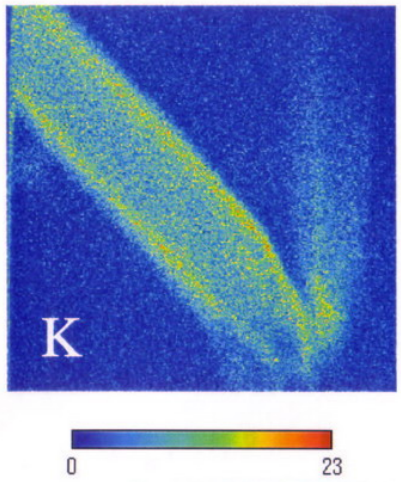


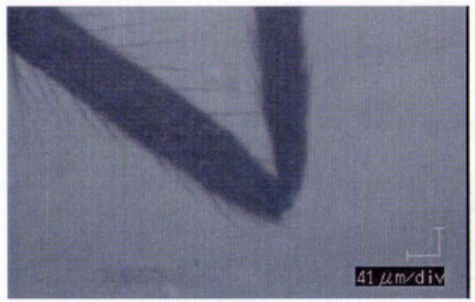




- **Multi element SiLi or Ge detectors.**
- **Large solid angle exploration of X-rays and back scattered photons.**
- **Designed for elemental analysis.**
- **Novel setup using 45 detection devices arranged in the shape of a pentagonal pyramid fully covering the sample.**
- **FWHM @5.9keV : 230eV (mean value)**

Application: micro-PIXE with improved measurement ability.
5 times better sensitivity than a conventional camera.





Optical microscope image

Innovative Design
For best efficiency

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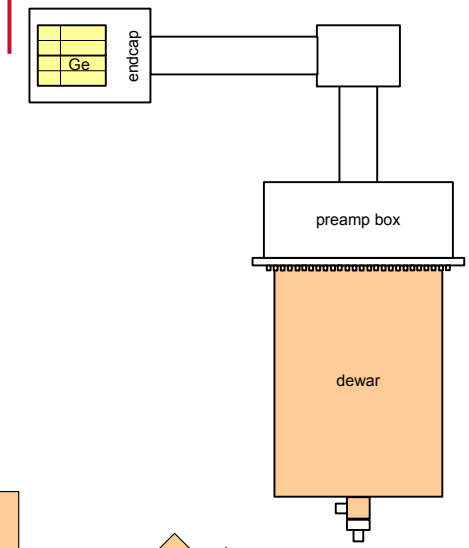
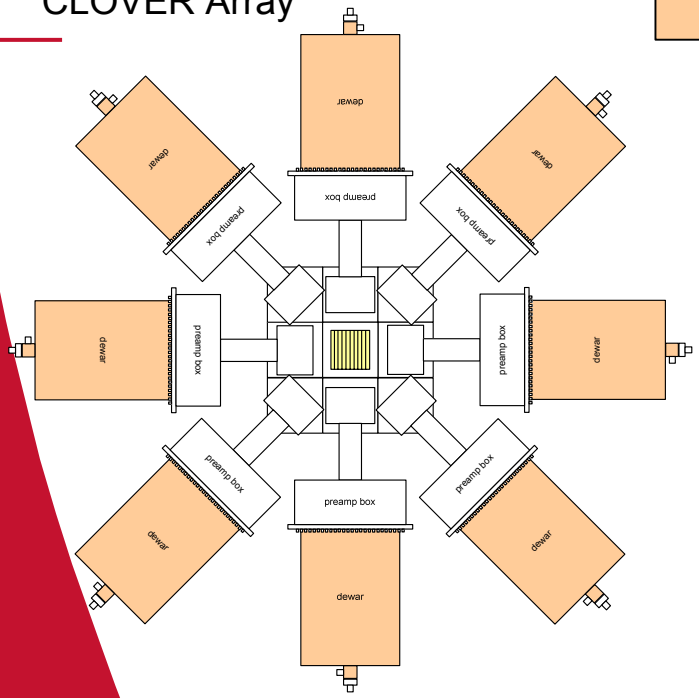
New XXXL solutions currently under development

4π Spectrometer using 8 Clovers or more

CLOVER DETECTOR



CLOVER Array



- **Bended Clovers : only two cryostat configurations will achieve interesting detection geometries.**
- **Design available with any Ge diode sizes.**
- **Segmentation available in case correction of Doppler effect is required**
- **Upgradeability with additional 8 detectors to maximize detection efficiency.**

Application: Complete spectroscopy of rare isotopes.

4π Detection Geometries Thanks to Clover & Cryostat Design

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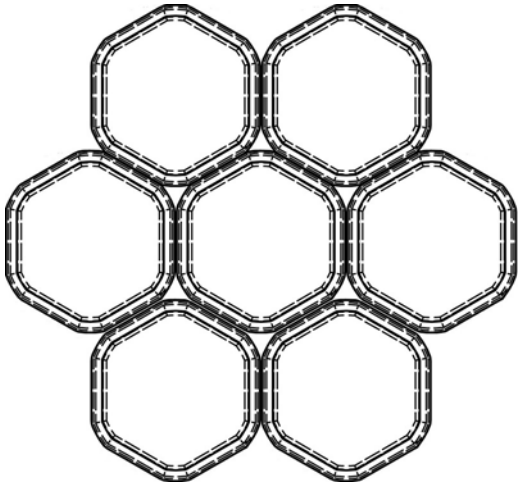
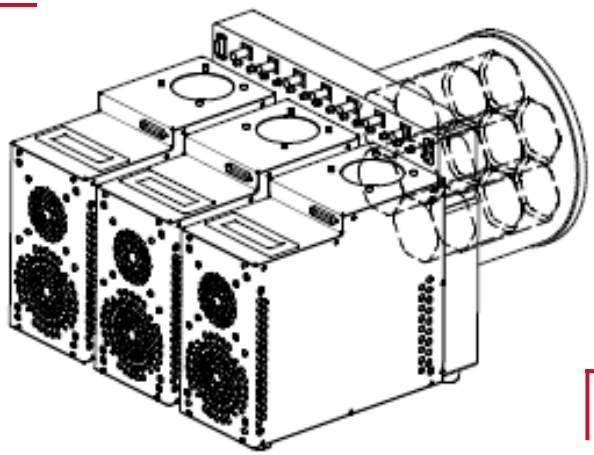
Encapsulated Germanium detector arrays

Hexagonal shaped capsules array



Pulse tube cooled 7 capsule array



- **Encapsulated Ge arrays to build up a close high efficient gamma ray system.**
- **Several Ge sizes are available.**
- **N type detectors are preferred for easy neutron damage repair if any.**
- **Compatible with harsh environment, like space or airborne applications.**
- **Easy maintenance.**
- **Ultra High Vacuum : safe operation even in case of incomplete heat cycling.**
- **Any shape possible (AGATA, GRETA, INTEGRAL, …).**
- **LN2 free cooling is available even in case of multiple electrical cooler use.**

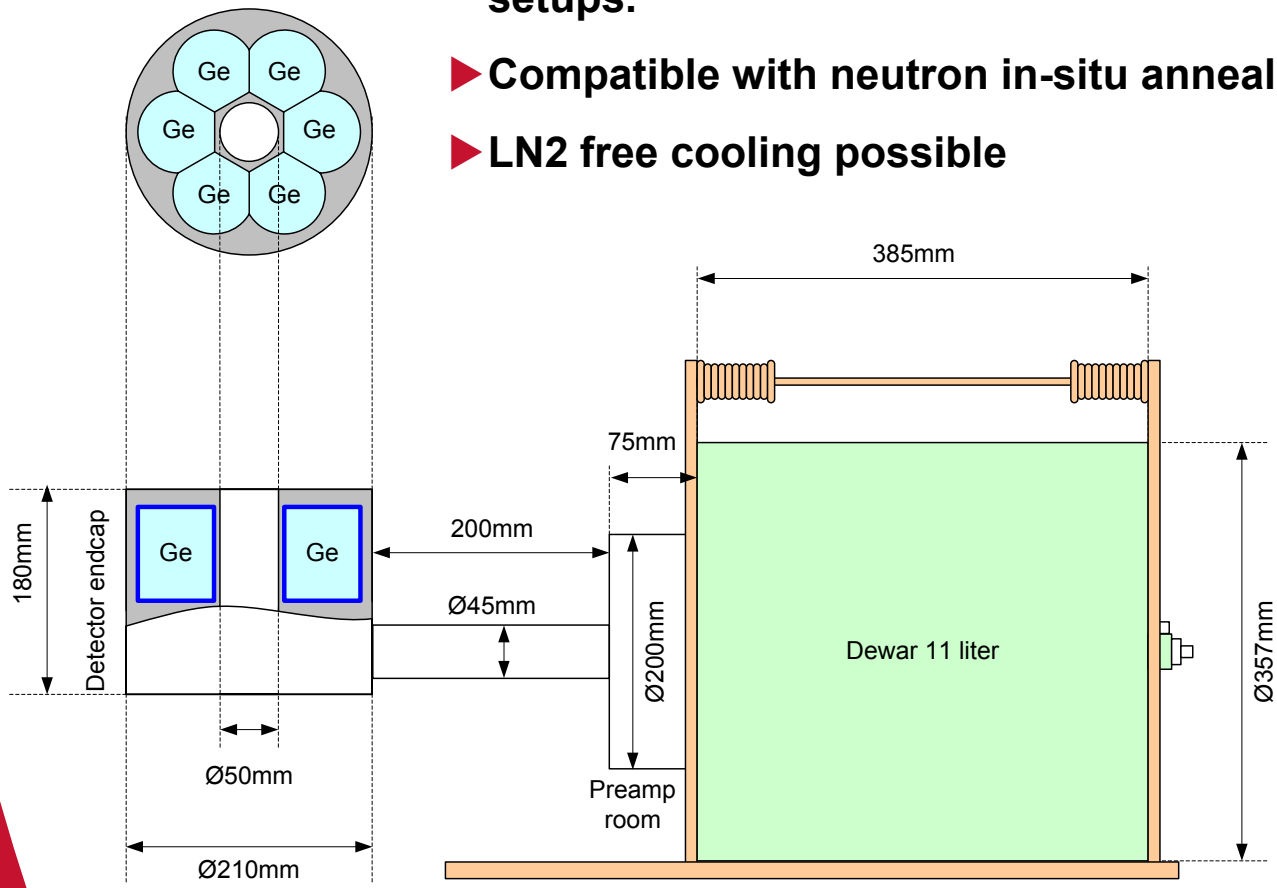
Application: high efficiency gamma spectroscopy for industrial or field survey

Interesting solution to build reliable & high efficient gamma spectrometers

Large well type system with Clover like arrays

Hexa Clover

- New opportunities to explore a 2 inch pipe with a unique 4π detection system. All attitude position possible.
- Versatility and adaptability of such a design to other setups.
- Compatible with neutron in-situ annealing.
- LN2 free cooling possible



Application: high efficiency 4π gamma spectroscopy for industrial need.

High efficient 4π detection using a unique array system

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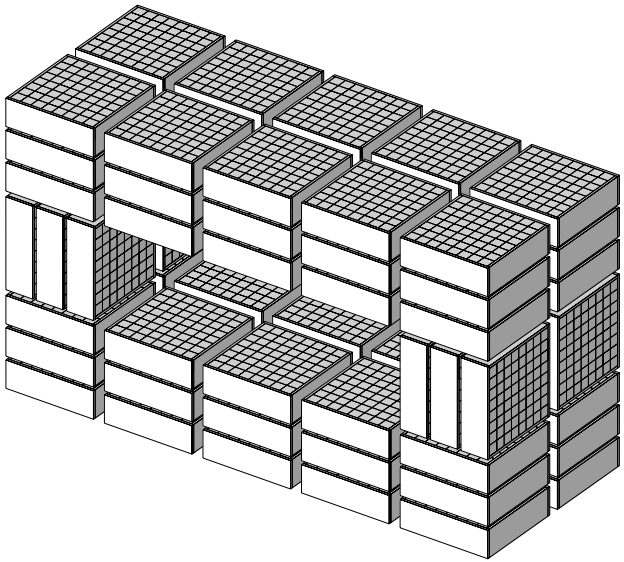
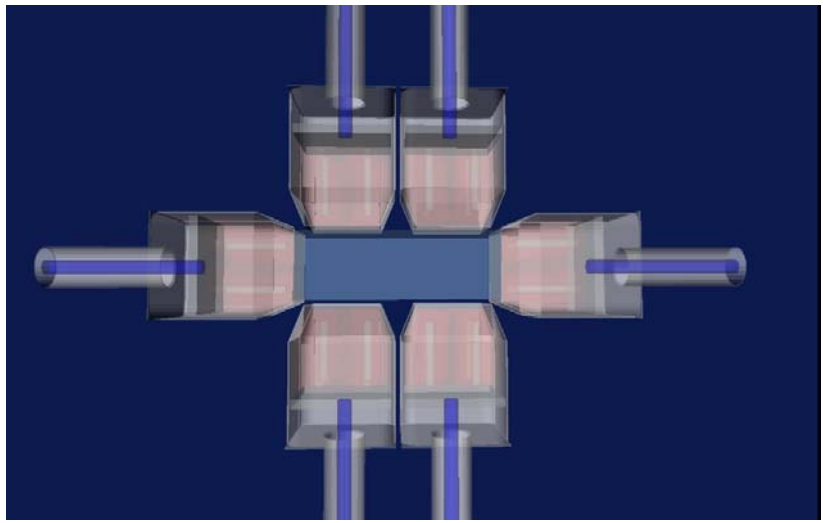
DSSD or Clover at choice for Tracking

DSSD Vs Clover



- Three layers of Double Sided Strip Detector. Two sizes : 64x64x22 or 128x64x22.
- Highly segmented Clovers. Each diode 60x90 seg16

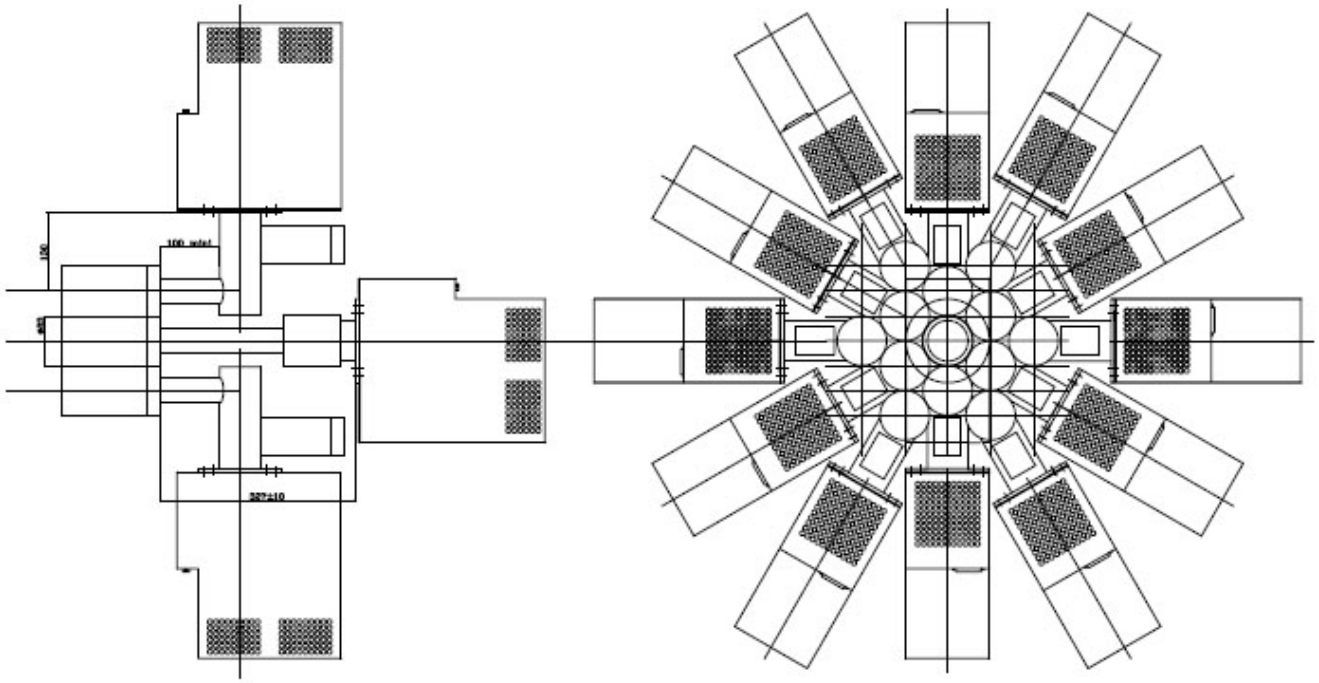


Application: high granularity & high efficiency gamma spectroscopy.

Multi LN2 free detector array

▶New design

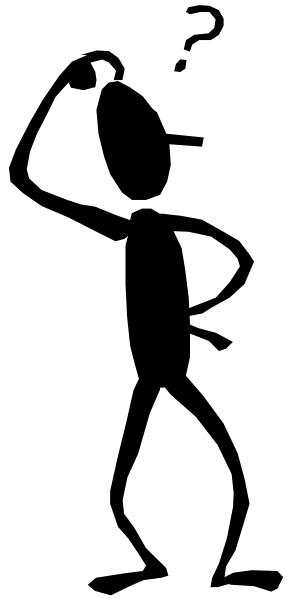
Electrical cooled coaxial detectors in specific bended cryostat.



Application: high granularity & high efficiency gamma spectroscopy.

THANK YOU FOR YOUR ATTENTION

Any new ideas?



- Feel free to contact us we will happy to brainstorm with you on any design or detector technology.
- Dr Marie-Odile LAMPERT: molampert@canberra.com
- Pascal QUIRIN: pquirin@canberra.com
- Or your local agent.