1

ITEP

A.S. Barabash

ITEP Majorana group

A.S. Barabash
S.I. Konovalov
V.I. Yumatov

We are in the MAJORANA from the beginning.
Contribution: MC simulations, background analysis, segmented HPGe-76 detector, shifts, 4 kg of enriched Ge-76.

We will try to increase financial support for the Project

1. To increase our activity in the Project.
2. To increase number of involved people up to ~ 5-6 persons.
3. To try to contribute with Ge-76 production (for the future experiments). 4 kg of Ge-76 still exist.

2

Lawrence Berkeley National Laboratory

Alan Poon

Lawrence Berkeley National Laboratory

U.S. DEPARTMENT OF ENERGY

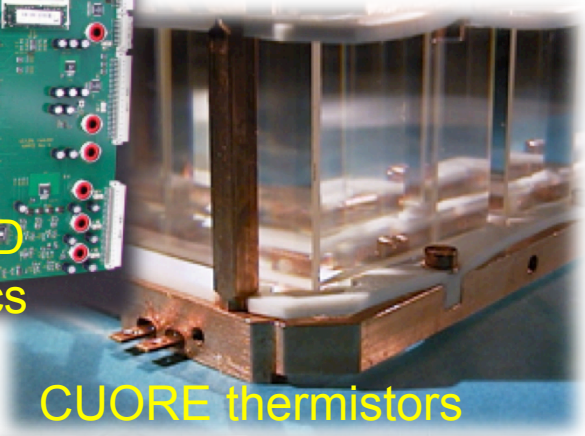
Alan Poon
awpoon@lbl.gov

LBNL – Low Background, neutrino & γ-array projects

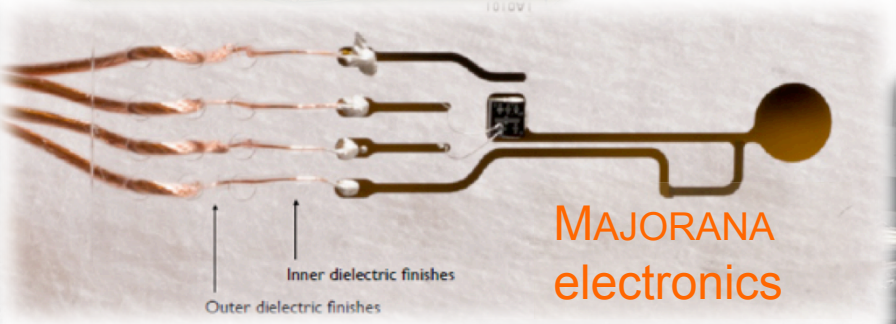
- Detector & electronics
- Mechanical design
- Construction
- Analysis & computation
- Project management


SNO PMT Support

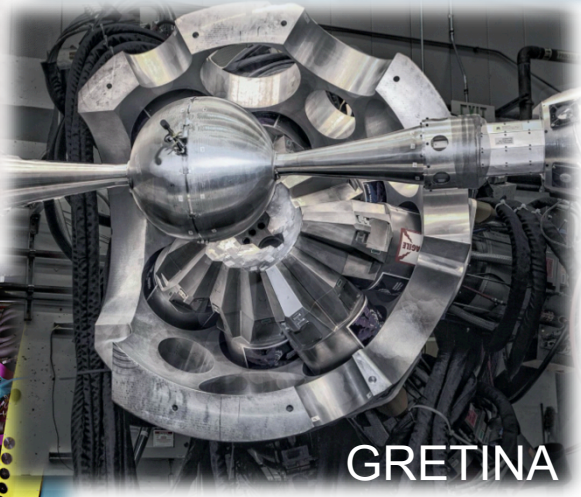

KamLAND electronics

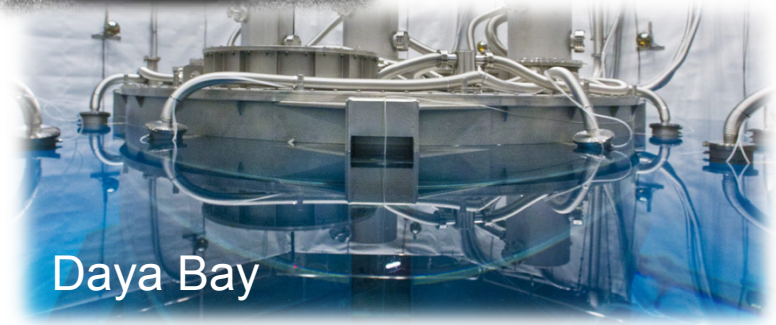

CUORE thermistors

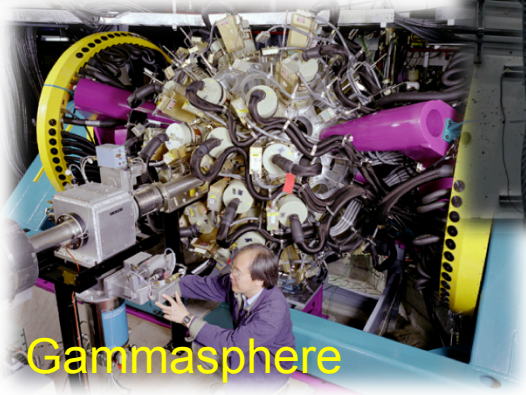

IceCube DOM



MAJORANA electronics


GRETINA

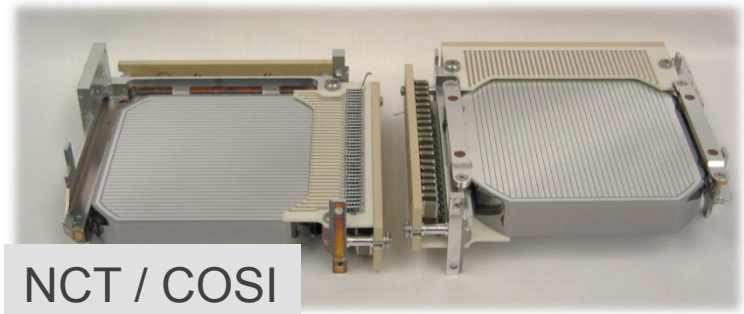

Daya Bay

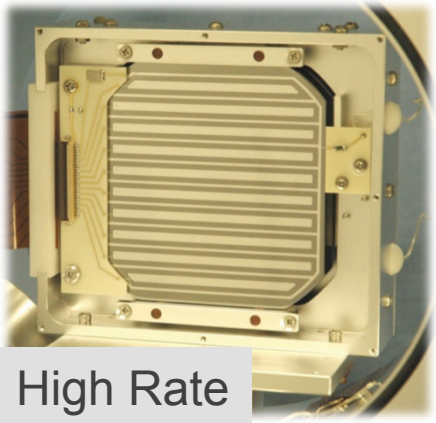

Gammasphere

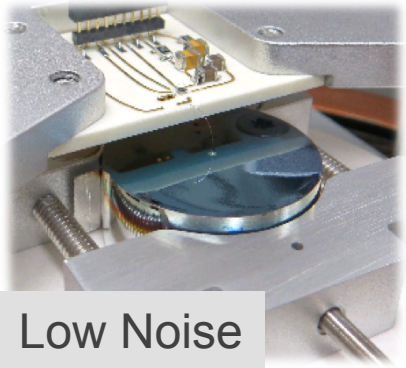
BERKELEY LAB

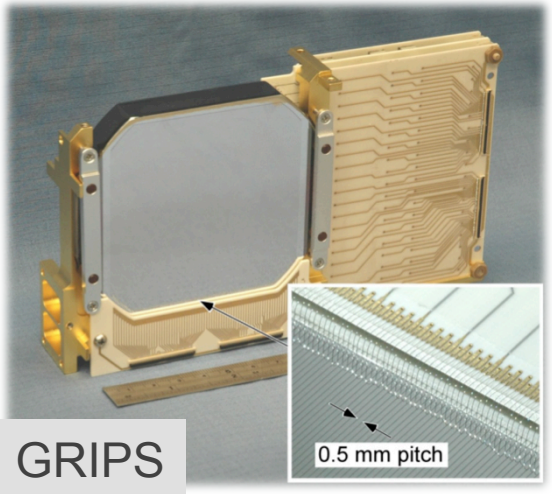
LBNL Semiconductor Detector Laboratory

Birthplace of HPGe, Si:Li, Si/Ge drift detectors
From HPGe crystals to advanced detectors: low noise, high rate, segmented

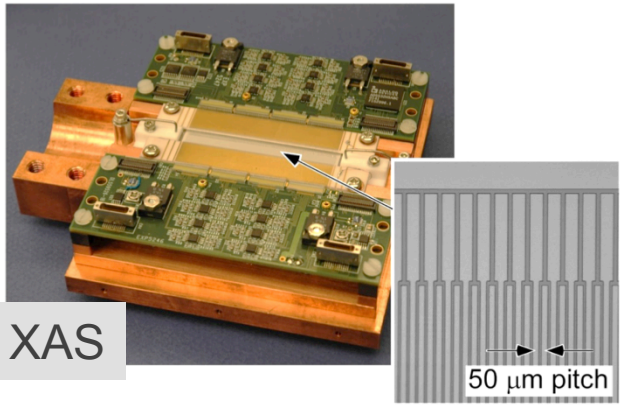

NCT / COSI


High Rate

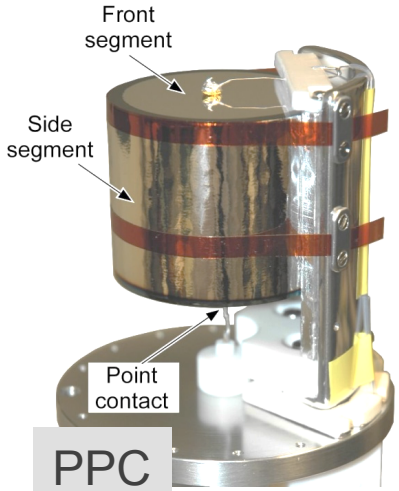

Low Noise



GRIPS



XAS



PPC

BERKELEY LAB

LBNL – Other supporting infrastructures

Class-100 cleanroom with ESD protection

Low Background Counting facilities at LBNL [1 station]) and SURF (4850') [2 stations]

Computation and data archiving at **NERSC**: **PDSF**, **HPSS**, and **ESNet** support

(SNO, KamLAND, IceCube, Daya Bay, STAR, ATLAS, MAJORANA, CUORE, LUX/LZ…)

BERKELEY LAB

3

Argonne National Laboratory

Guy Savard

Argonne Capabilities related to 76Ge double beta decay experiments

Guy Savard

Scientific Director of ATLAS

Argonne National Laboratory
&
University of Chicago

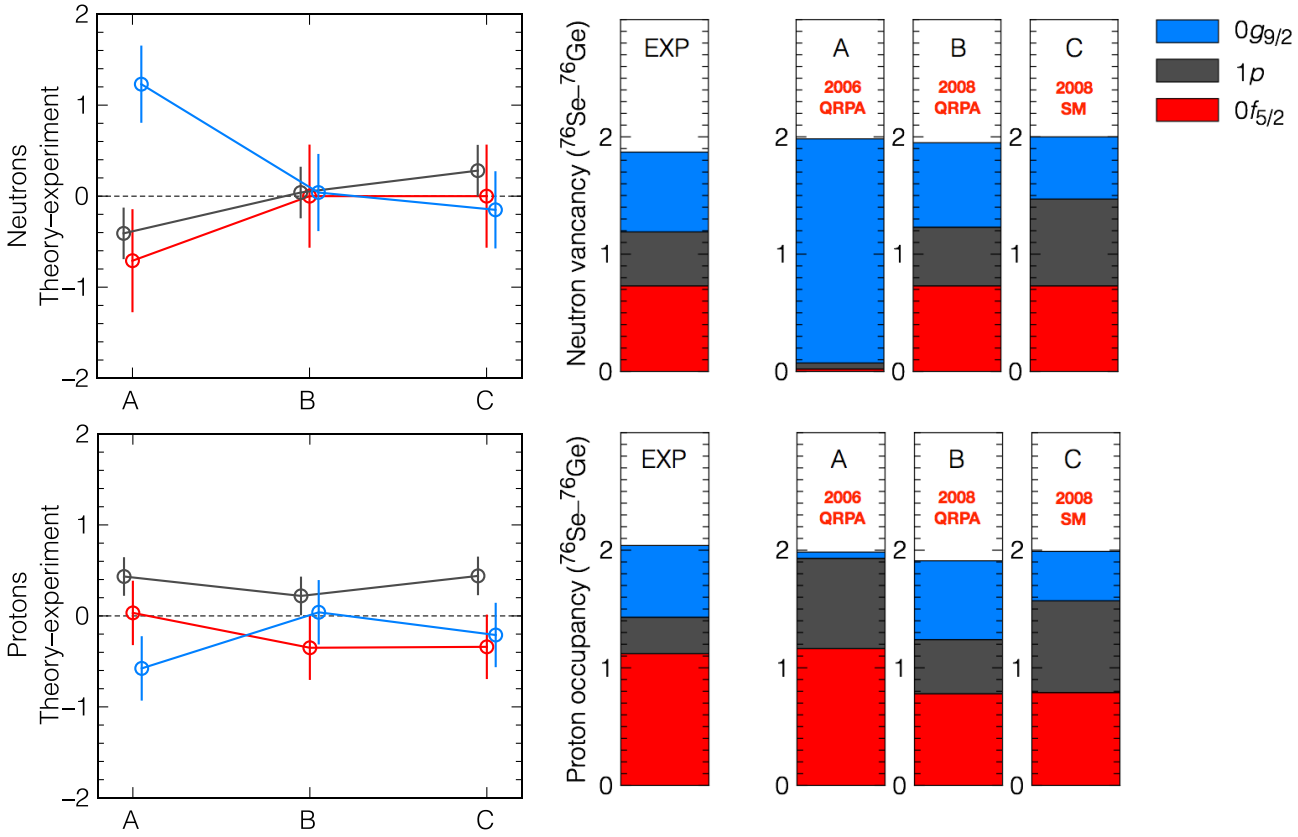
München, April 17, 2016

Argonne low-energy group activities

- Varied physics program
  - Nuclear structure, Nuclear astrophysics, Fundamental interactions
- Operates a large user facility and its equipment
  - ATLAS, the US DOE low-energy nuclear physics national user facility …. ~ 400 users/year performing experiments
  - Gamma-ray detector arrays
    - GAMMASPHERE: 110 HPGe detectors
      - Maintained, operated, upgraded over last 2 decades
    - Hosted GRETINA (US Ge tracking array) in 2014-2015, coming back in 2017
    - X-array (20 HPGe crystals) + all kind of NP detectors
- Expertise detecting no neutrinos with high accuracy
  - Beta-neutrino correlation in ^{8}Li, ^{8}B and ^{6}He
  - Other precision work (^{225}Ra EDM, 0νββ Q-value, superallowed beta decay, …)

Experimental program to reduce uncertainties in the nuclear matrix elements

Using single- and two-nucleon transfer reactions to constrain calculations of nuclear matrix elements. For example, probing the ***ground state occupancies*** *and quantitatively determining how they* ***change*** *in 0ν2β decay.*



Work on Ge and Se by Schiffer et al. highlighted major discrepancies between the calculations and experimental data.

Consequently QRPA NMEs ***reduced*** *from* ***5.36 →4.11 (25%)*** *and SM NMEs* ***increased*** *from* ***2.81 →3.26 (15%)****. However, other approaches yield larger values ...*

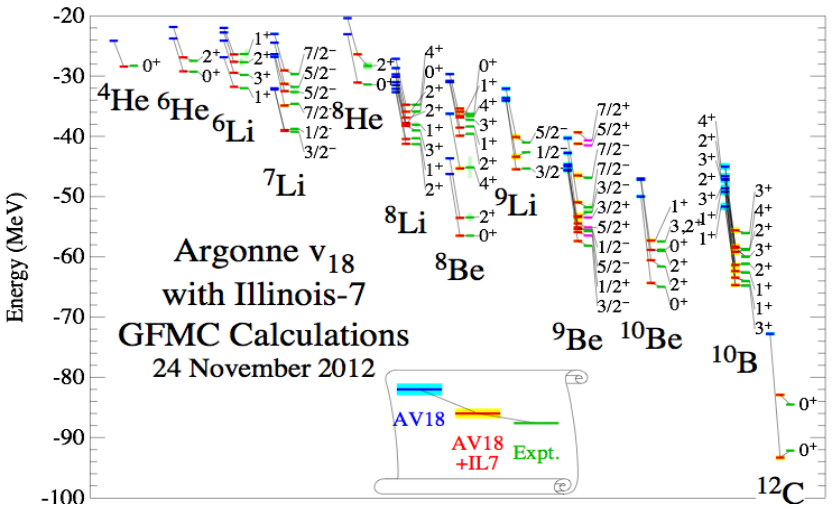
Major challenges remain with these inherently complex calculations. There are other data which could further constrain these calculations, and innovative theoretical approaches are being considered (next slide).

Bringing “ab-initio” calculations to heavier systems: Cluster Variational Monte Carlo

MODEL: Non-relativistic hamiltonian with two- and three-body forces

$$H = \sum_i \frac{\mathrm{p}_i^2}{2m} + \sum_{i<j} v_{ij} + \sum_{i<j<k} V_{ijk}$$

So far accurate Quantum Monte Carlo calculations limited to A≤12



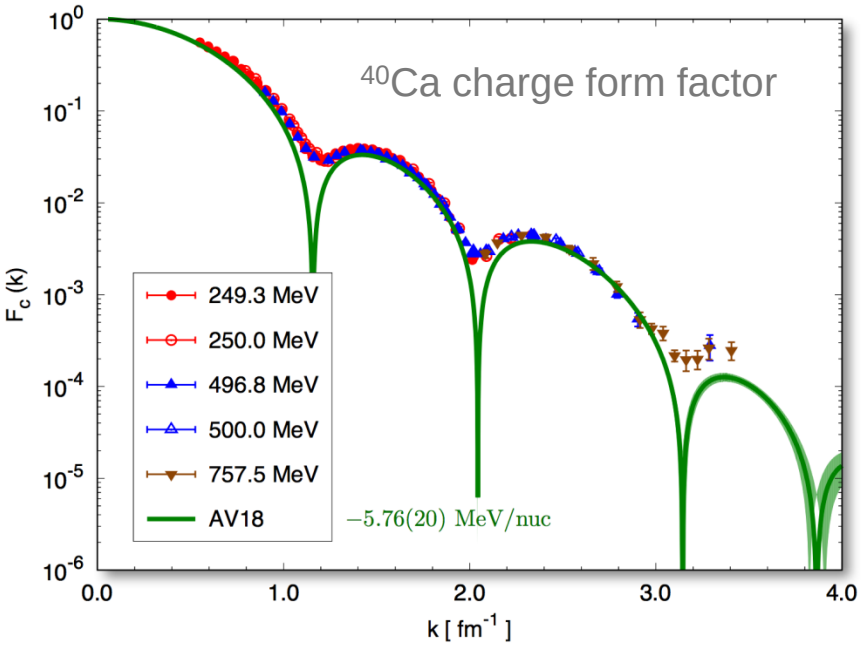
NEW METHOD: Variational approach with correlations built in the wave function

$$E_T \equiv \langle \Psi_T | H | \Psi_T \rangle \geq E_0$$

$$|\Psi_T\rangle \equiv \left[\prod (1 + U_{ijk})\right] \left[\mathcal{S} \prod (1 + U_{ij})\right] \left[\prod_{i<j} f_{ij}^c\right]$$

employ the cluster expansion technique

$$E_T = \sum_i c_i + \sum_{i<j} c_{ij} + \sum_{i<j<k} c_{ijk} + \sum_{i<j<k<l} c_{ijkl}$$



Most relevant expertise

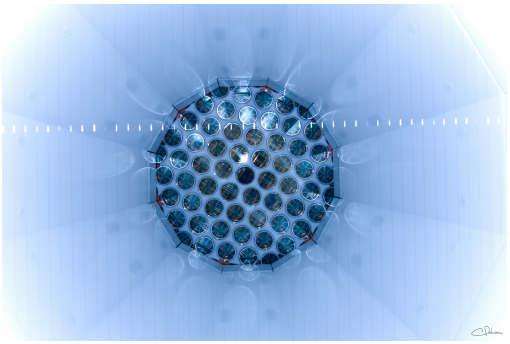
- Operating and maintaining large arrays of Germanium detectors
- Digital acquisition for Ge detector arrays (GAMMASPHERE, GRETINA) …. have already contributed to Majorana DACQ
- Signal decomposition for position information in GRETINA tracking arrays → pulse-shape analysis
- Complex Monte-Carlo at low-energy (expertise developed in beta-neutrino correlation work)
- Nuclear structure experiments and calculations to improve nuclear matrix elements
- Expertise in large projects within DOE
- And of course: Interest in the physics

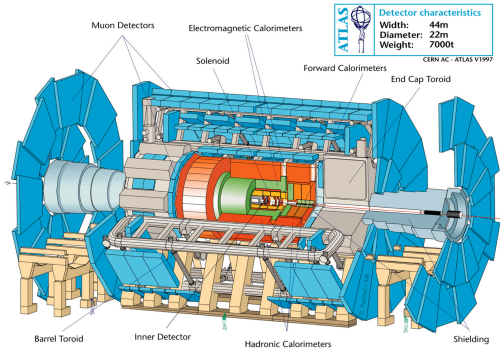
4

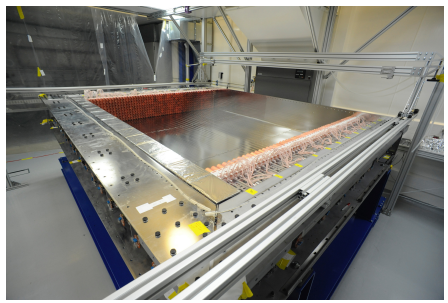
UCL

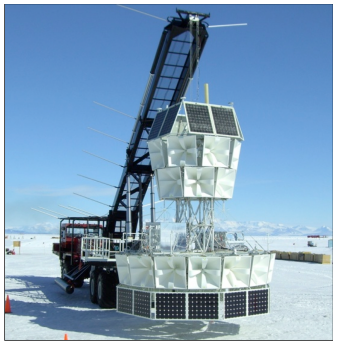
R. Saakyan

UCL High Energy Physics Group









20 Faculty + 20 RA/technical + 30 PhD students **http://www.hep.ucl.ac.uk/**

Energy Frontier with **ATLAS** at **LHC**

Neutrino Physics with **SuperNEMO**, **MINOS+**, **NOVA** and new generation neutrino oscillation experiments

Direct detection of dark matter with **LUX** and **LZ** experiments

Probe physics at energies beyond LHC indirectly with UHE neutrinos at South Pole (**ANITA/ARA**), muon's magnetic moment (**FNAL g-2**), lepton flavour violation (**COMET**)

Theoretical studies of strong interactions, QCD, and physics beyond the standard model

Developing novel instrumentation for future experiments and their applications in **proton cancer therapy** and **muon tomography**

DBD Expertise — SuperNEMO

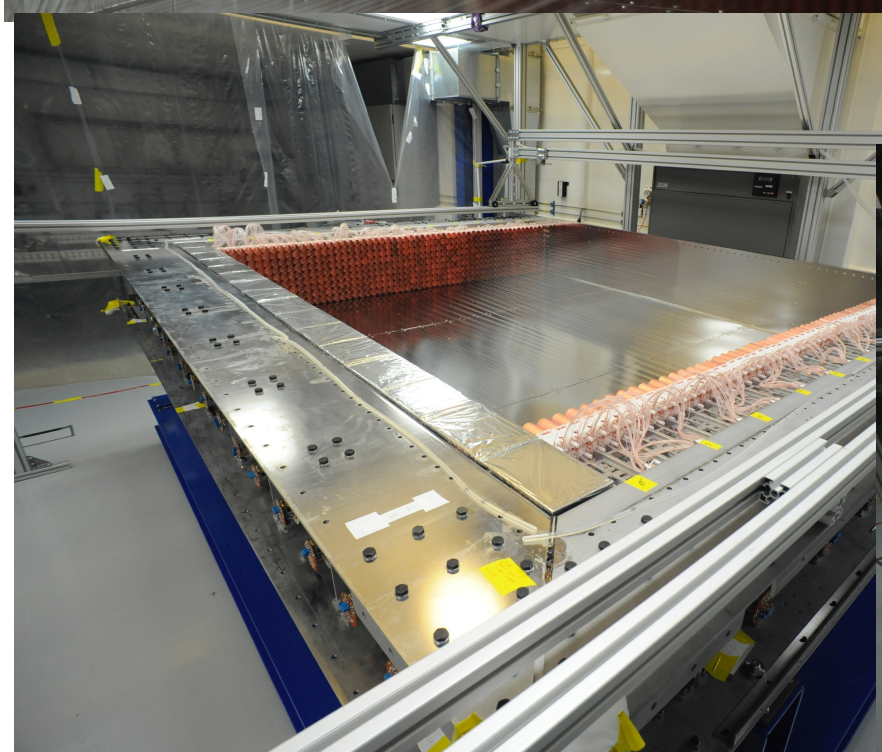
And NEMO-3!

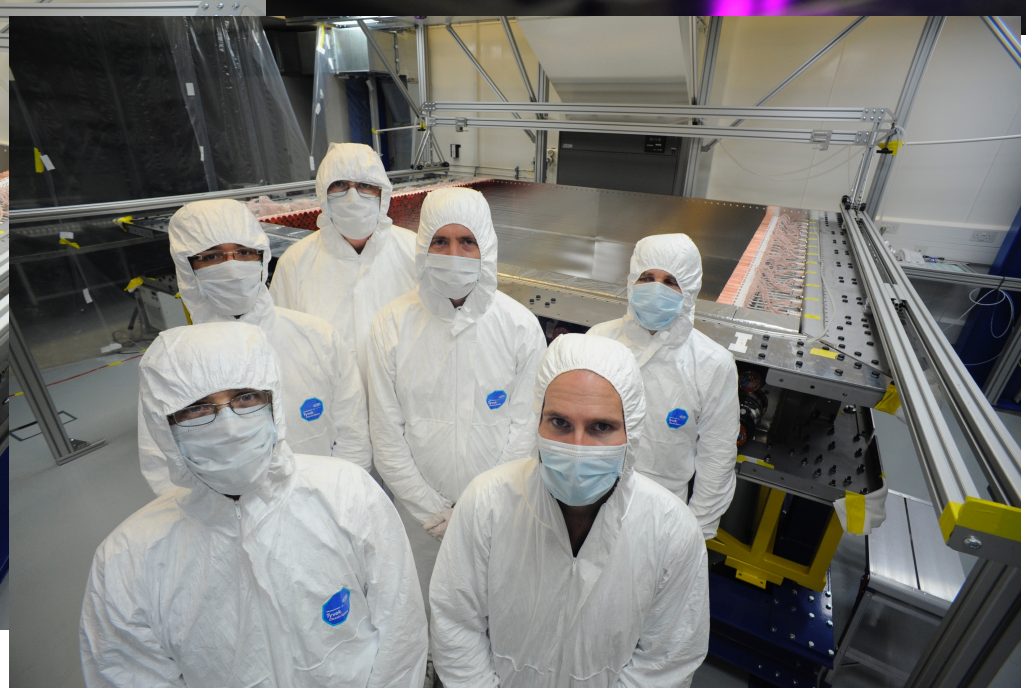
- UCL — Largest SuperNEMO group. Provides Co-Spokesperson and UK Principal Investigator. 3 academics, 3 postdocs, 4PhD students + technical staff
- UK contributes ~40% to SuperNEMO
  - Tracker construction, commissioning and integration — UCL + Manchester
  - Readout electronics and HV delivery for Tracker — UCL + Manchester
  - Low background assays (Rn emanation + HPGe + ICPMS) — UCL
  - Core software, reconstruction software — UCL, Warwick, Imperial, Manchester
- NEMO-3 Analysis — UCL + Manchester

Facilities

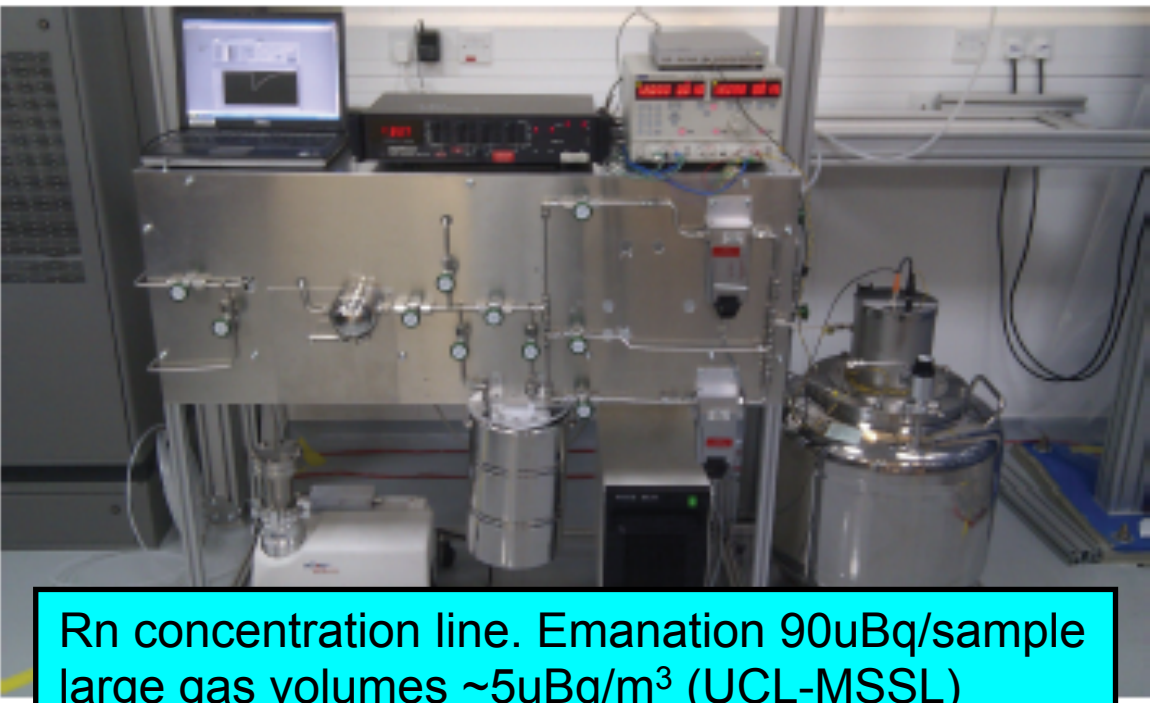
- On-campus laboratories and workshops
- Large (250 m^2) clean room in MSSL outside London
- New Boulby underground facility

Tracker construction at MSSL



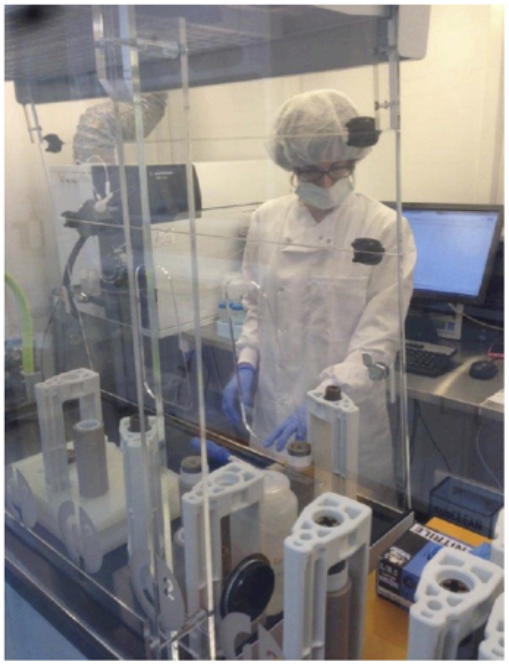


Low Background Screening Facilities



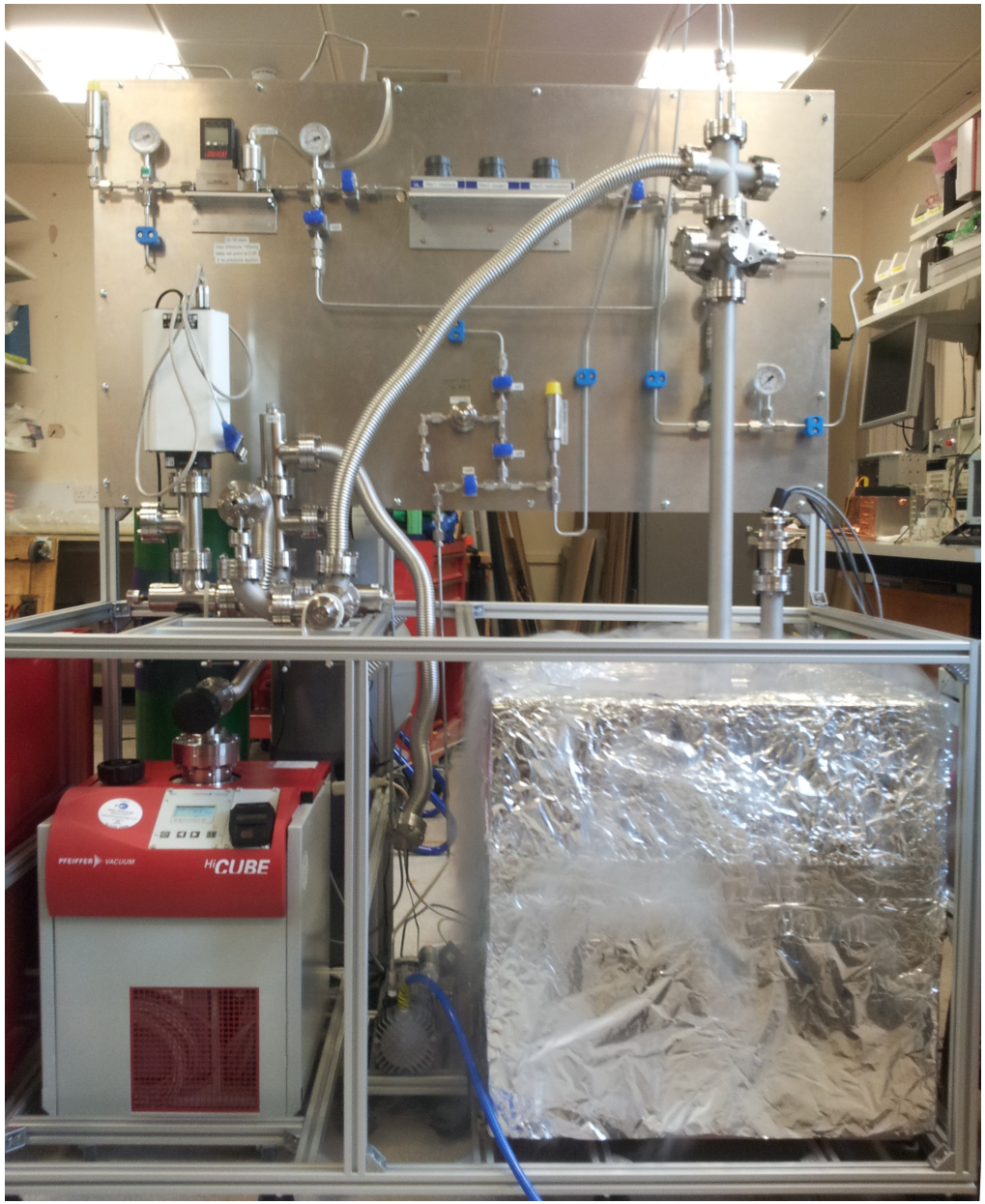
Rn concentration line. Emanation 90uBq/sample
large gas volumes ~5uBq/m^3 (UCL-MSSL)

4 HPGe detectors at new
Boulby underground facility



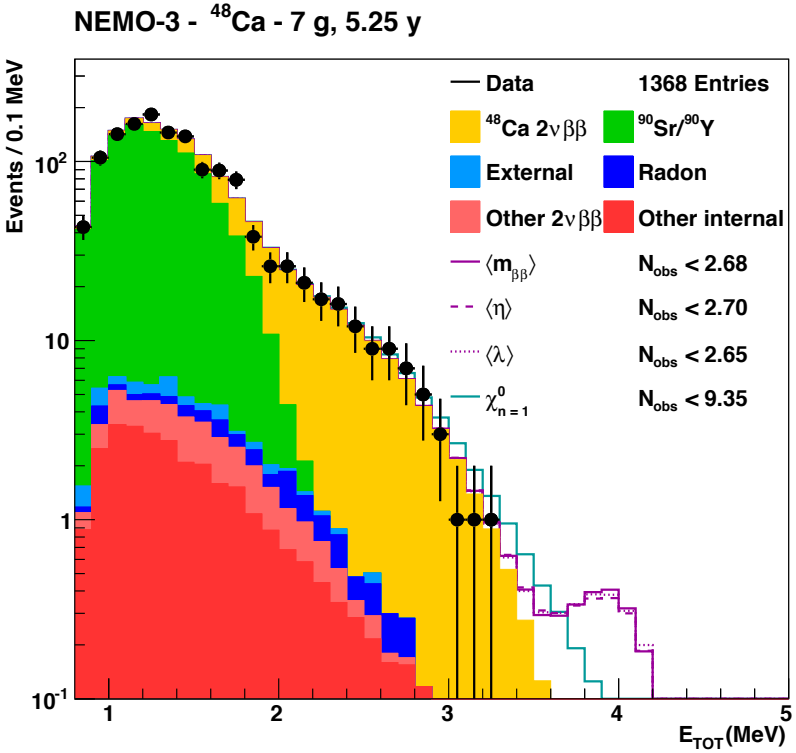
ICPMS Facility at UCL.
Sensitivity ~ppt for U/Th

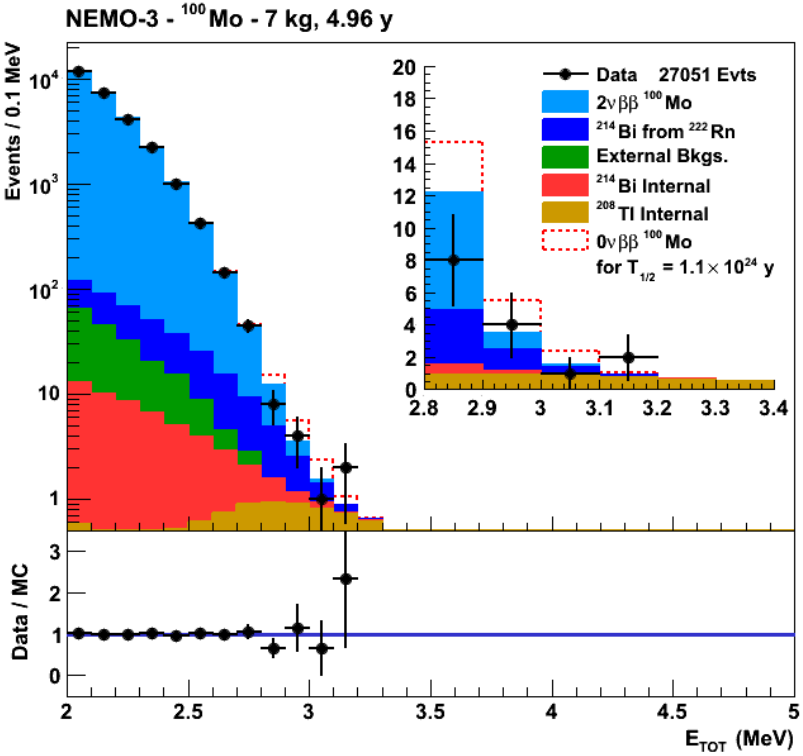
LAr R&D Test-stand at UCL



- R&D bench to test LAr readout systems
  - Single phase vs dual phase
  - SiPM, ThGEM etc
  - HV Feedthrough
- Initially for DUNE but involvement from Dark Matter and other generic LAr use cases

NEMO-3 Results





- Analysis 2vbb and 0vbb of 7 isotopes: ^{100}Mo, **^{82}Se**, ^{150}Nd, ^{130}Te, ^{116}Cd, **^{96}Zr**, **^{48}Ca**
- UCL actively involved in analyses of 5 isotopes and led publications of 3
- Excited states analysis
- Non bb physics (e.g. Lorentz violation)

5

University of Alberta

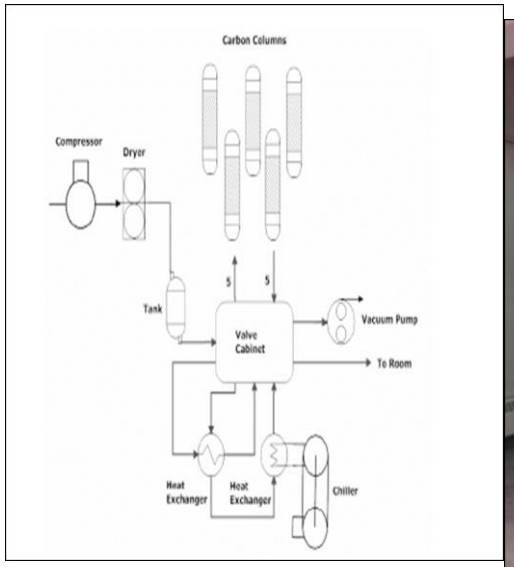
Aksel Hallin

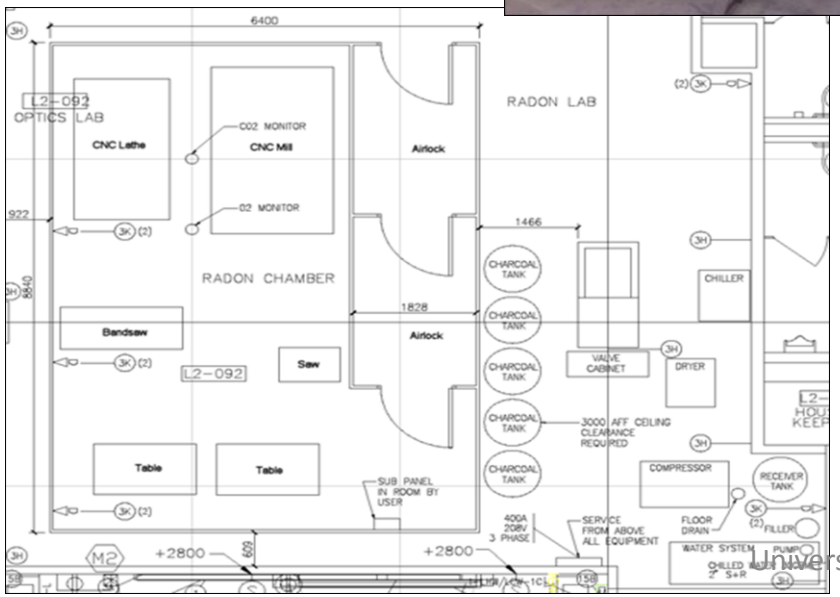
University of Alberta

Low radon cleanroom
Fabrication of large/unique components
Acrylic Expertise
Calibration/Data Analysis


In several passes, stubs are precision machined out of the main AV sphere.

Low Radon Cleanroom





6

Padova University and INFN Padova

Riccardo Brugnera

Padova University and INFN Padova

group: 3-4 staff members

Past activities:

ZEUS experiment: Barrel and Rear Muon chambers: production and qualification tests of the chambers, electronics, slow control, simulation, data analysis
Silicon Micro Vertex: production and qualification tests for the Si detectors, electronics

OPERA experiment: Resistive Plate Chambers: production and qualification tests of the RPCs, electronics, slow control, simulation, data analysis

Present activities:

GERDA experiment: slow control, tests of the Ge diodes, data analysis

JUNO experiment: electronics of the PMTs

Interest for a NG-Ge76 experiment:

- we have some interest but
- possible involvment has to be weighted with our other commitments

18

Laboratori Nazionali del Gran Sasso

LAUBENSTEIN, Matthias

INFN - LNGS

Meeting on next generation ^{76}Ge experiment

IBZ, Munich, Germany

April 25th – 27th 2016

- Interest of LNGS to host a 200-kg-^{76}Ge science driven experiment.
- Active support for screening, electronics (expertise present for low background cold electronics, and SiPMs), workshop, chemistry lab and cryogenics.
- Active support by local personnel (researchers and technicians).

7

Comenius University in Bratislava

Pavel P. Povinec

Next Generation Ge experiment (suggested activities from the Bratislava group)

Pavel P. Povinec

Department of Nuclear Physics,

Comenius University in Bratislava,

Slovakia

(povinec@fmph.uniba.sk)

- **Radiopurity measurements of construction materials (Gamma-spectrometry, Accelerator mass spectrometry, Neutron activation analysis (a detection limit < 0.1 mBq/kg)**
- **Monte Carlo simulations of the detector background from cosmic rays, and from U and Th (and their decay products) contaminants in construction materials**
- **Participation in data acquisition and data evaluation**

Participants : P. Povinec, R. Breier, M. Ješkovský, J. Kaizer, plus 2 PhD students)

8

LANL

Steve Elliott

The LANL Group

Personnel, Supported by DOE-NP

- **Staff: S. Elliott, K. Rielage, M. Boswell, J. Goett**
- **Postdocs: P. Chu, R. Massarczyk, B. White, B. Zhu**
- **Tech, designer, engineer**
- **Part of large nuclear physics group (expt. and theory)**

Experience & Capabilities

- **Long history in ν physics, solar ν, $\beta\beta$**
- **Low background expertise**
- **Mechanical design: shield, cryostat, string, calibration**
- **Facility design: WIPP, SURF**
- **Varied experience building $\beta\beta$ experiments including Ge**
- **Neutron measurements, cosmogenic production, (n,n'X)**
- **Robotics, source fabrication, spectrum analysis, γ assay**
- **Simulation and analysis**

9

Institute of Experimental and Applied Physics, Czech Technical University

Ivan Štekl

Activities in ββ decay

Ivan Štekl

Institute of Experimental and Applied Physics, Czech Technical University

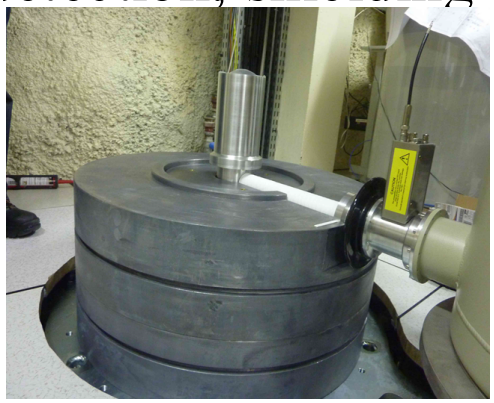
1) Close cooperation with *LSM underground laboratory (since 1992)*

2) *Participation in following experiments:* **TGV/SPT** (2νEC/EC decay of ^{106}Cd using HPGe detectors and Si pixel detectors); **NEMO 3** (neutron shielding, steel frame, anti-radon facility in LSM); **SuperNEMO** (Rn diffusion, Rn emanation, sensitive Rn measurement, ultra-low background HPGe detector 600 cm^3, R&D of scintillating detectors, steel frame; simulation of background); **COBRA** (CdTe pixel detectors)

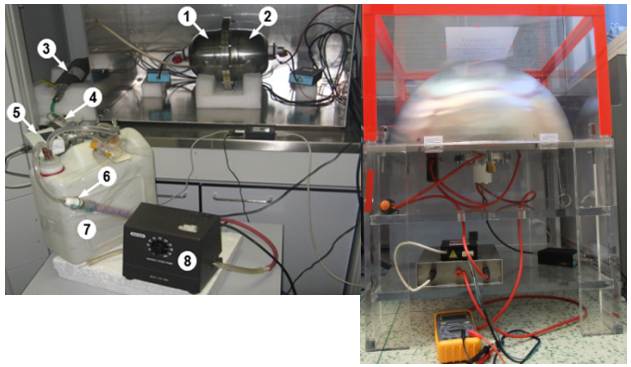
3) *Low background expertise:*

- Low background HPGe spectroscopy (600 cm^3, ~ 100 μBq/kg; second HPGe detector under construction, common activities of IEAP CTU, JINR and CU)
- Rn program: anti-radon setup (removes Rn from the air, 150-200 m^3/h, A < 10 mBq/m^3), cooperation with ATEKO company, sensitive Rn detection, shielding against Rn, Rn emanation.
- Shielding (gamma rays, neutrons)

4) *Theory:* close cooperation with F. Šimkovic (CU)
regular organization of MEDEX conference (nuclear matrix elements calculation, Suhonen-Civitarese-Štekl)

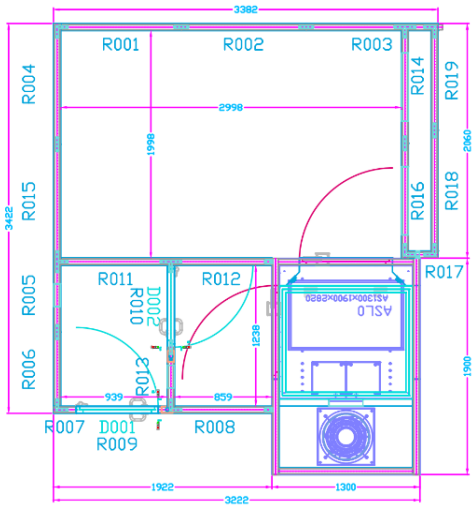


1) Sensitive detector of radon
(V=50 liters, 10 mBq/m^3, 300 l under construction)
2)Apparatus for measurements of Rn diffusion
3) Testing prototype of anti-radon setup
(NRPI, 20 m^3/h; -86ºC; second stage: liquid N_2)

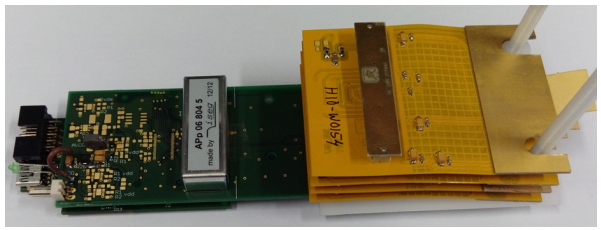


4) **Automatic system of samples changer** for HPGe detector (SURO-Nuvia-IEAP)

5) **Clean room with suppressed Rn activity**
(IEAP CTU-NRPI-Ateko)

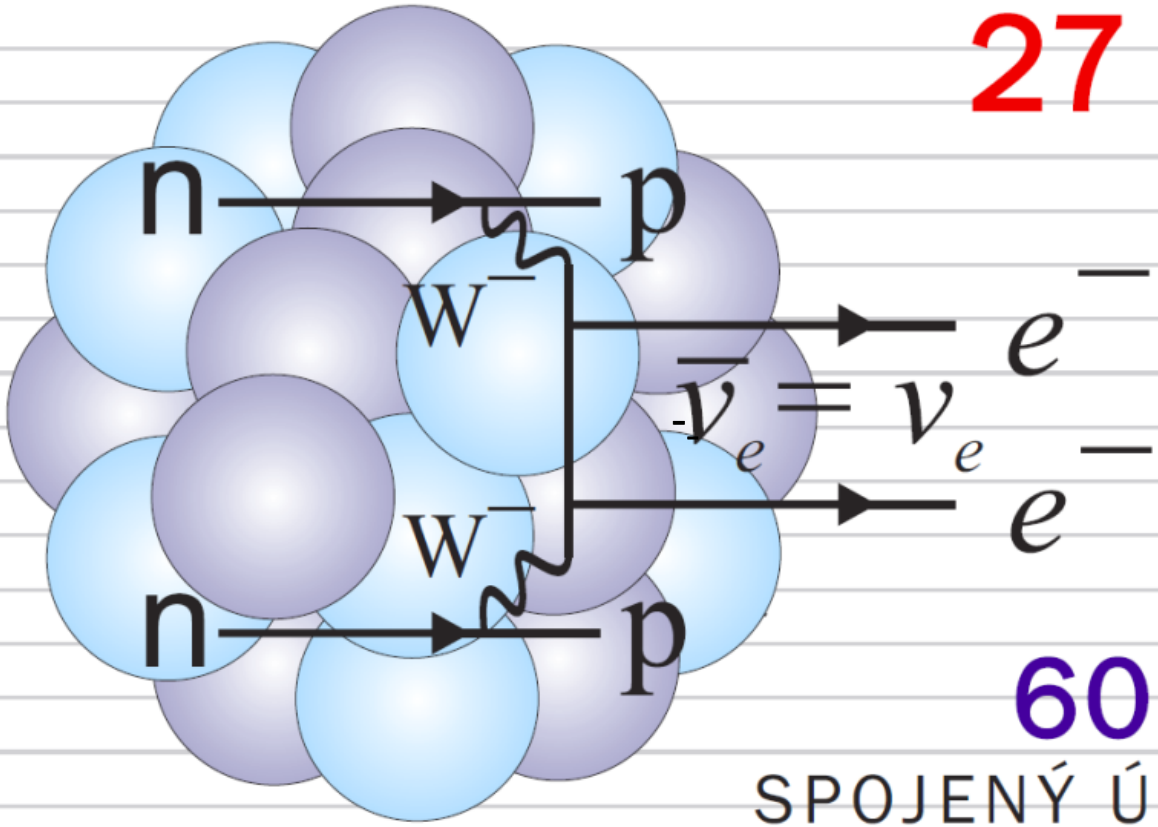


6) **Pixel detectors in ββ decay**
(Si, CdTe)



ČESKÁ REPUBLIKA

27 Kč



60 let

SPOJENÝ ÚSTAV JADERNÝCH VÝZKUMŮ, DUBNA

10

Triangle Universities Nuclear Laboratory

Matt Green

Triangle Universities Nuclear Laboratory

Duke University, North Carolina State University, University of North Carolina Chapel Hill

DOE Office of Nuclear Physics Center of Excellence

Faculty
- Matthew Green (NCSU)
- Reyco Henning (UNC-CH)
- John Wilkerson (UNC-CH)

Research Staff
- Matthew Busch
- Bret Carlin
- Jeannie Cox
- Mark Emamian
- Mark Howe
- Marty Johnson
- Richard O'Quinn
- Gary Swift
- Chris Westerfeldt

Postdoctoral Fellows
- Tom Caldwell
- Chris O'Shaughnessy
- Wenqin Xu

Grad Students
- Alex Fullmer
- Tom Gillis
- Chris Haufe
- Sam Meijer
- Jamin Rager
- Anna Reine
- Ben Shanks
- Jim Trimble
- Kris Vorren
- Kevin Wierman

Undergrads
- Robert Alfredson
- Jake Murphy
- John Nance
- Chiara Salemi
- Chris Silver
- Andrew Smith
- Jason Surbrook

Active Collaborations
- MAJORANA DEMONSTRATOR
- NG-Ge76
- COHERENT
- KATRIN
- HALO
- CALIOPE (T-violation positronium)

Facilities
- TUNL high vacuum
- Machine shops (all 3 universities)
- Clean rooms (HW development and wet lab)
- Accelerators : LENA, Tandem, HIγS (photons)
- PULSTAR Reactor (at NCSU) for NAA
- Underground radio assay : KURF → SURF
- Underground Machine shop at SURF
- High performance computing arrays

Duke UNIVERSITY · NC STATE UNIVERSITY · THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL · COSMS INSTITUTE

Areas of Expertise / Interest

- HPGe detector development
- Low-background detector deployment
- Cryostat design
- High vacuum systems
- Advanced fabrication techniques
- Fast electronics
- Real-time data acquisition
- Digital signal processing
- Analysis / simulations
  - 0νββ
  - Low Energy, below SM
- Radio-assay
  - Low-background γ-counting
  - In-house NAA capability
- Mechanical engineering
- Project engineering

Significant Leadership on MAJORANA DEMONSTRATOR

- John Wilkerson - Principal Investigator, Project Manager
- Matthew Busch - Project Engineer
- Matthew Green - Module Task Lead
- Reyco Henning - Commissioning Task Lead
- Mark Howe - DAQ Task Lead
- Thomas Caldwell - MJD Experimental Operations Director
- Plus several Deputy Task Leads, Analysis Working Group Leads

Strong Connections to Oak Ridge National Lab

- **Joint Faculty Appointments**
  - Matthew Green: NCSU/ORNL
  - John Wilkerson: UNC-CH/ORNL
  - David Radford ORNL/UNC-CH (Adjunct)

- **ORNL Core Universities: Duke, NCSU**

University of Cologne

EBERTH, Juergen

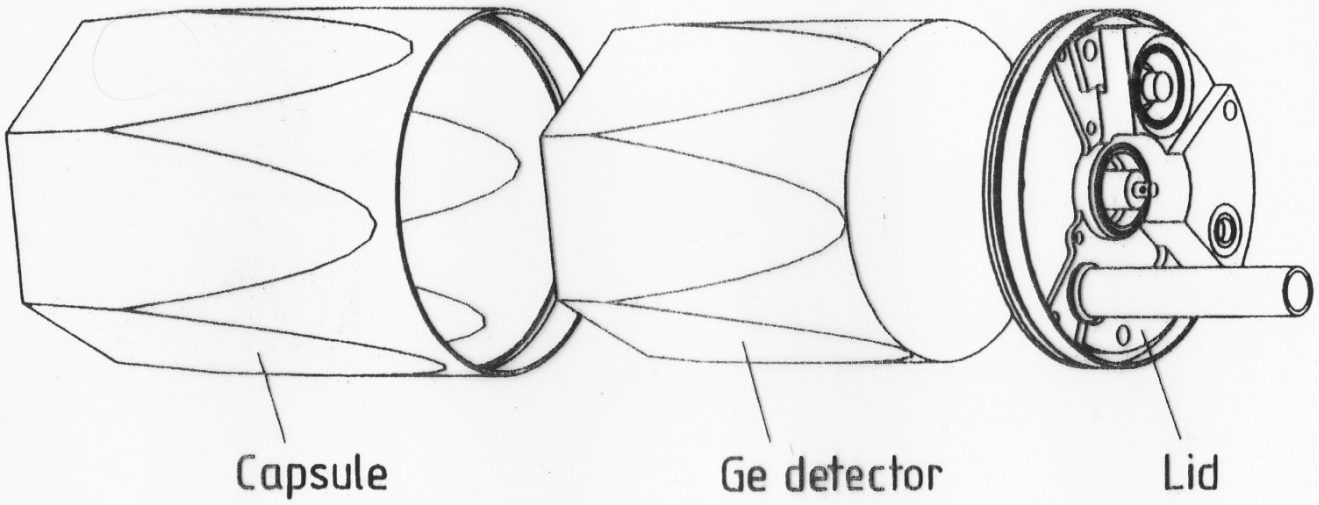
Encapsulation of Ge Detectors

developed in the late 1980‘s

Aim: Easy installation and reliable long-term operation of Ge multi-detector arrays

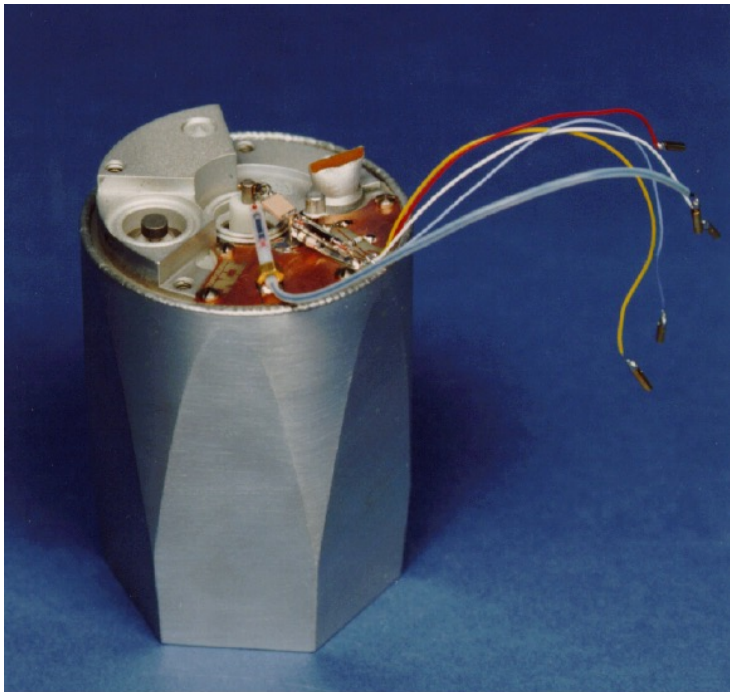
Examples: EUROBALL, MINIBALL, AGATA, GRETINA, INTEGRAL

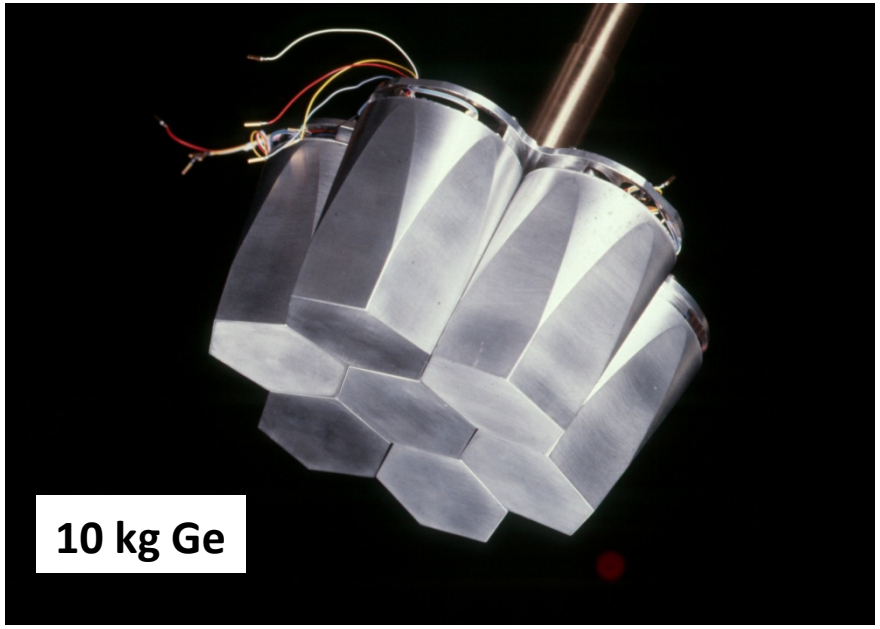
capsule and lid sealed by electron-beam welding
internal Getter, vacuum < 10^{-6} mb,
temperature range -196 ^{0}C and +110 ^{0}C

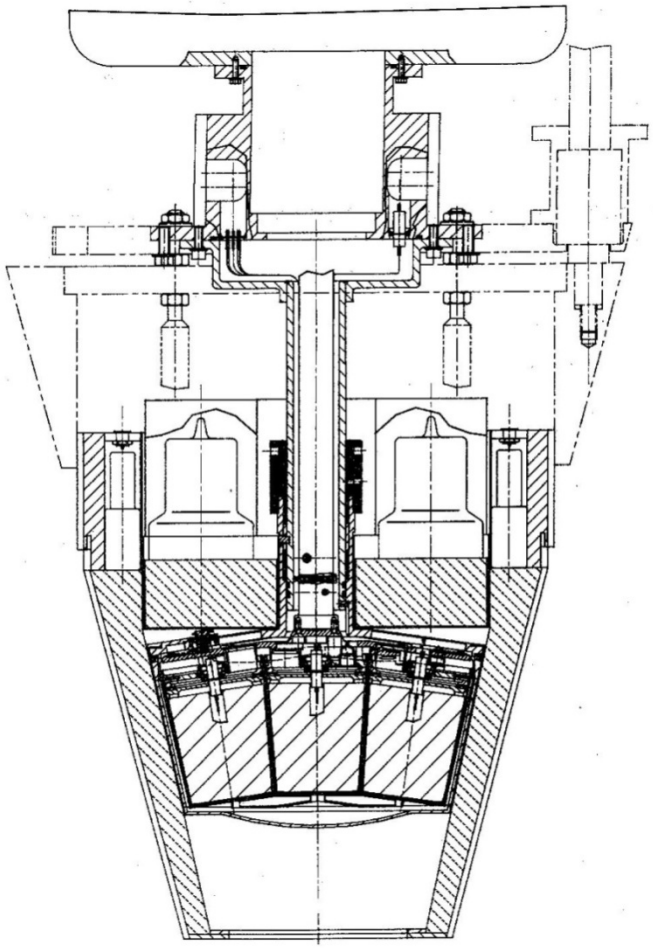


Collaboration: Köln, Jülich, Eurisys

J. Eberth et al., NIM A369 (1996) 135







The EUROBALL Cluster Detector 1992

150 Ge detectors of EUROBALL type produced in 1991 – 1996

20 cluster detectors comprising 200 kg of HPGe

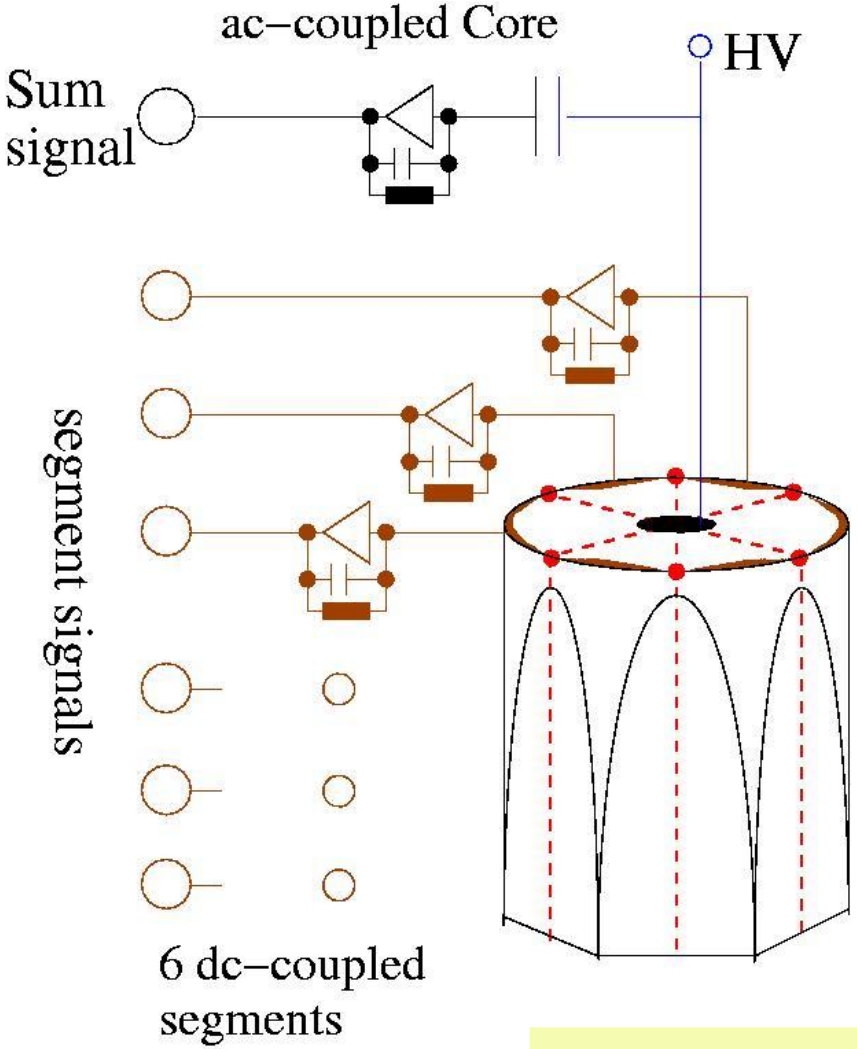
Failure rate < 7% in more than 20 years of operation

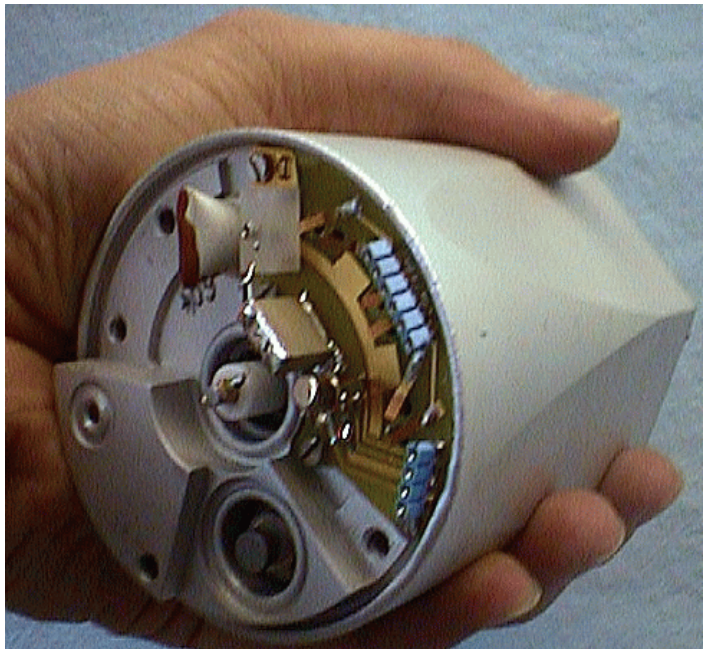
In spite of many annealings from neutron damage, transport to different host labs:

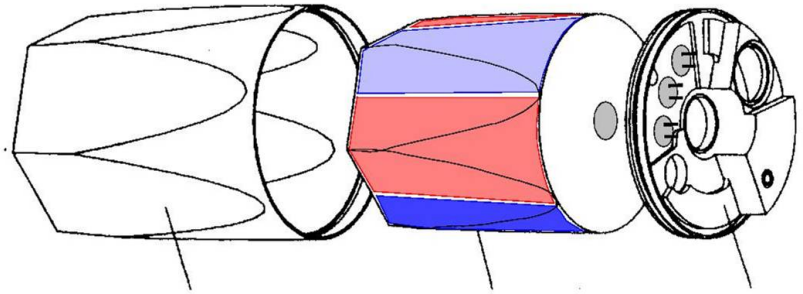
- LNL Italy
- IPHC Strasbourg France
- GSI Germany
- RIKEN Japan
- ....

Back up slides

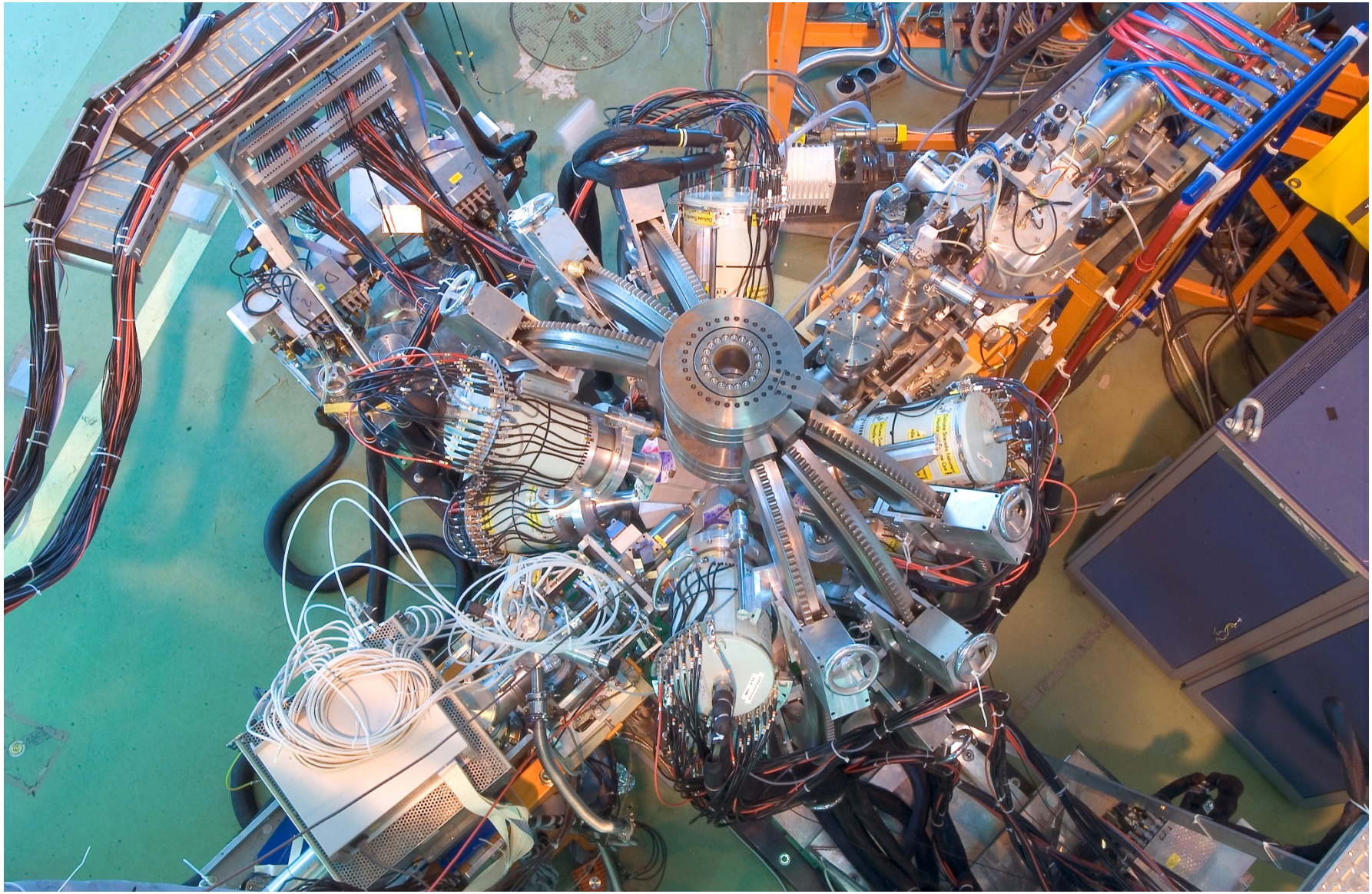
The 6-fold segmented, encapsulated MINIBALL detector
24 detectors in 8 triple cryostats operational since 2002
At REX/ISOLDE CERN



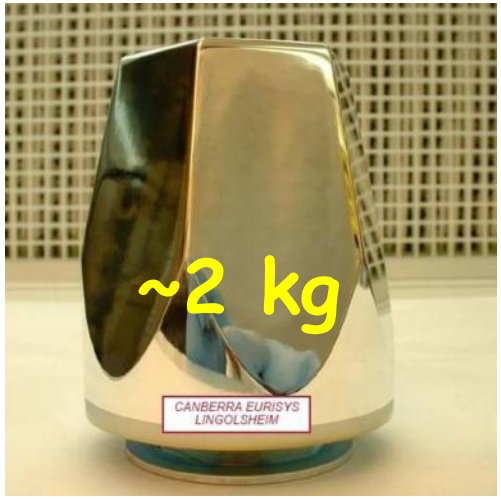


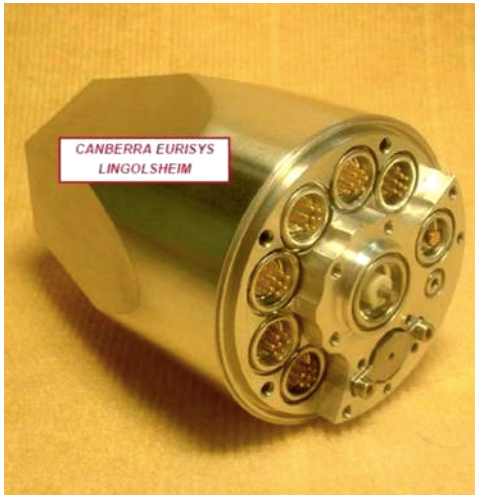


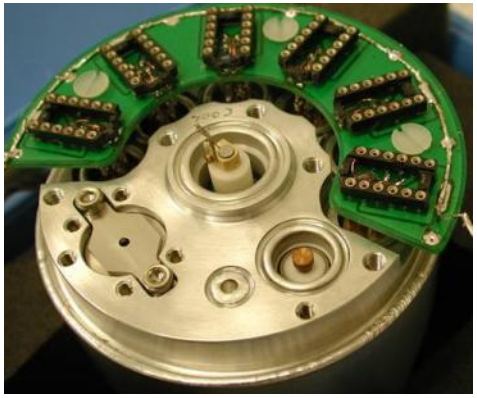
Collaboration: Köln, Heidelberg, München, Leuven

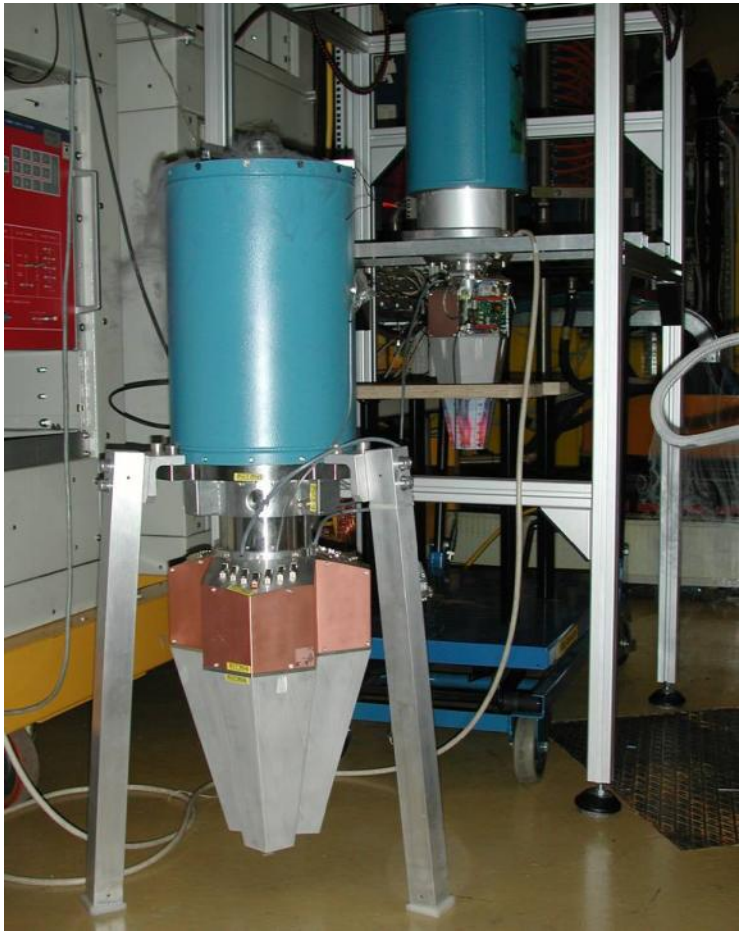


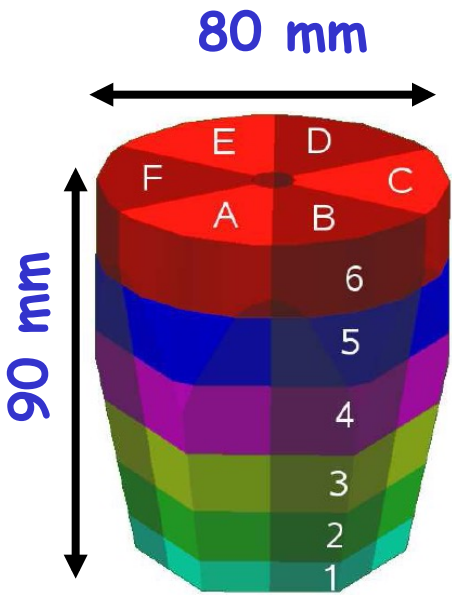
AGATA detectors and the AGATA triple-cluster





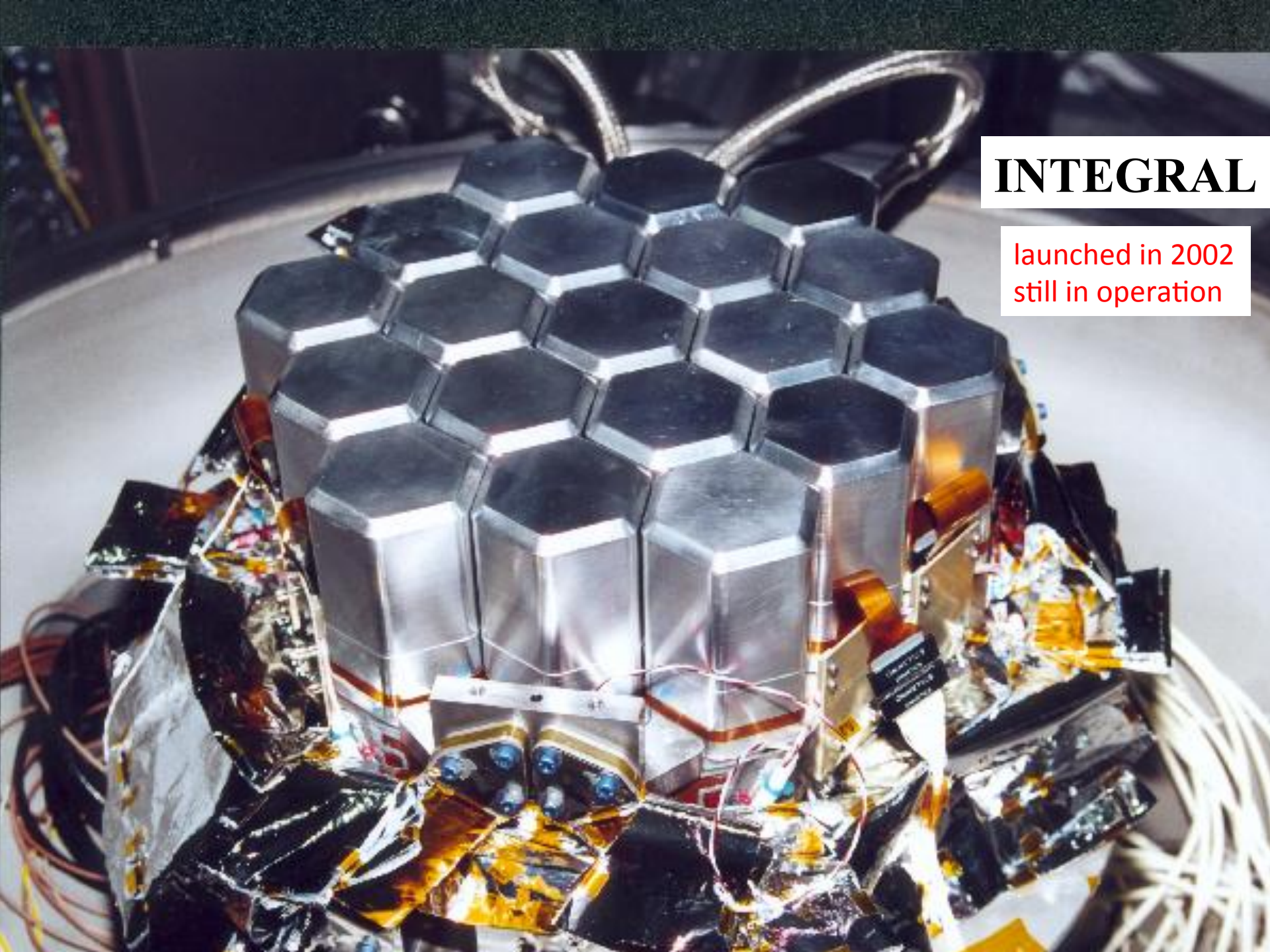






6x6 segmented cathode

Continuous delivery since 2005, today
30 detectors in 10 triple-cryostats installed at GANIL


INTEGRAL
launched in 2002
still in operation

Mars Odyssey 2001

Mission ongoing

Excellent long-term stability of encapsulated Ge detectors

Can one use this technology for 76Ge-enriched HPGe detectors?

Main problem: radio purity of components

12

University of Cologne

REITER, Peter

γ-ray detection with HPGe detectors

- detector design and construction
- electron hole mobilities
- cross talk in segmented HPGe detectors
- space charge distributions
- neutron damage
- energy resolution
- pulse shape analysis and position resolution

Peter Reiter

Institute of Nuclear Physics, University of Cologne

Meeting on the Next Generation

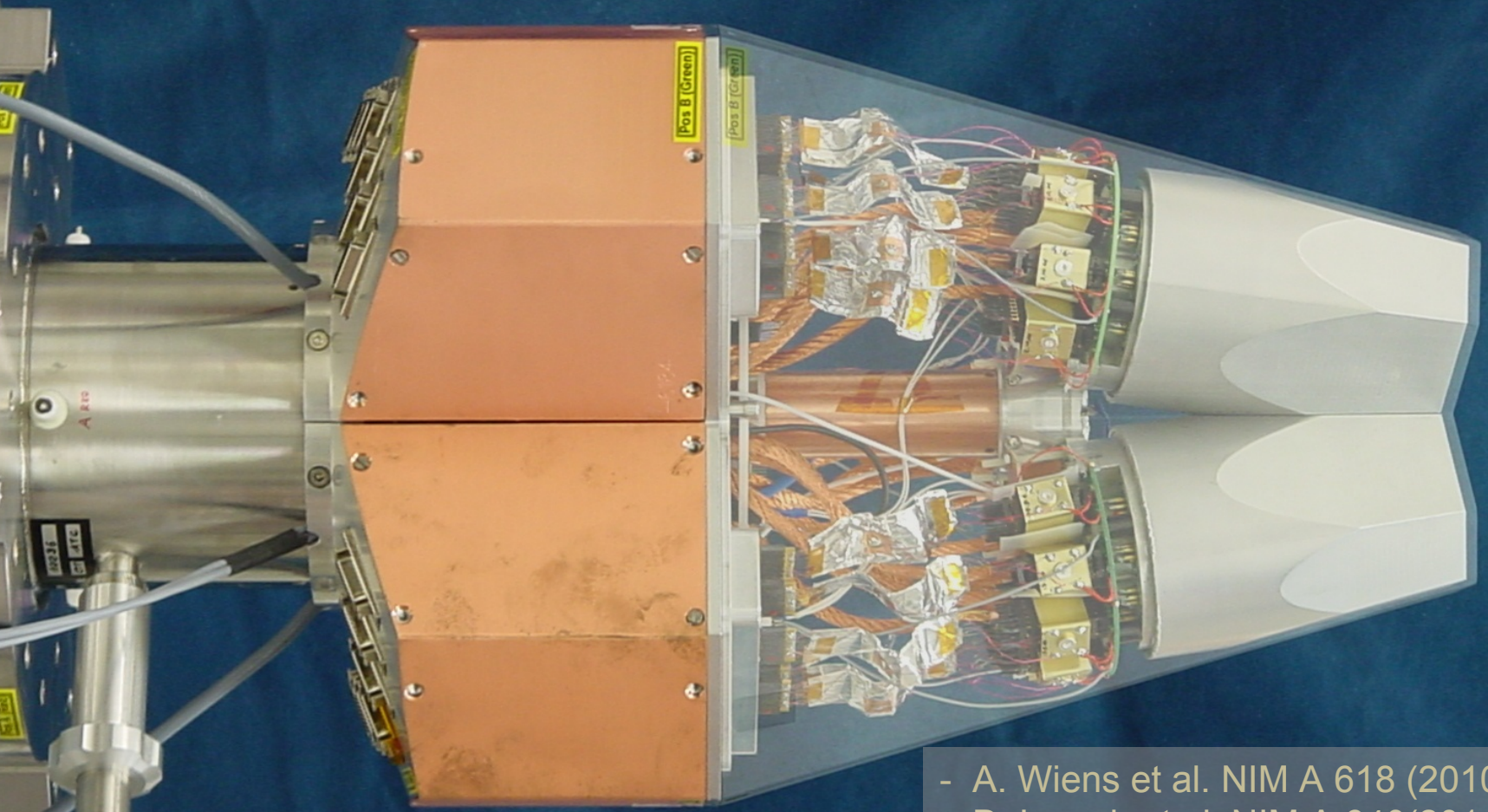
^{76}Ge Experiment

Munich 25.4. – 27.4.2016

AGATA Triple Cryostat

- integration of 111 high resolution spectroscopy channels
- cold FET technology for all signals

Challenges:
- mechanical precision
- LN2 consumption
- microphonics
- noise, high frequencies



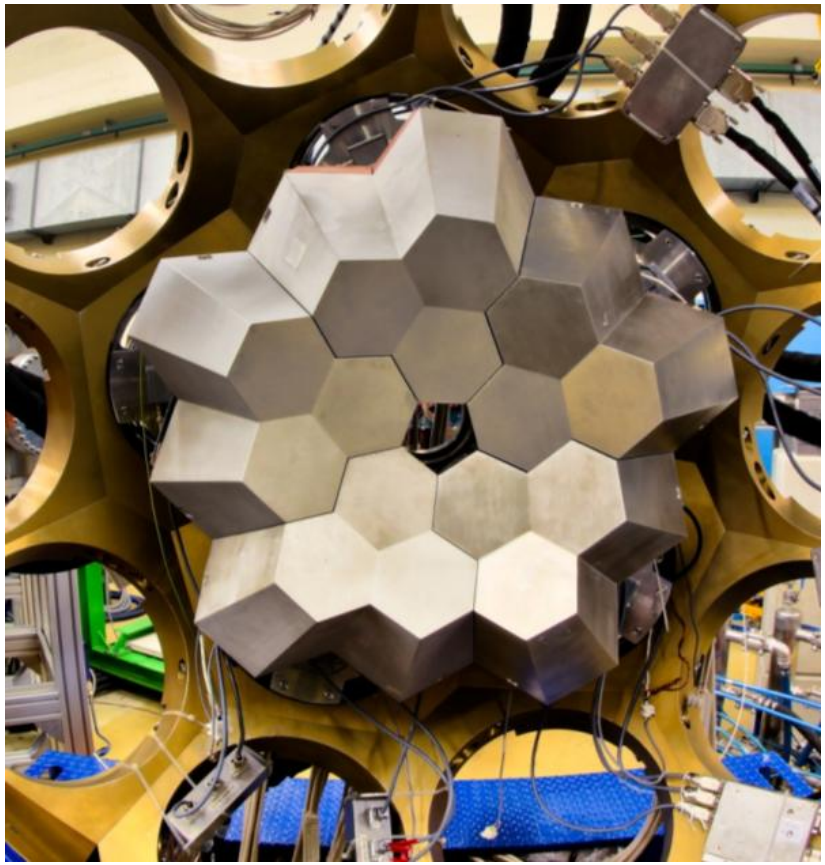
- A. Wiens et al. NIM A 618 (2010) 223–233
- D. Lersch et al. NIM A 640(2011) 133-138

From Demonstrator to AGATA

LNL: 2009-2011
15 crystals (5 TC)

GSI: 2012-2014
24 crystals (3 DC+6 TC)

GANIL: 2014-2019
45 crystals (15 TC)



Status 10 TC + 1 DC

Research results

HPGe detector design and construction

The AGATA triple cluster detector
A. Wiens, H. Hess, B. Birkenbach, B. Bruyneel, J. Eberth, D. Lersch, G. Pascovici, P. Reiter, for the AGATA collaboration, H.-G. Thomas
Nucl. Instr. and Meth.A 618 223(2010)

AGATA—Advanced GAmma Tracking Array
G.Duchene, E.Farnea, A.Gadea, A.Korichi, J.Nyberg, P.Reiter, J.Simpson corresponding author
Nucl. Instr. and Meth. A668 (2012) 26

Conceptual design and infrastructure of the installation of the first AGATA sub-array at LNL
A. Gadea, et al.;
Nucl. Instr. and Meth. A 654 (2011) 88

The LN2 level meter for the AGATA triple cluster detector
D. Lersch, G. Pascovici, B. Birkenbach, B. Bruyneel, J. Eberth, H. Hess, P. Reiter, A. Wiens, H. Thomas,
Nucl. Instr. and Meth. A 640 (2011)133

Charge carrier mobilities in HPGe

Characterization of Large Volume HPGe Detectors. Part I: Electron and Hole Parameterization
B. Bruyneel, P. Reiter, G. Pascovici
Nucl. Instr. and Meth.A (2006) 569, Issue 3, 764-773

Characterization of Large Volume HPGe Detectors. Part II: Experimental Results
B. Bruyneel, P. Reiter, G. Pascovici
Nucl. Instr. and Meth.A (2006) 569, Issue 3, 774-789

Space charge distributions

Space charge reconstruction in highly segmented HPGe detectors through capacitance-voltage measurements
B. Bruyneel, B. Birkenbach, P. Reiter
Nucl. Instr. and Meth. A 641 (2011) 92

Determination of Space Charge Distributions in highly segmented HPGe–Detectors
B. Birkenbach, B. Bruyneel, J. Eberth, H. Hess, D. Lersch, G. Pascovici, P. Reiter, A. Wiens
Nucl. Instr. and Meth. A 640 (2011) 176

Neutron damage

Correction for neutron damage in AGATA detectors using Pulse Shape Analysis
B. Bruyneel, B. Birkenbach, J. Eberth, H. Hess, Gh. Pascovici, P. Reiter, A. Wiens, D. Bazzacco, E. Farnea, C. Michelagnoli, F. Recchia for the AGATA collaboration
Eur. Phys. J. A (2013) 49: 61

Cross talk in segmented HPGe detectors

Crosstalk corrections for improved energy resolution with highly segmented HPGe-detectors
B. Bruyneel, P. Reiter, A. Wiens, J. Eberth, H. Hess, G. Pascovici, N. Warr, S. Aydin, D. Bazzacco, F. Recchia and for the AGATA Collaboration
Nucl. Instr. and Meth.A 608, (2009) 99

Crosstalk properties of 36-fold segmented symmetric hexagonal HPGe detectors
B. Bruyneel, P. Reiter, A. Wiens, J. Eberth, H. Hess, G. Pascovici, N. Warr, D. Weisshaar
and for the AGATA Collaboration
Nucl. Instr. and Meth.A 599, (2009) 196

Energy resolution & response

Improved energy resolution of highly segmented HPGe detectors by noise reduction
A. Wiens, B. Birkenbach, B. Bruyneel, J. Eberth, H. Hess, Gh. Pascovici, P. Reiter, D. Bazzacco, E. Farnea, C. Michelagnoli, F. Recchia
Eur. Phys. J. A (2013) 49: 47

Response of AGATA Segmented HPGe Detectors to Gamma Rays up to 15.1 MeV
F.C.L. Crespi, et al.;
Nucl. Instr. and Meth. A705 (2013)47

Position resolution

Interaction position resolution simulations and in-beam measurements of the AGATA HPGe detectors
P.-A. Söderström, et al
Nucl. Instr. and Meth. A638 (2011) 96

Position resolution of the prototype AGATA triple-cluster detector from an in-beam experiment
F. Recchia, et al.;
Nucl. Instr. and Meth.A 604 (2009) 555

Pulse shape analysis

Pulse Shape Analysis and Position Determination in segmented HPGe detectors:
The AGATA Detector Library
B. Bruyneel, B. Birkenbach, P. Reiter
Eur. Phys. J. A (2016) 52: 70

Back up slides

Pulse shape analysis

Eur. Phys. J. A (2016) **52**: 70
DOI 10.1140/epja/i2016-16070-9

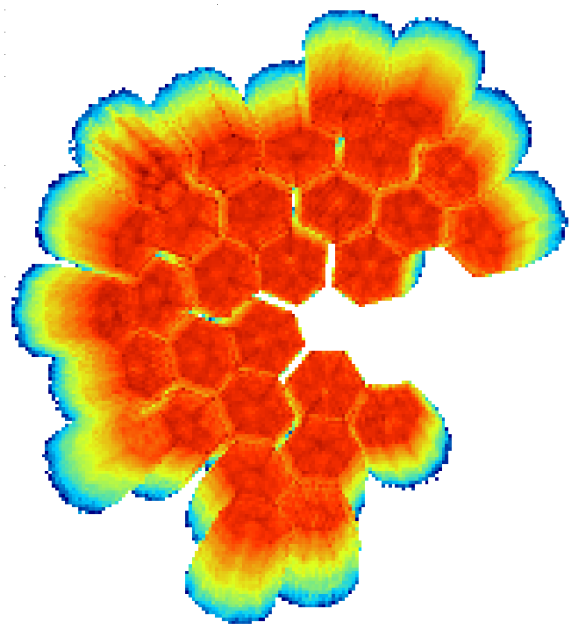
THE EUROPEAN PHYSICAL JOURNAL A

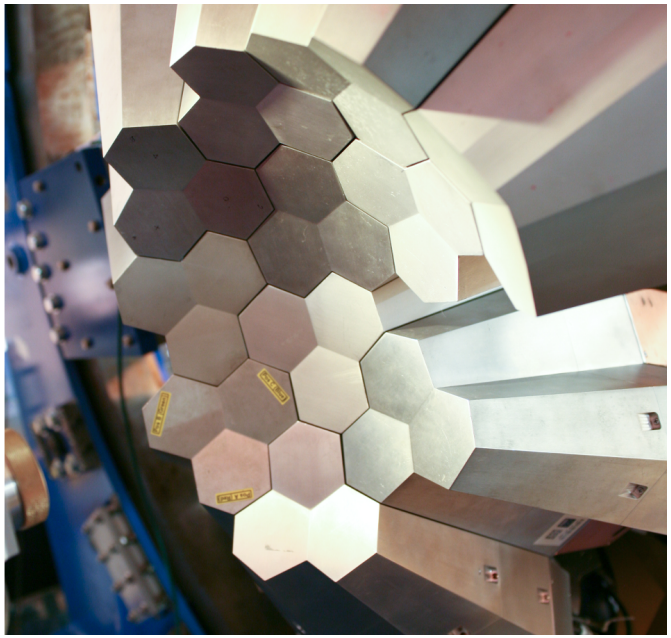
Special Article – Tools for Experiment and Theory

Pulse shape analysis and position determination in segmented HPGe detectors: The AGATA detector library

B. Bruyneel[1,2], B. Birkenbach[1,a], and P. Reiter[1]

[1] Institut für Kernphysik, Universität zu Köln, 50937 Köln, Germany
[2] CEA Saclay, Service de Physique Nucleaire, F-91191 Gif-sur-Yvette, France





HPGe detector group at IKP, Cologne

- P. Reiter
- J. Eberth

- B. Birkenbach — detector characterization, PSA, physics
- H. Hess — detector development, maintenance

Post docs

- L. Lewandowski — PSA, tracking
- D. Schneiders — detector development, MC simulations
- A. Vogt — AGATA physics

PhD students

- O. Arnapolina — AGATA physics
- M. Glass — detector development
- R. Hetzenegger — trapping correction
- R. Hirsch — Imaging application
- T. Steinbach — Imaging application

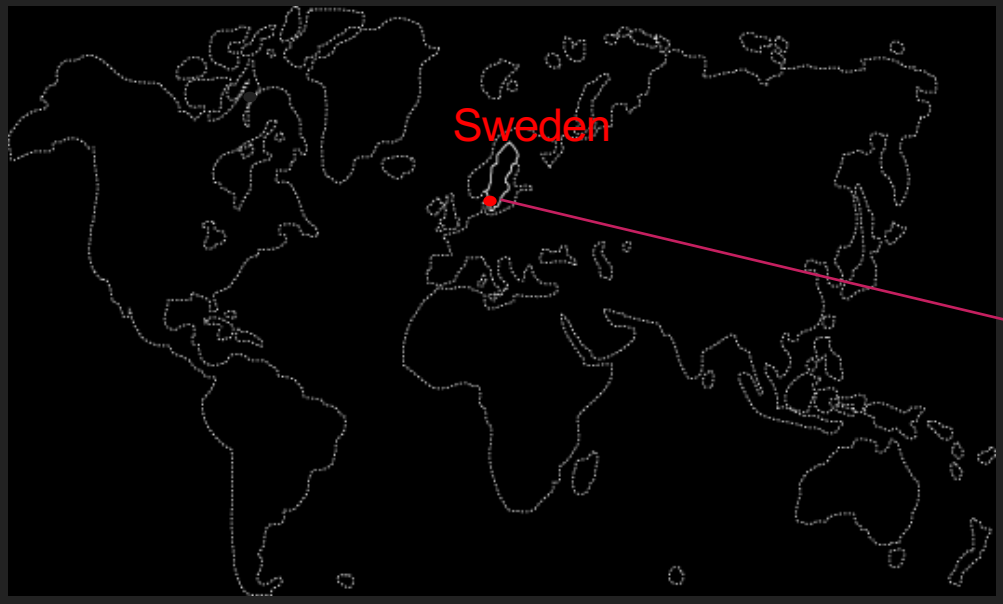
Master-, Bachelor students

13

Chalmers University of Technology

Prof. NILSSON, Thomas

CHALMERS UNIVERSITY OF TECHNOLOGY



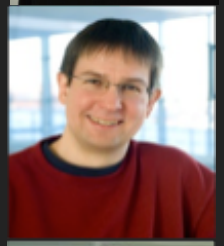
About 11,000 students,

2,744 employees

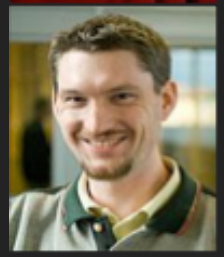
EXPERIMENTAL SUBATOMIC PHYSICS - CHALMERS UNIVERSITY OF TECHNOLOGY

Staff

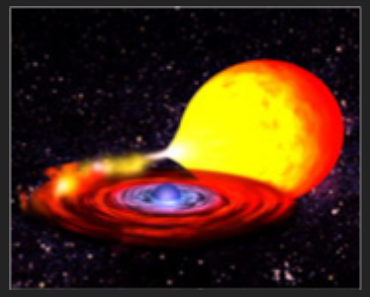
Thomas Nilsson



Andreas Heinz

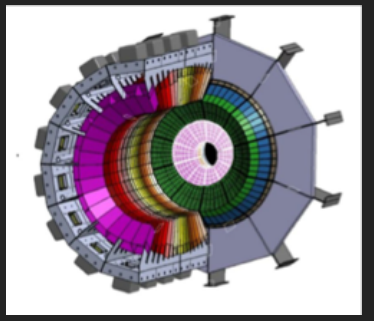


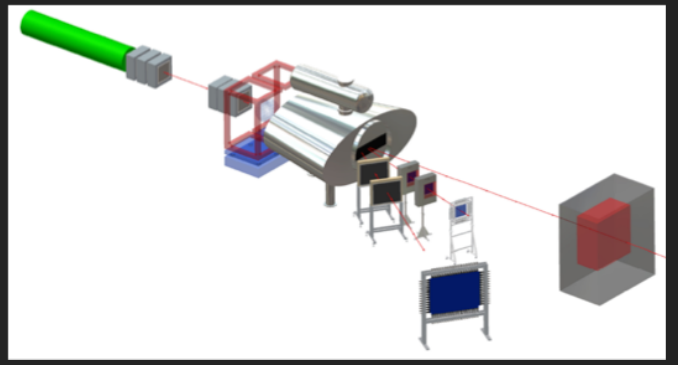
Håkan Johansson



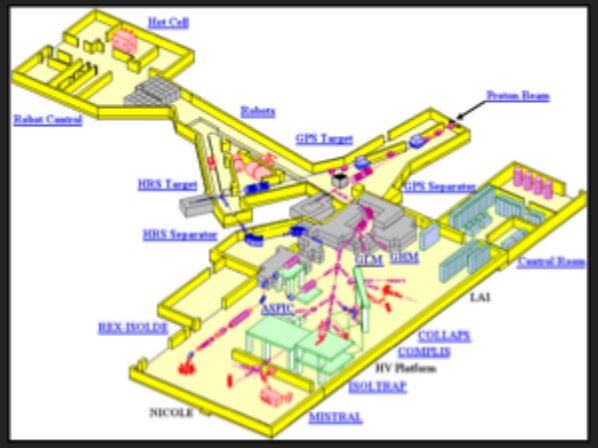
Structure of exotic nuclei and questions in nuclear astrophysics studied with Radioactive Ion Beams...

Paloma Fernandez Díaz
(PostDoc)





...constructing the future
R^{3}B set-up@FAIR



...at CERN-ISOLDE (low energy)

...at GSI/FAIR (relativistic energy)

Simon Lindberg
(PhD students)

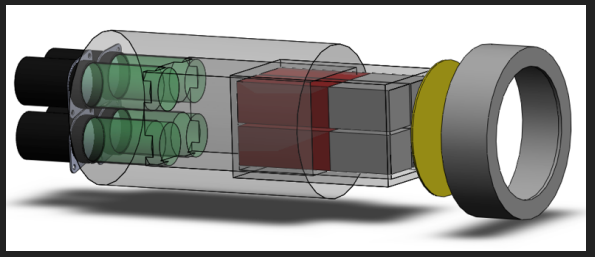
Ronja Thies

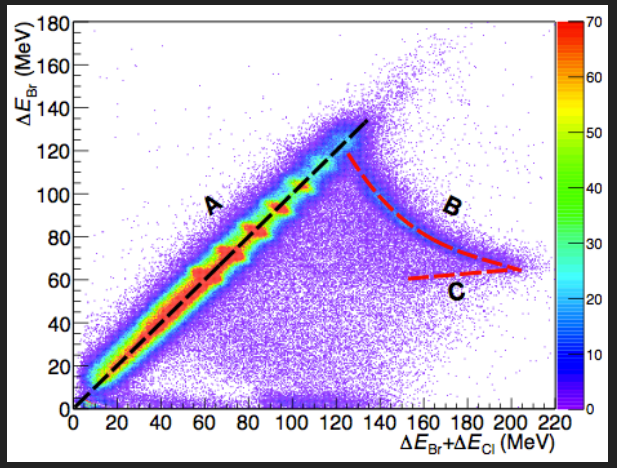
Björn Jonson

Göran Nyman

RELEVANT EXPERIENCE AND COMPETENCES

- New in 0**νββ** (pending funding) but earlier activities in WI/BSM physics:
  - $0^+ \rightarrow 0^+$ (V_{ud} in CKM)
  - Beta-beam and nnbar@ESS conceptual studies
- Experienced in
  - DAQ, FEE and trigger (defining FAIR-NUSTAR DAQ TDR)
  - PSA method development
  - Photo sensors (CALIFA – LAr synergies?)
  - Large scale GEANT4 simulations, in particular w. cosmics
  - Radioisotope production (spallation, fragmentation, fission)
- Some Ge-detector experience
  - MINIBALL, AGATA, standard Ge





FUNDING BIG SCIENCE PROJECTS IN SWEDEN

- **Swedish Research Council - Council for Research Infrastructures**
  - Government agency
  - Funds CERN, FAIR, ESO etc
  - Representing in above councils + e.g. APPEC
  - Makes national roadmaps, involved in ESFRI
  - New infrastructures/experiments must have broad national backing
  - Scientists review and decide

- **KA Wallenberg Foundation**
  - Private foundation
  - Funds high-profile basic science projects (investment+manpower) for 3-5 years
    - Budget: ~140 M€/a
    - Example: Swedish participation in Xenon 1t (Jan Conrad)
  - Not bound by roadmaps
  - Scientific review, board decides