

# JUROGAM II

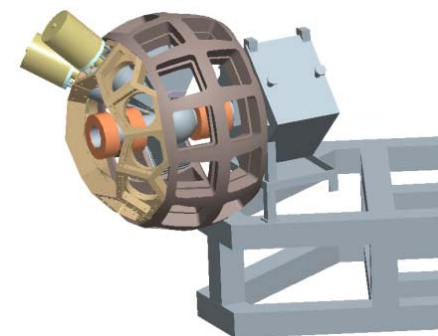
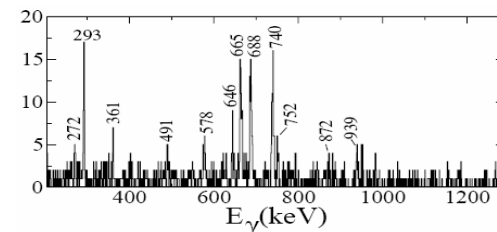
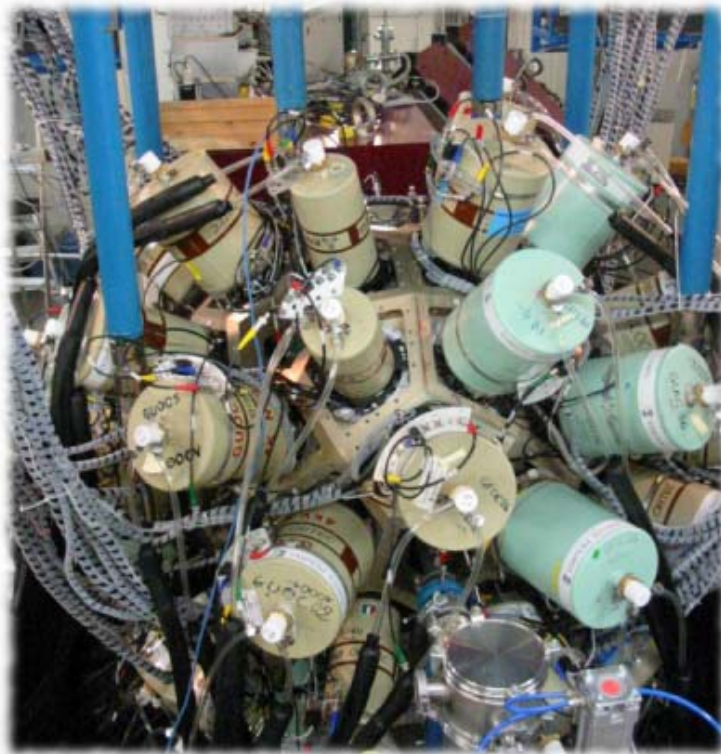
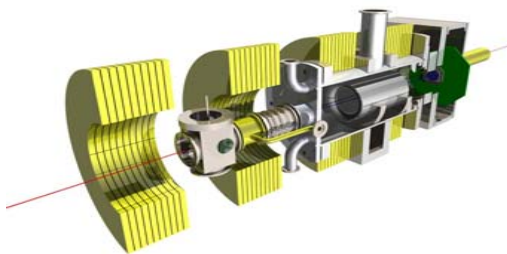
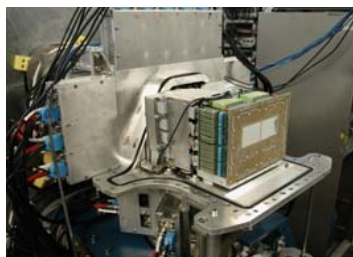
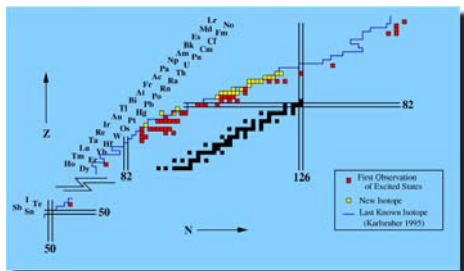
**Pete Jones**  
(JUROGAM project manager)

for JUROGAM / GREAT collaboration

*Department of Physics*  
*University of Jyväskylä, Finland*



# JUROGAM II : Future Spectroscopy



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GAMMAPOOL Workshop 2006  
ECT\*, Trento Italy

8-12 May 2006



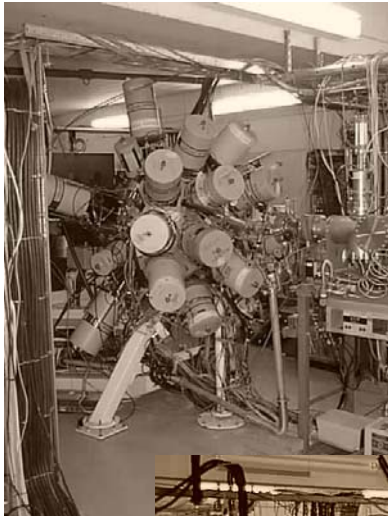
# Contents

- Past & Present
- Experimental methods
  
- JUROGAM Physics
  
- Developments
  
- JUROGAM future



# A brief history : the JUROSPHERE years

1997-2001



PHYSICAL REVIEW C

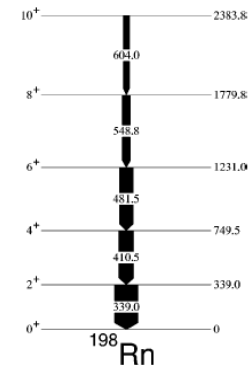
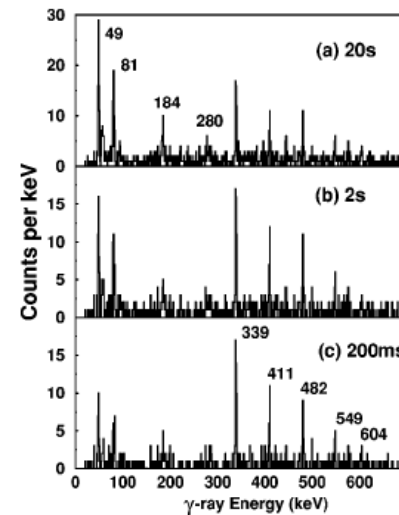
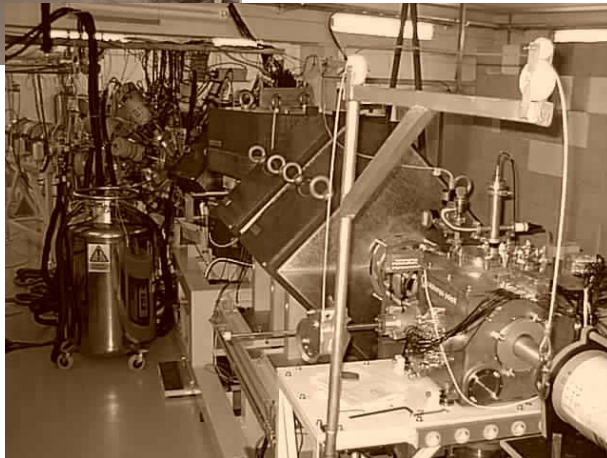
VOLUME 59, NUMBER 2

FEBRUARY 1999

$\gamma$  decay of excited states in  $^{198}\text{Rn}$  identified using correlated radioactive decay

R. B. E. Taylor, S. J. Freeman, J. L. Durell, M. J. Leddy, S. D. Robinson, and B. J. Varley  
*Schuster Laboratory, University of Manchester, Manchester M13 9PL, United Kingdom*

$$\epsilon_{\text{ph}} = 1.7\%$$



$$\sigma = 200\text{nb}$$



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# The Present : JUROGAM

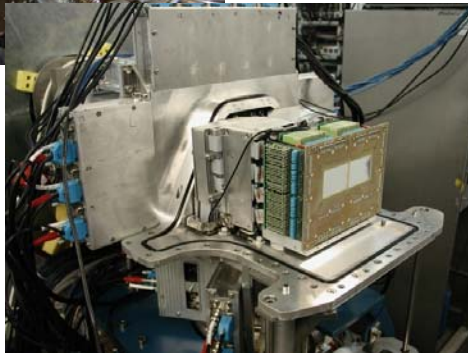
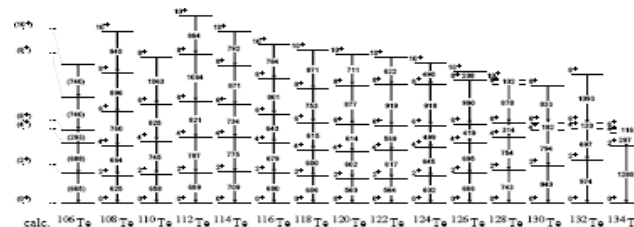
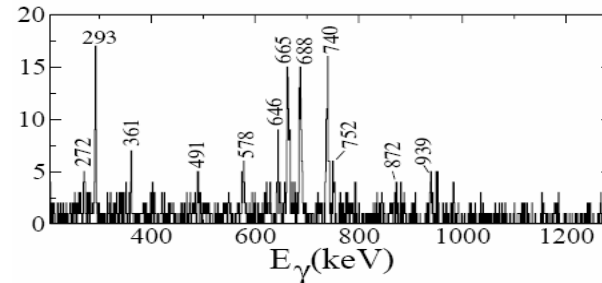
## 2003-2007

PHYSICAL REVIEW C 72, 041303(R) (2005)

First identification of excited states in  $^{106}\text{Te}$  and evidence for isoscalar-enhanced vibrational collectivity

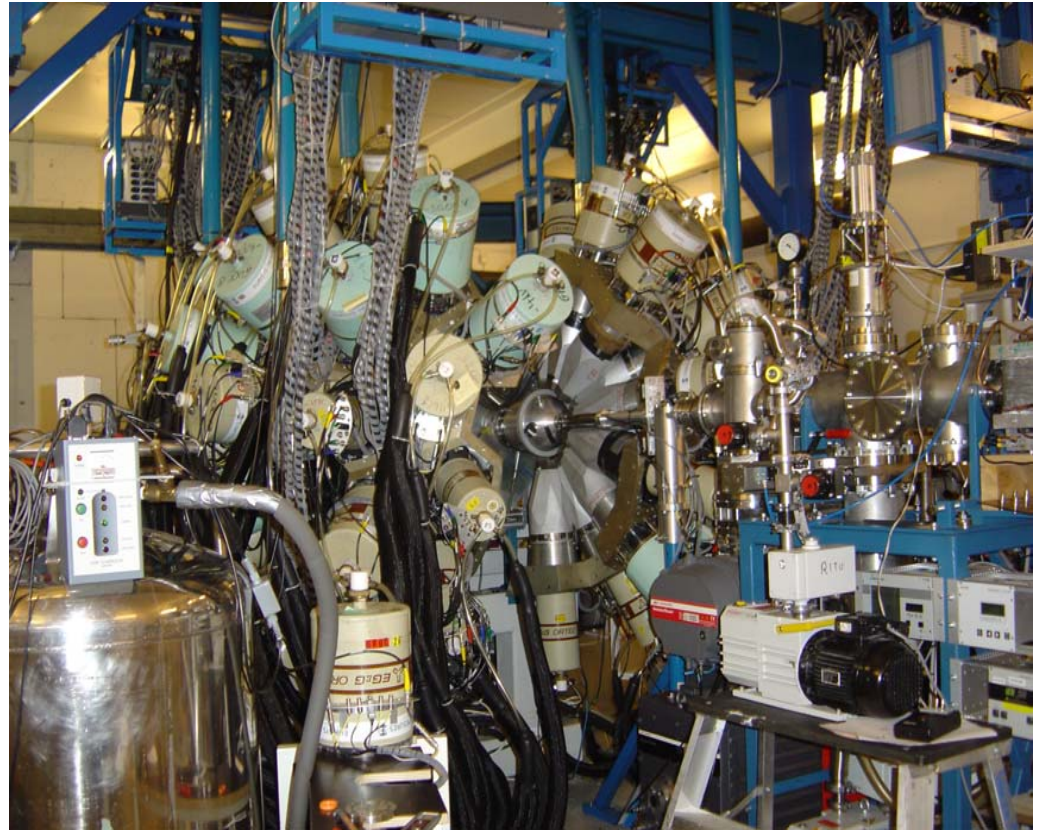
B. Hadinia,<sup>1,\*</sup> B. Cederwall,<sup>1</sup> J. Blomqvist,<sup>1</sup> E. Ganioglu,<sup>1,7</sup> P. T. Greenlees,<sup>2</sup> K. Andgren,<sup>1</sup> I. G. Darby,<sup>2,3</sup> S. Eeckhaud,<sup>2</sup> E. Ideguchi,<sup>4</sup> P. M. Jones,<sup>2</sup> D. T. Joss,<sup>5</sup> R. Julin,<sup>2</sup> S. Juutinen,<sup>2</sup> S. Ketelhut,<sup>2,†</sup> K. Lagergren,<sup>1,‡</sup> A.-P. Leppänen,<sup>2</sup> M. Leino,<sup>2</sup> M. Nyman,<sup>2</sup> J. Pakarinen,<sup>2</sup> E. S. Paul,<sup>3</sup> M. Petri,<sup>3</sup> P. Rauhila,<sup>2</sup> M. Sandzelius,<sup>1,2</sup> J. Sarén,<sup>2</sup> C. Scholey,<sup>2</sup> J. Uusitalo,<sup>2</sup> R. Wadsworth,<sup>6</sup> and R. Wyss<sup>1</sup>

$$\epsilon_{\text{ph}} = 4.2\%$$

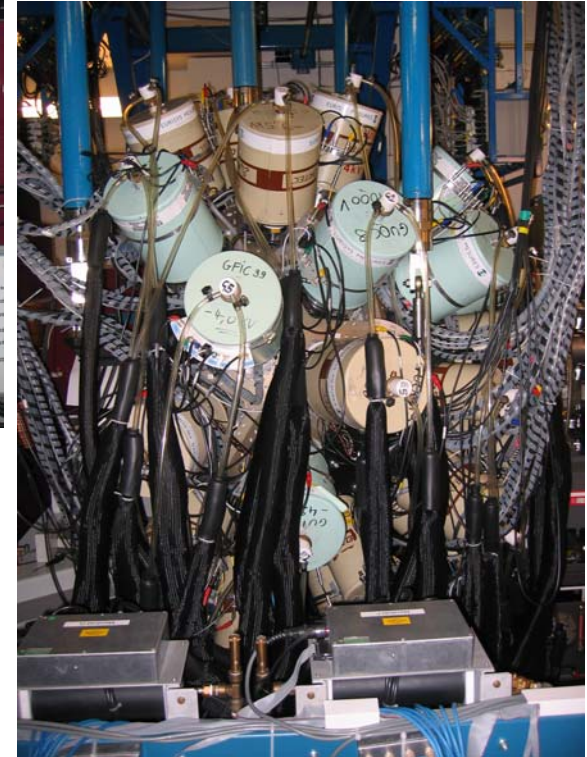
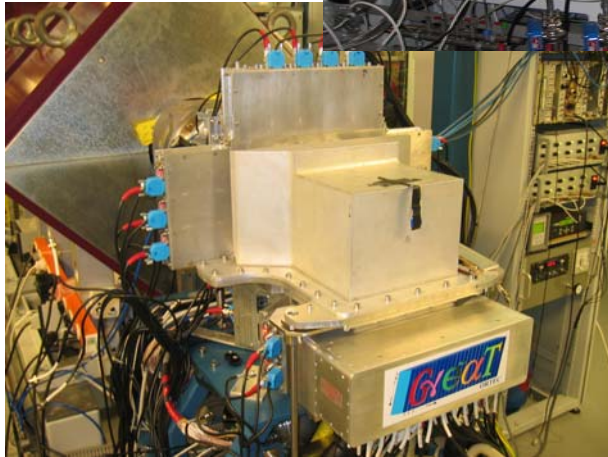


# JUROGAM

- 43 Anti-Compton suppressed HP-Ge detectors ( $E = 4.2\% / 1.3 \text{ MeV}$ )
- JYFL "Host Laboratory" for ex-EUROBALL detectors 2003-2007
- Comprises of all EB Phase I + GASP detectors.
- UK-France loan pool completes the array



# How to do what we do...



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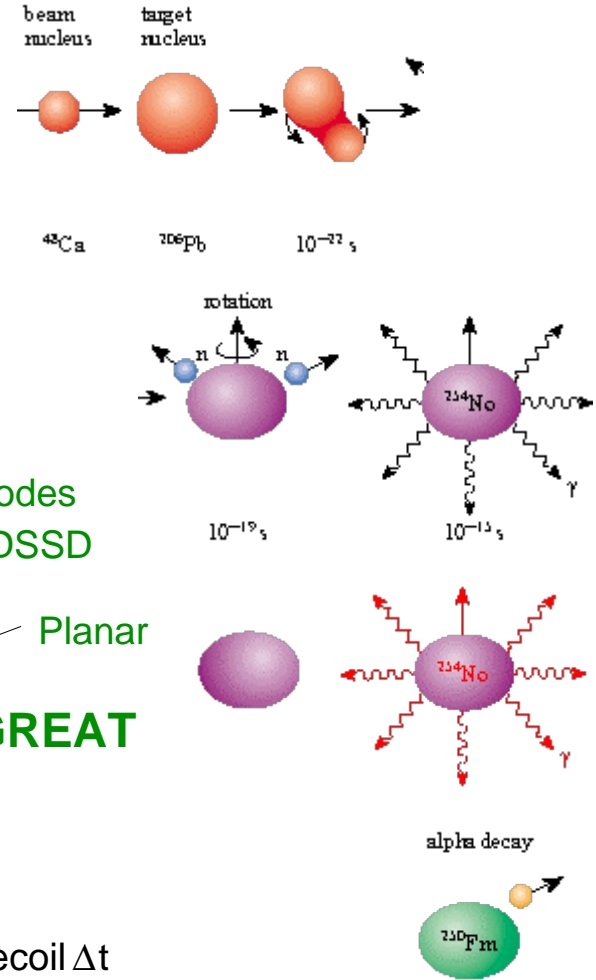
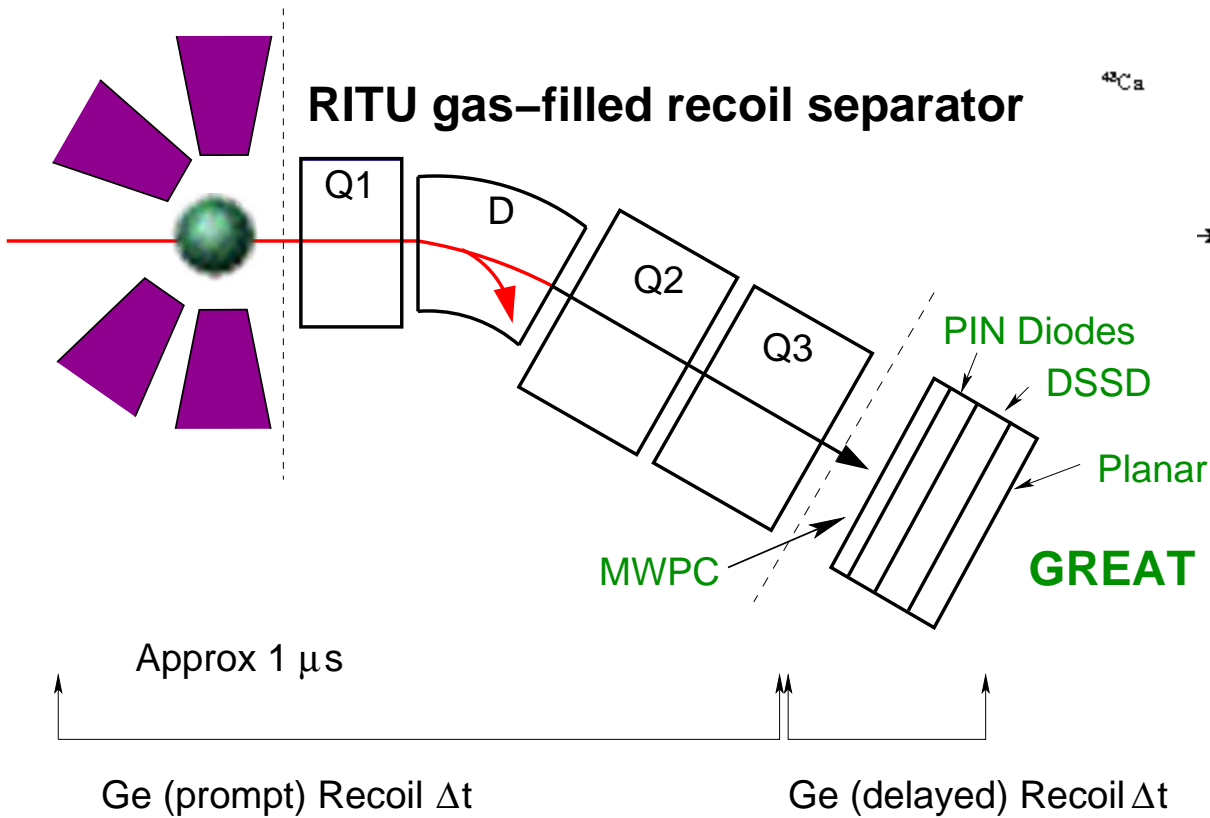
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# “Complete Spectroscopy”

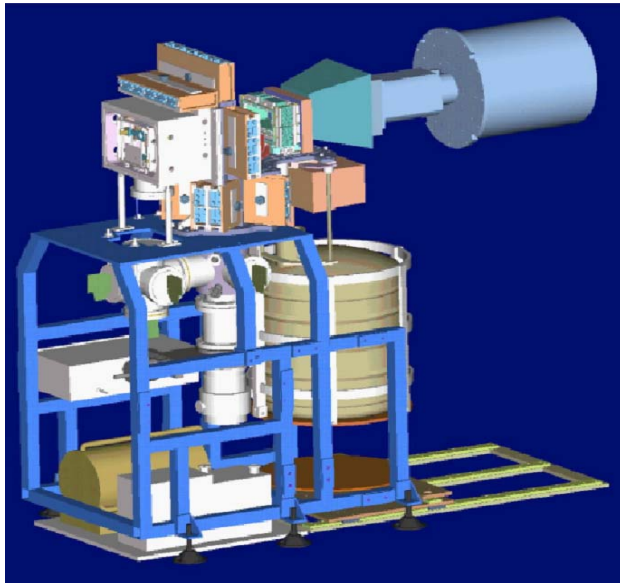
## Jurogam Array





# Tools of the Trade

- 2 x 60mm x 40mm DSSD
- 28 x 40mm x 40mm PIN Diodes
- 24 x 12 Segmented Planar Ge
- Compton-Suppressed Segmented Ge Clover
- Position-Sensitive MWPC
- Triggerless Data Acquisition System
- 100 MHz common clock
- 10 ns resolution
- 380+ channels timestamped



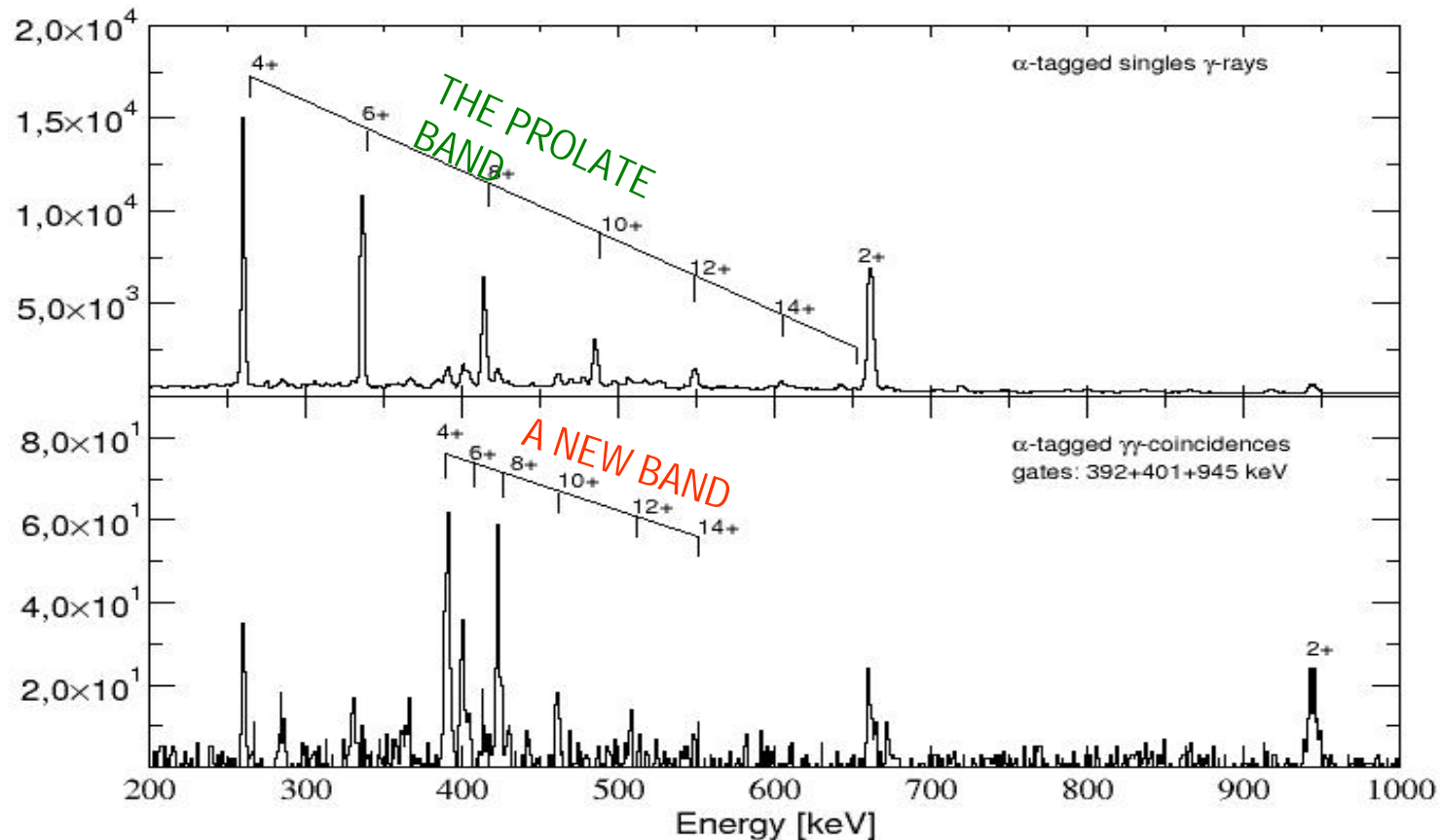
# JUROGAM Physics Programme and Methodology

- Multiple Shape Coexistence
- Spectroscopy of Heavy Nuclei
- Study of Nuclei Near Proton Drip Line
- Study of Isomeric States
- Lifetime measurements
- Beta-Decay Tagging
- Study of Octupole Deformation



# RDT experiment for $^{186}\text{Pb}$ with JUROGAM+RITU+GREAT

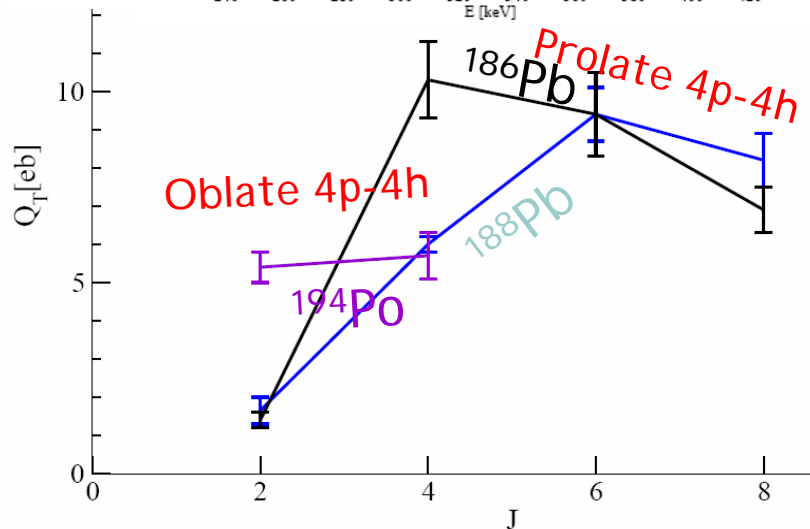
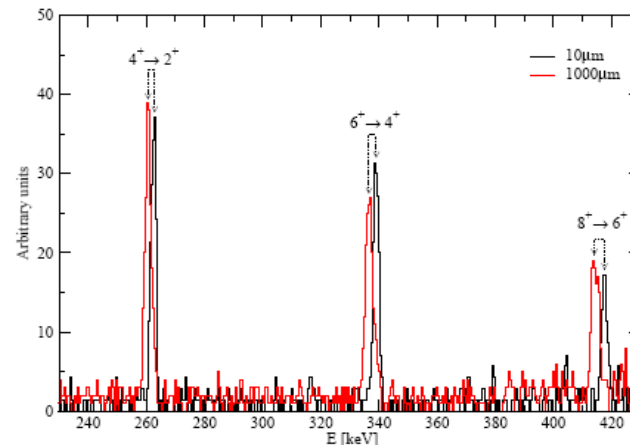
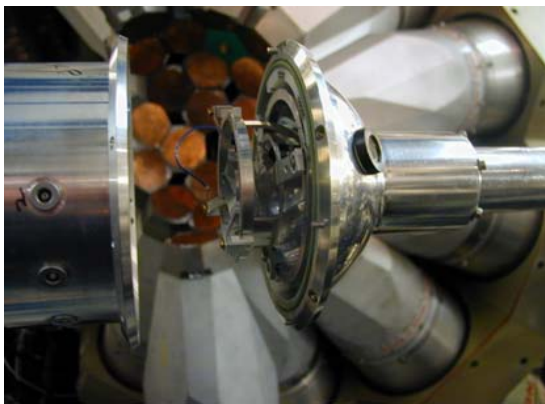
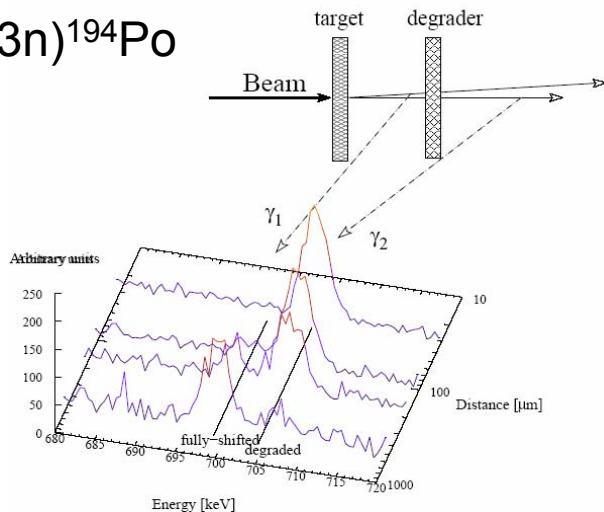
$^{106}\text{Pd}(^{83}\text{Kr},3n)^{186}\text{Pb}$



# Differential-Plunger-Lifetime measurements by using RDT for intruder bands in very neutron deficient $^{186,188}\text{Pb}$ and $^{194}\text{Po}$

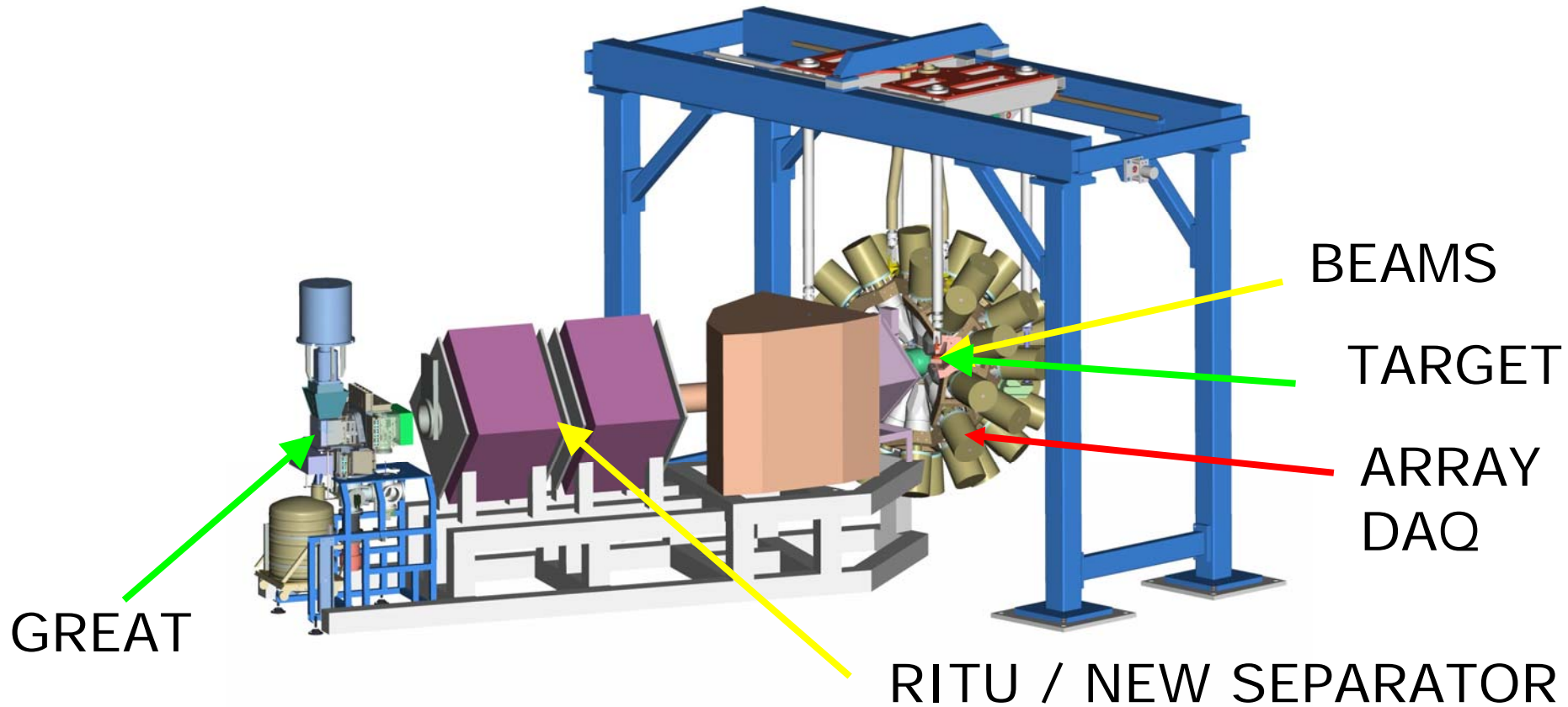
## Differential plunger inside JUROGAM

$^{114}\text{Cd}(^{83}\text{Kr},3n)^{194}\text{Po}$





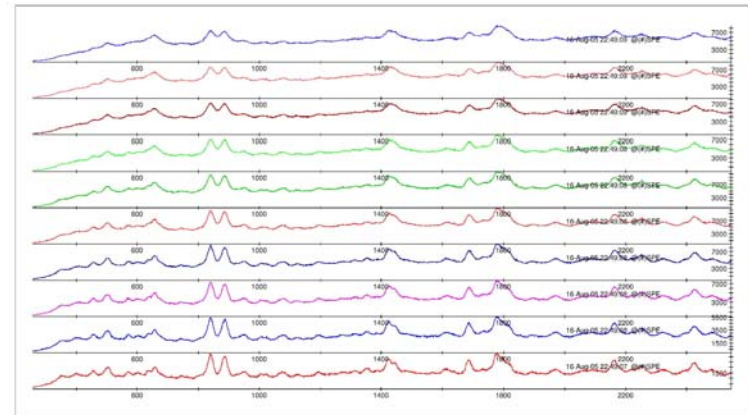
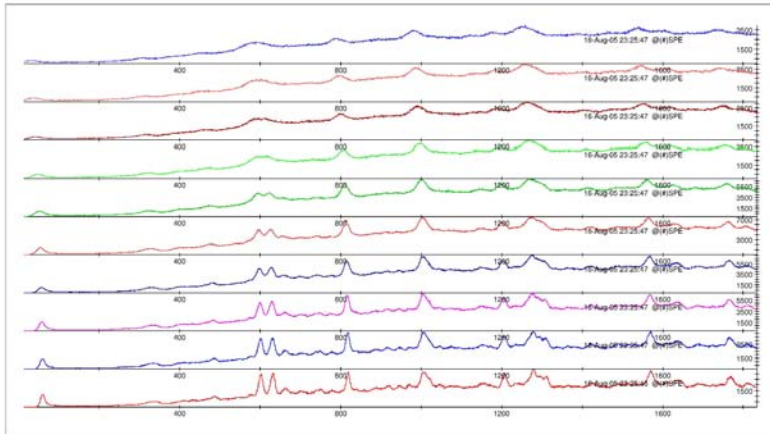
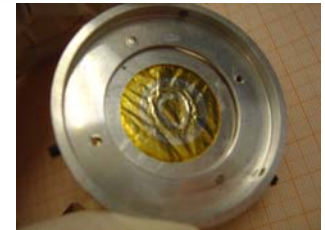
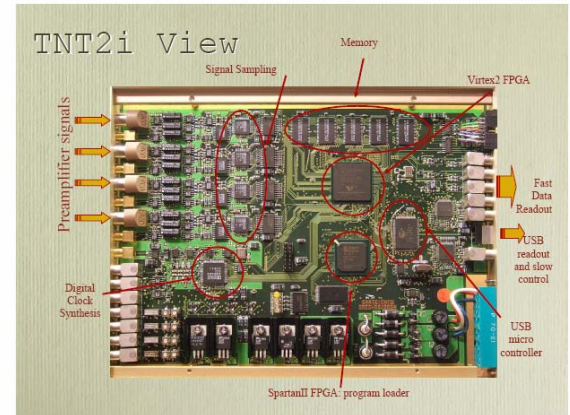
# The next step...



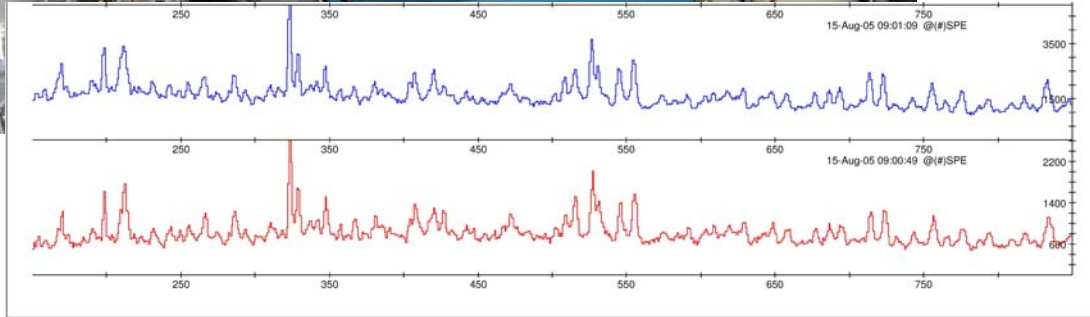
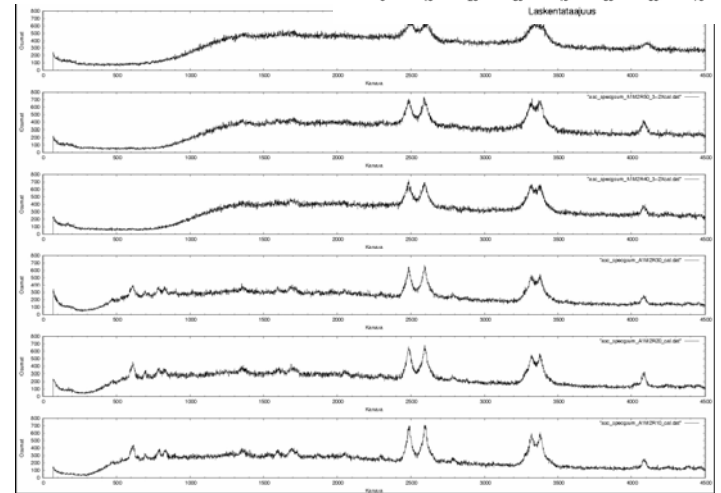
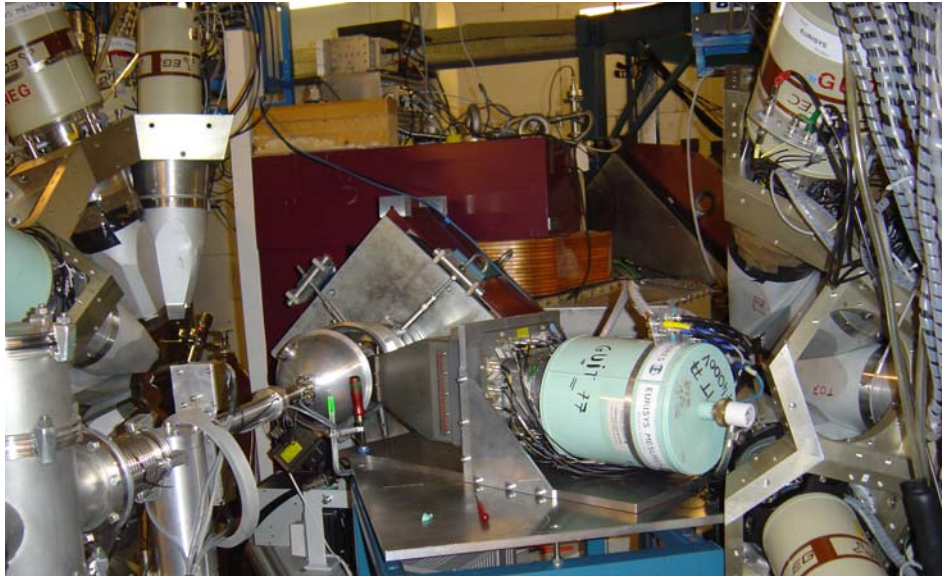
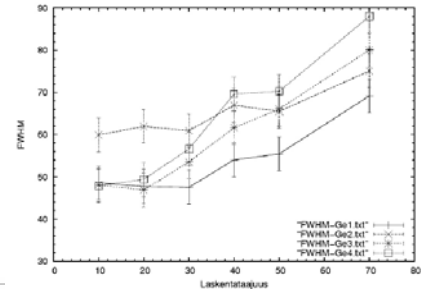
# Digital Electronics...

- Idea : Test both analogue and digital electronics in *real* situation
- Test effects of counting rates
- Performance more realistic than with sources (multiplicity)
- Idea of what kind of gamma-ray array need would be for the future

- $^{107,109}\text{Ag}(^{36}\text{Ar}, 2p2n)^{139}\text{Eu}$
- 160MeV  $\beta \sim 2.5\%$
- $I_b = 5 - 50 \text{ pA}$
- Ge count rate 10-100kHz
- RITU Gas counter 1-10kHz



# Count Rate & Efficiency...



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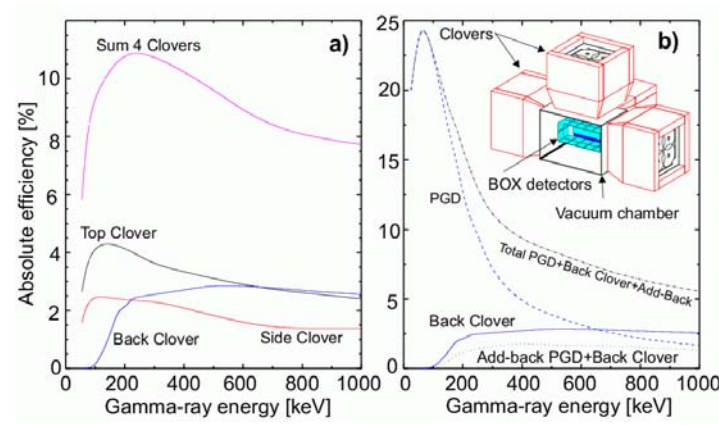
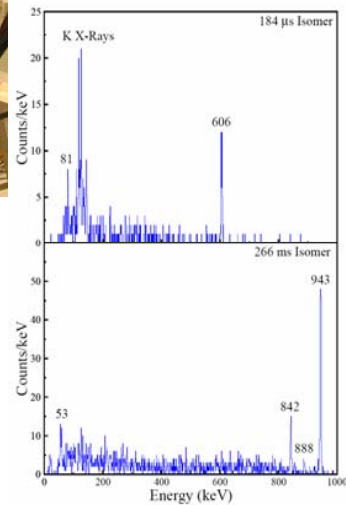
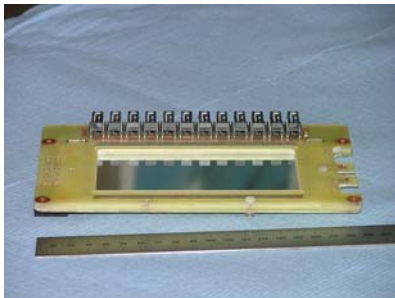
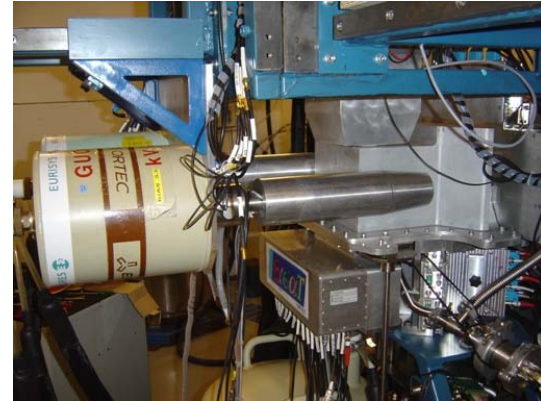
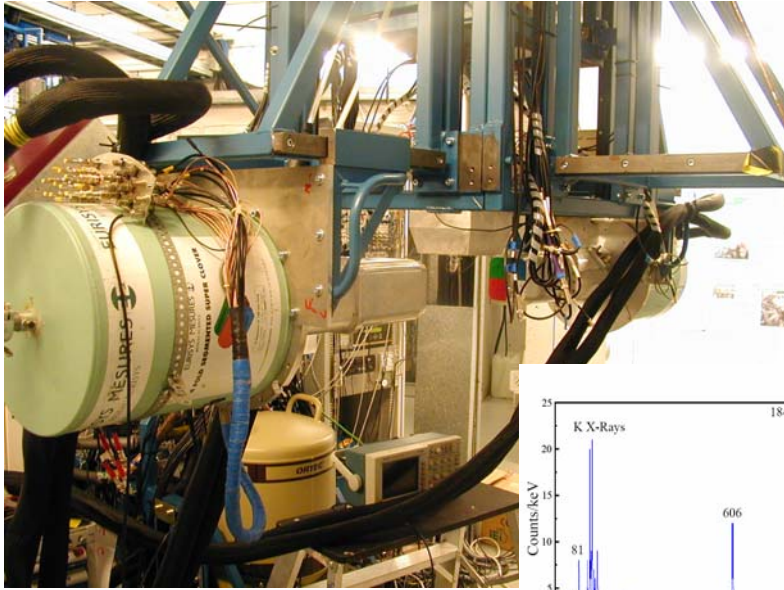
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# Focal Plane Upgrades



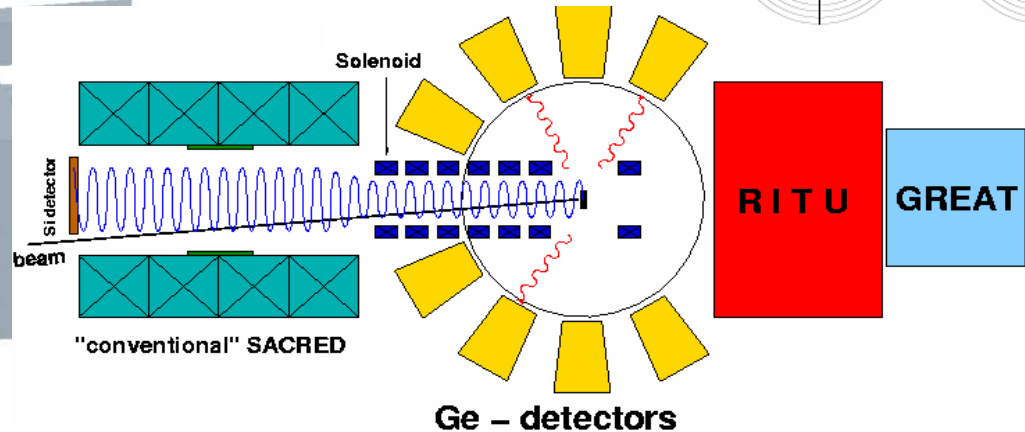
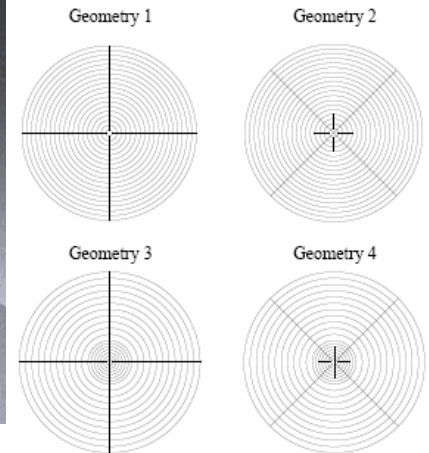
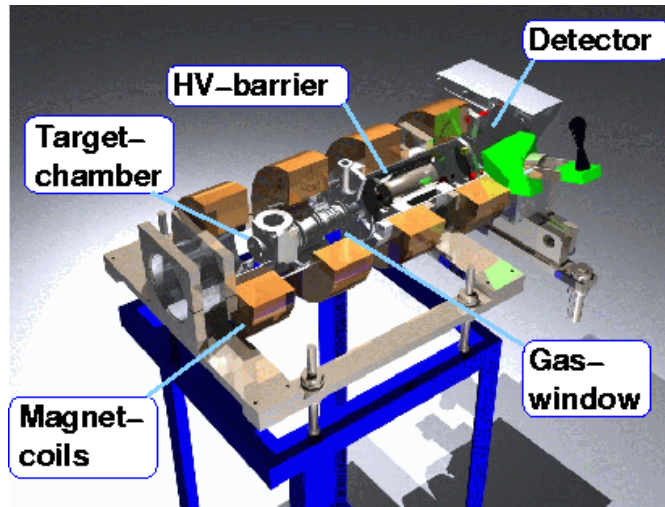
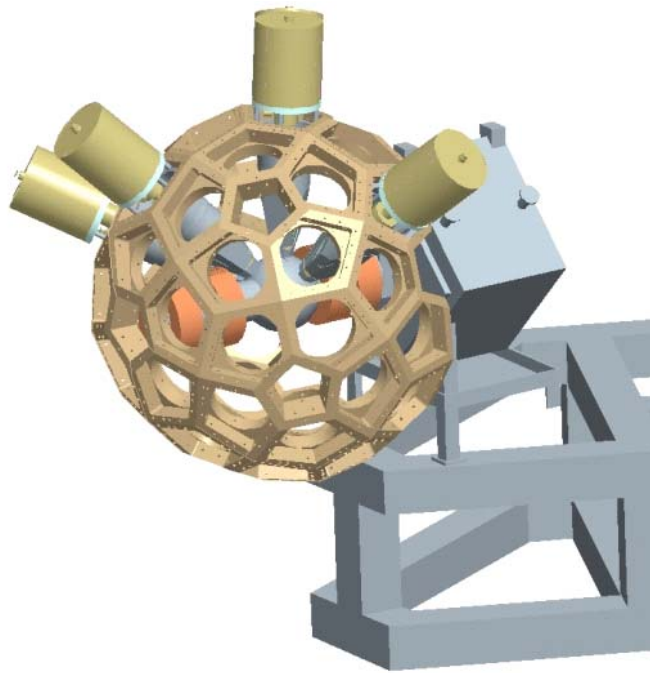
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# SAGE : 2007



## ➤ Simultaneous Gamma and CE studies



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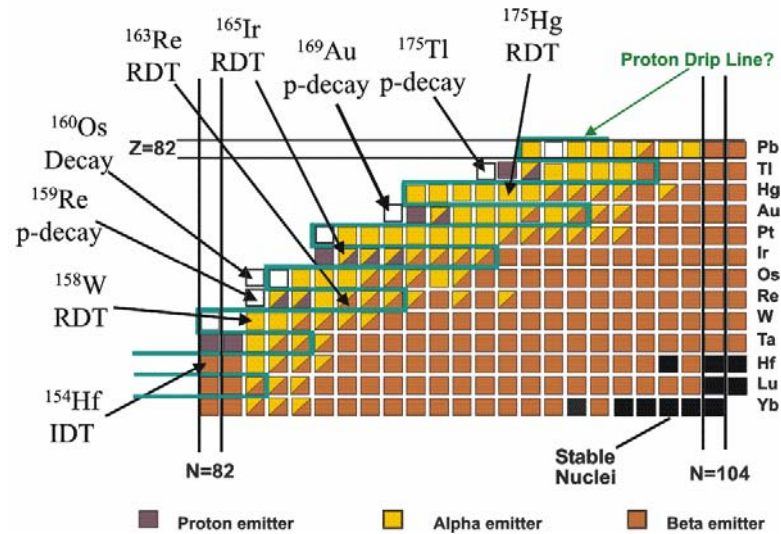
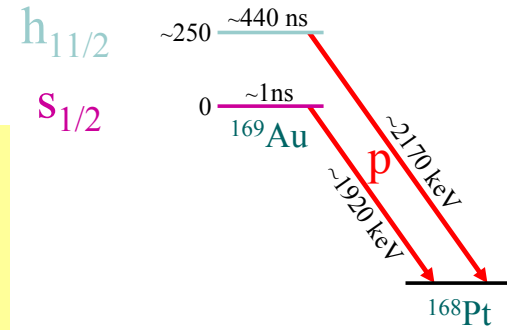
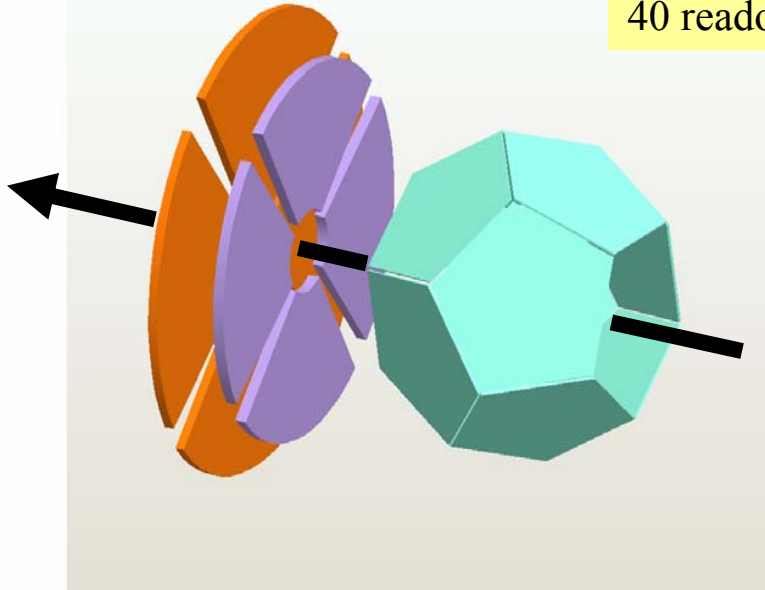
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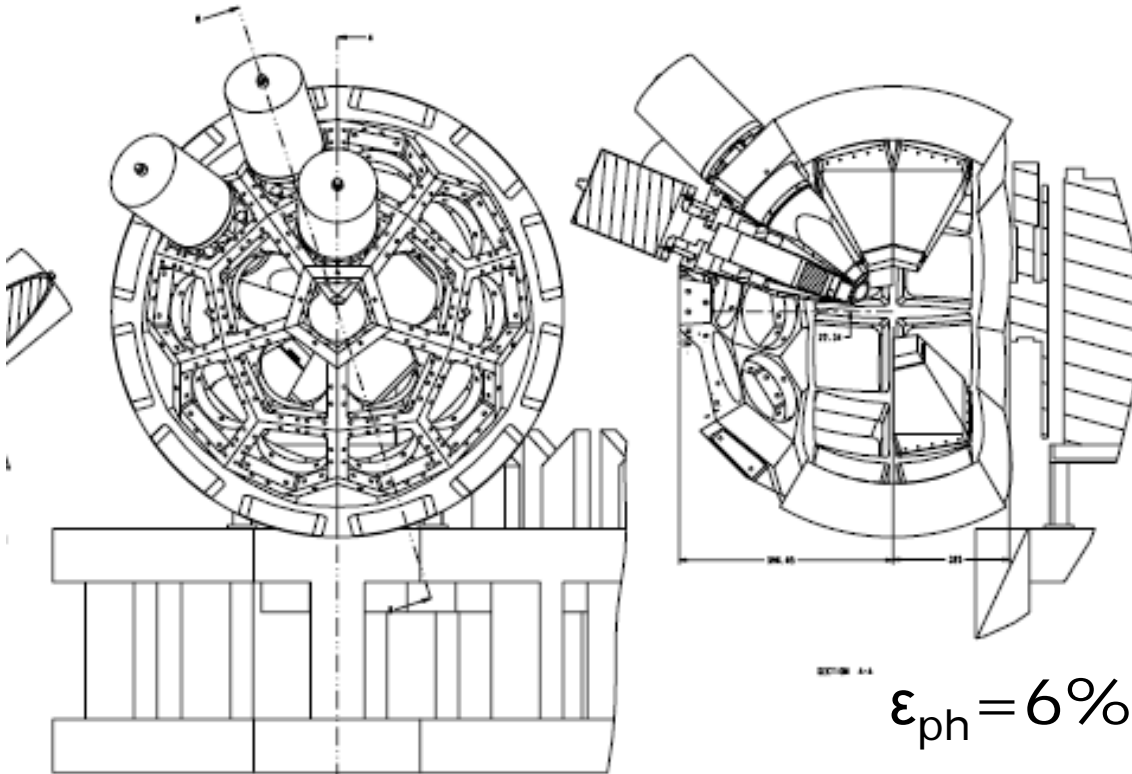
# LISA : 2007

$\Delta E$ -E telescopes  
 Single element pentagons  
 Single element E quadrants  
 16  $\Delta E$  rings  
 40 readout channels

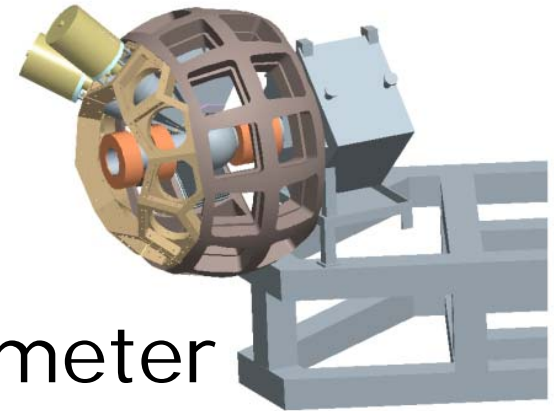
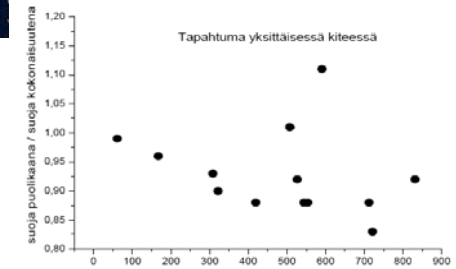
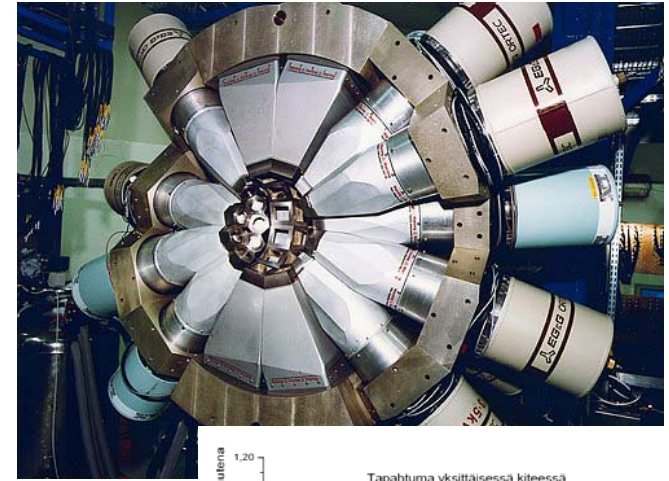


## Fast charged particle decay modes for tagging

# JUROGAM II : 2008



$$\epsilon_{ph} = 6\%$$



➤ Efficient and versatile spectrometer



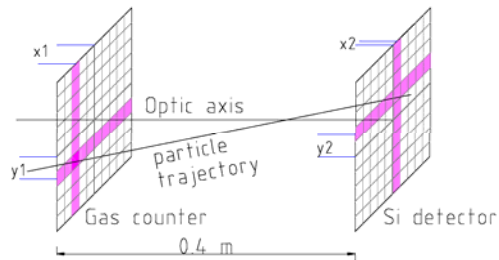
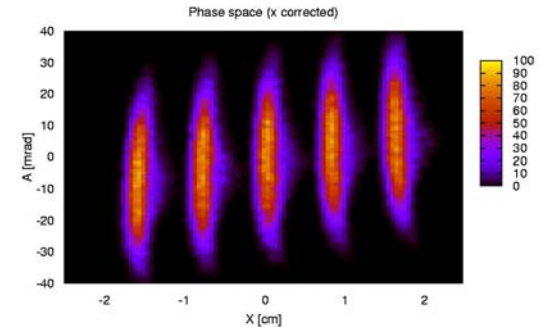
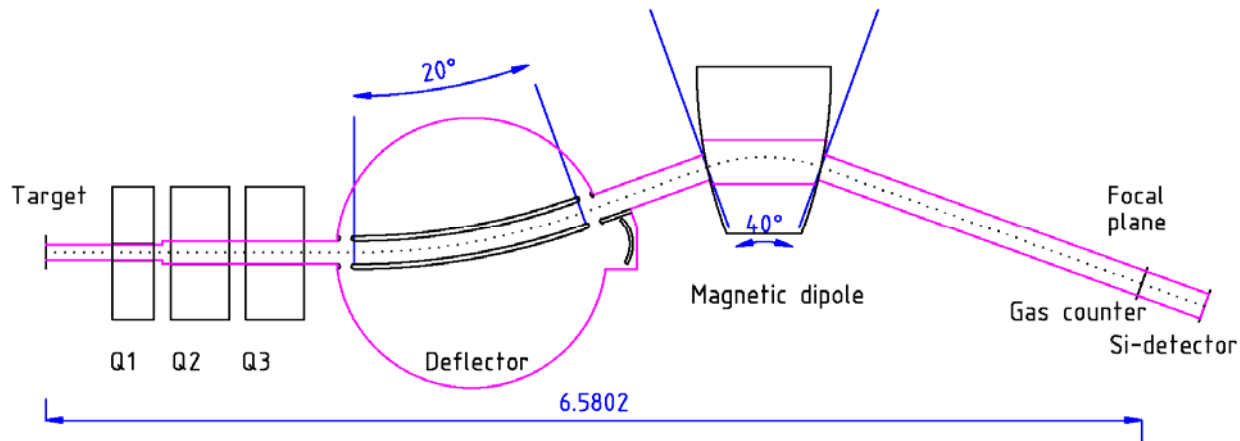
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# New JYFL Vacuum Separator



**What kind of research work can be done were the RITU separator is not feasible:**

**Probing the  $N \approx Z$  line up to  $^{112}\text{Ba}$**

- decay spectroscopy (proton and  $\alpha$ -particle decay) at the  $^{100}\text{Sn}$  region
- rp-process
- proton-neutron pairing interaction
- mirror nuclei
- o study of isospin symmetry breaking
- o proton skins ( $N < Z$  nuclei)
- superdeformation and hyperdeformation ( $N \approx Z \approx 40$ )

## ➤ Vacuum mode complementary to RITU

# Future Horizons



- JUROGAM
- SAGE & LISA exploitation 2007+
- Digital Instrumentation
- JUROGAM II 2008 : *A Versatile Array*
- Future Advances

