

Testing of the SHIP focal plane Detector system: Preliminary Measurements

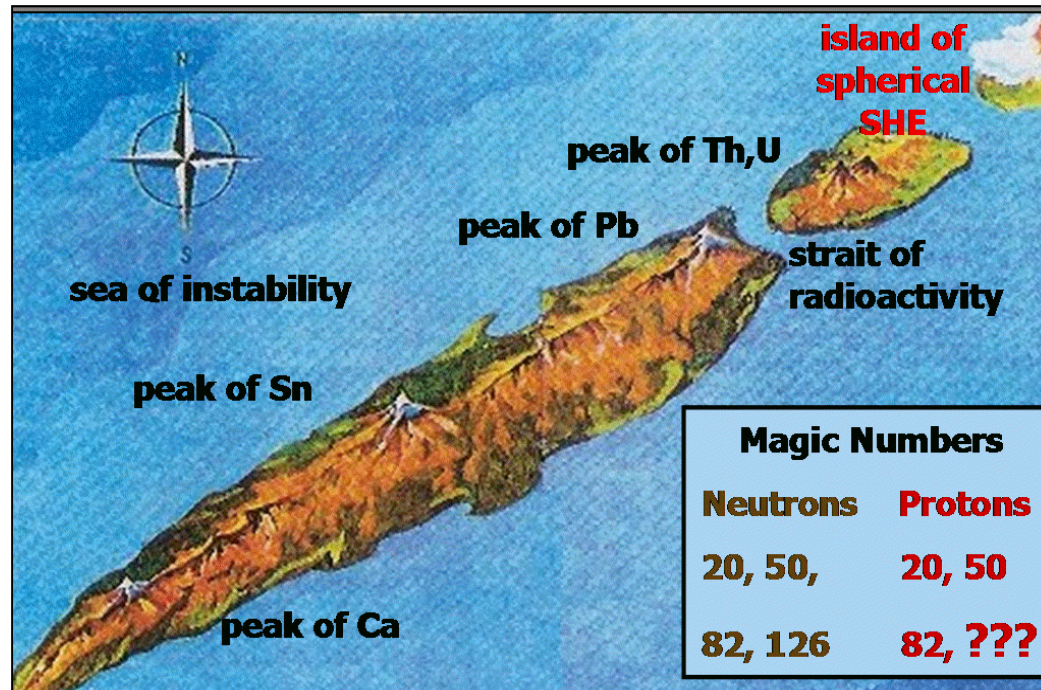
Andrew Mistry
HIM

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Motivation: Superheavy Elements

- Nuclear structure features of superheavy nuclei (decay spectroscopy)
 - quasi-particle excitations → deformation/K-isomers
 - single particle levels – trends towards the next closed p- and n-shell
 - X-ray Z-identification



“MoDSS” (Mobile Decay Spectroscopy Set-up)

configuration

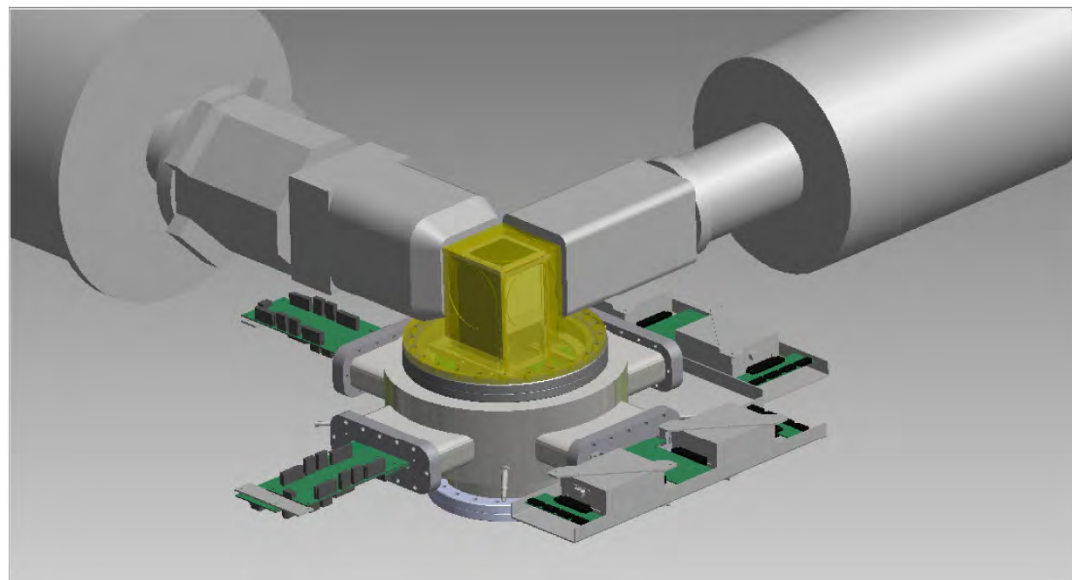
- *stop detector:* 1 × DSSD (60×60 strips)
- *box detectors:* 4 × SSSD (32 strips)

chamber

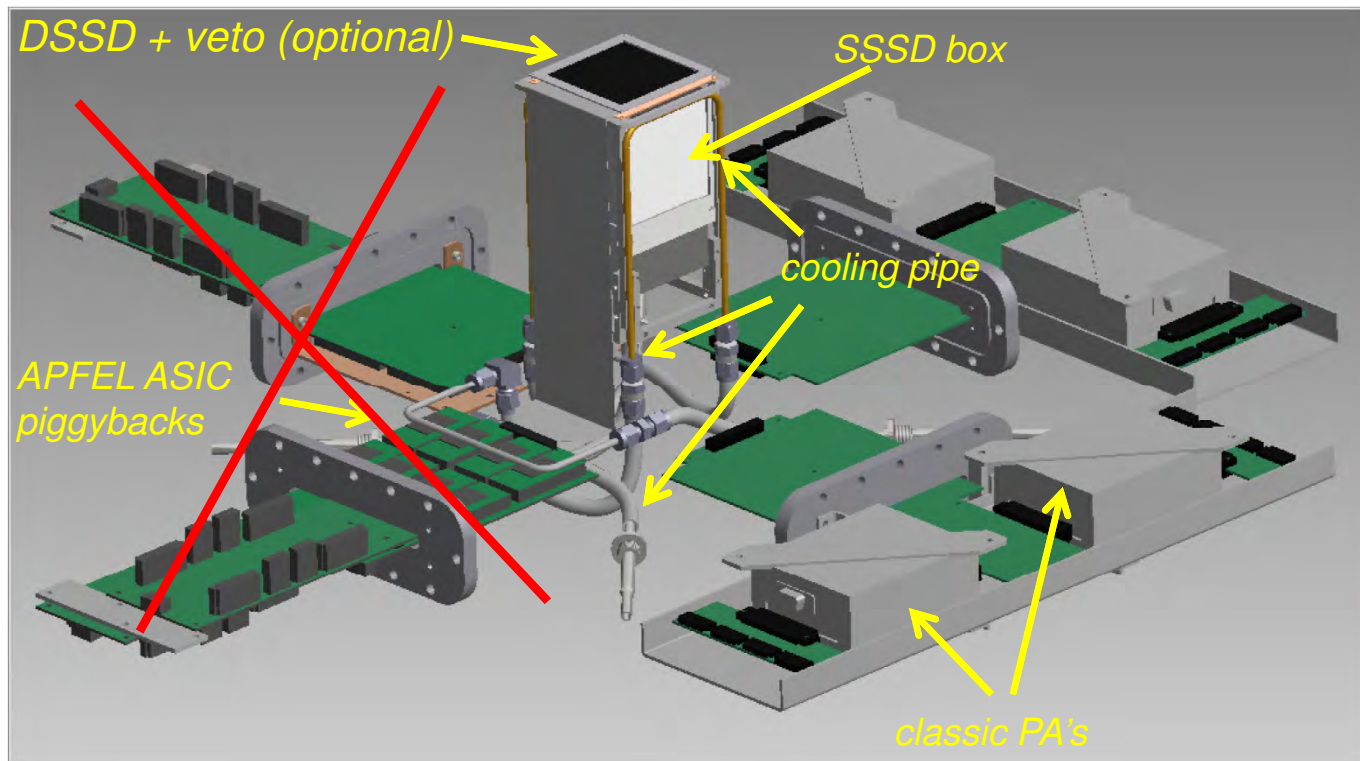
- *compact (overall length 35 cm)*
- *Al-cap with thin γ window (1,5 mm)*
- *compatible due to 150 mm standard flange*
- *electronics partly integrated (vacuum)*

DSSD

- *integrated cooling (Cu-frame) and connection (flex-PCB)*
- *60×60 strips/mm (pitch 1 mm)*
- *300 μ m*



Courtesy of D. Ackermann



Electronics and read-out

2 read out options:

1. classic PA

- PCB vacuum feed through
- 2×32 channels
- differential output

2. ASIC APFEL (fast shaping and amplification)

- integrated in PCB vacuum feed through
- cooled
- 64 input channels (8 piggybacks)
- 2 amplification factors
 - 1
 - 16/32 switchable
- differential output

In total max. 256 channels

MBS architecture

- local server + mass storage (standalone)

• 2 MBS branches

1. RIO power PC/VME

- analog shaping and amplification (Mesytech STM16+)
- 32-fold 12bit ADCS (Mesytec MADC, CAEN V785)

2. FEBEX + MBS-Linux PC

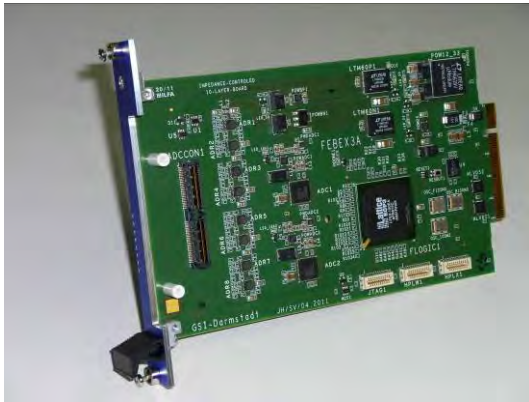
- 1 FEBEX frame – 198 channels

- event builder

FEBEX Readout

This Experiment

- Front End Board with optical link Extension version: FEBEX 3B
 - 16 channels
 - 60 MHz
 - 14 bit flash ADC
 - Onboard FPGA trapezoid filter
- FEBEX + conventional PA
- fast timing
- (almost) deadtime free
- pulse shape analysis options

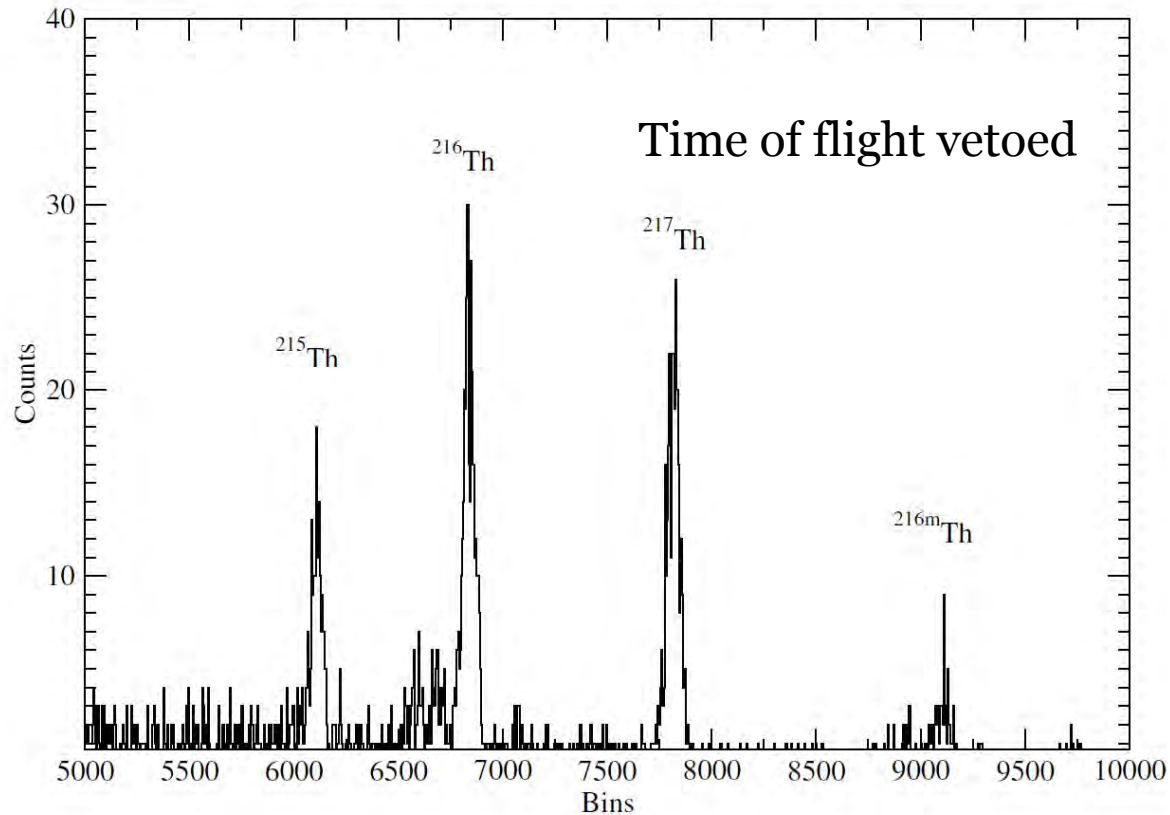


Previous measurements with MoDSS

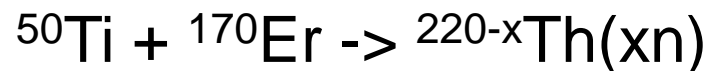
- Employed at GANIL in Nov 2014 for test run with the **LISE** separator
- $^{50}\text{Ti} + ^{209}\text{Bi} \rightarrow ^{257}\text{Db}(2n)$ in March 2015
- Analysis ongoing

Previous measurements with MoDSS

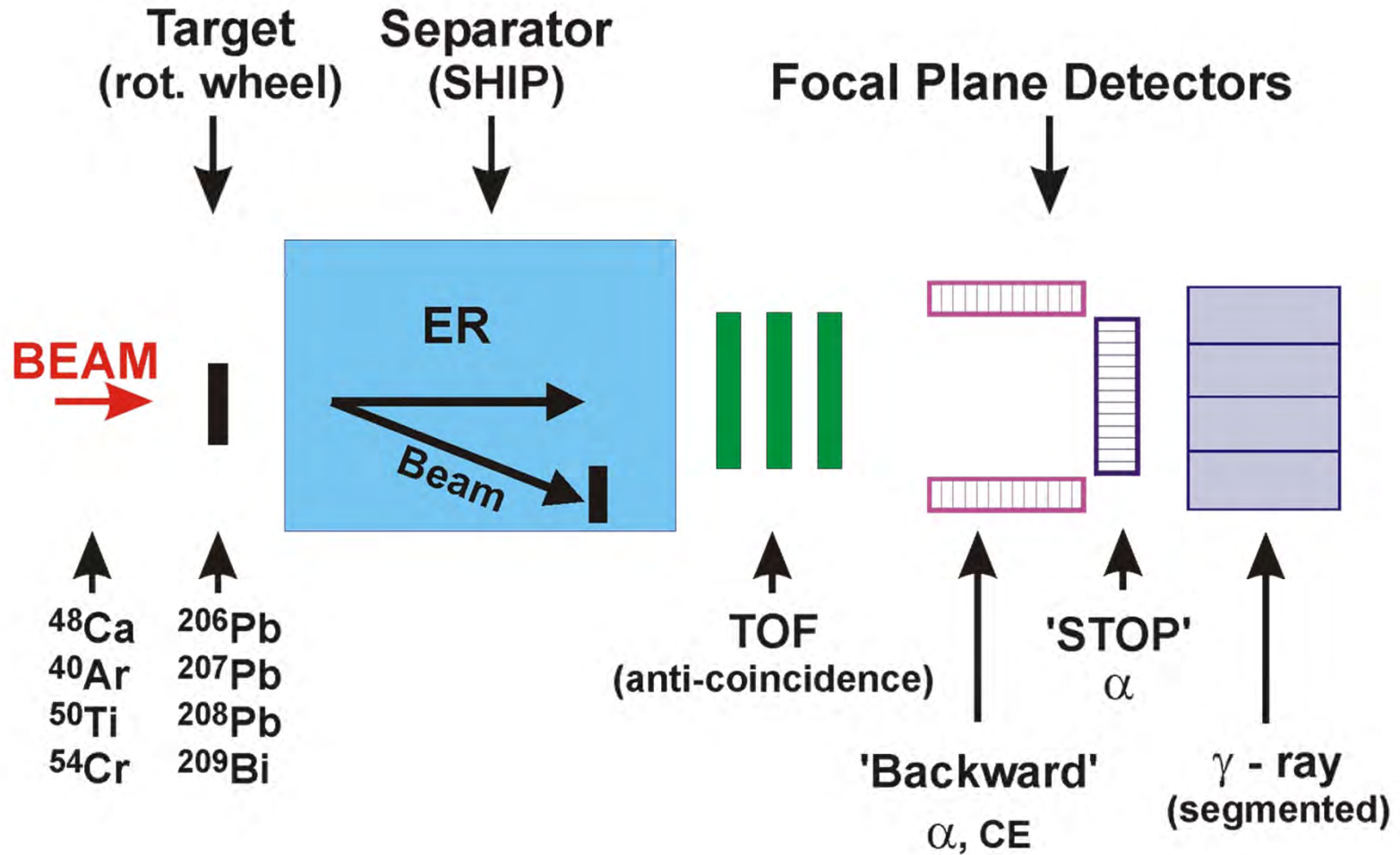
DSSD Y Strip 24 Th



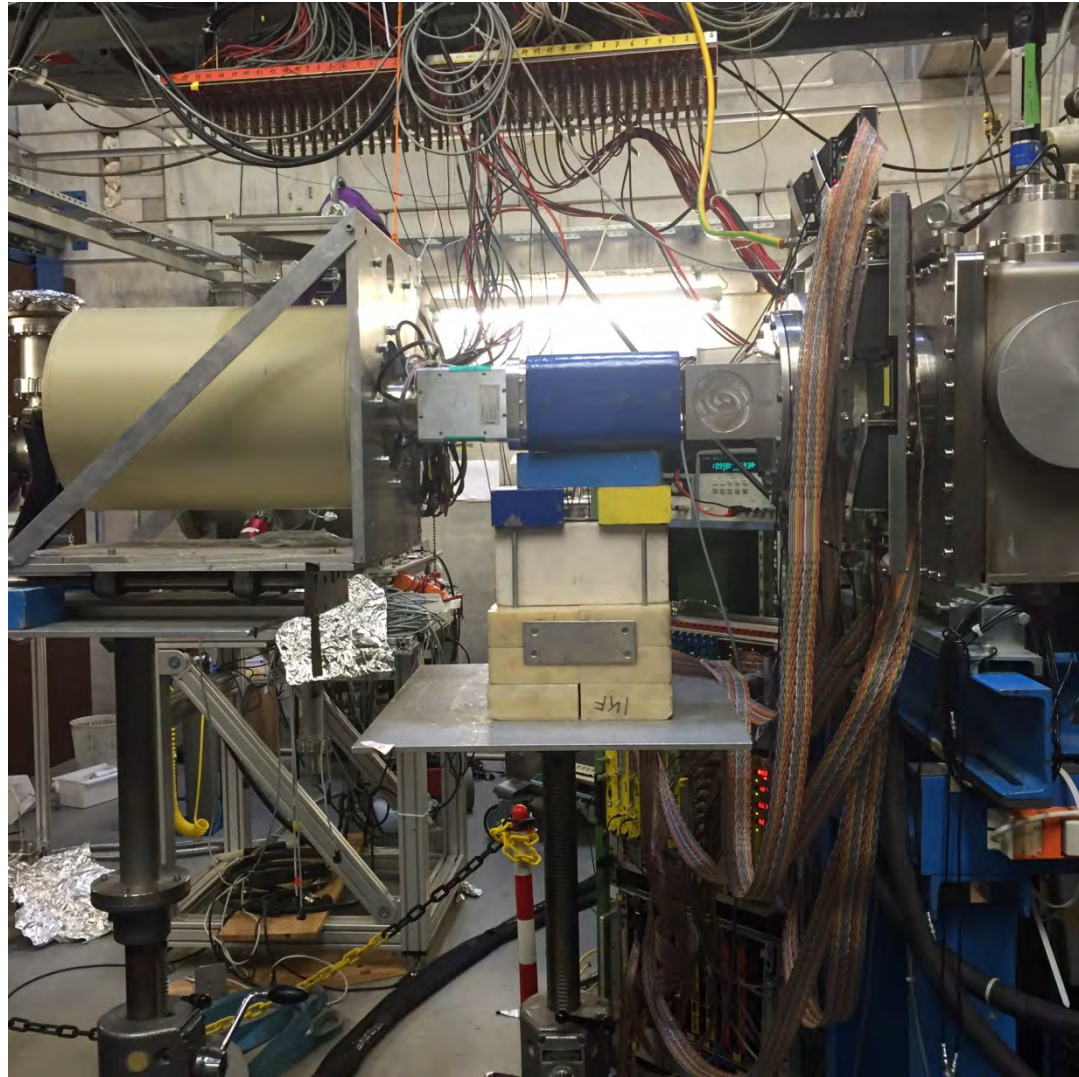
GANIL 2015



Setup at SHIP

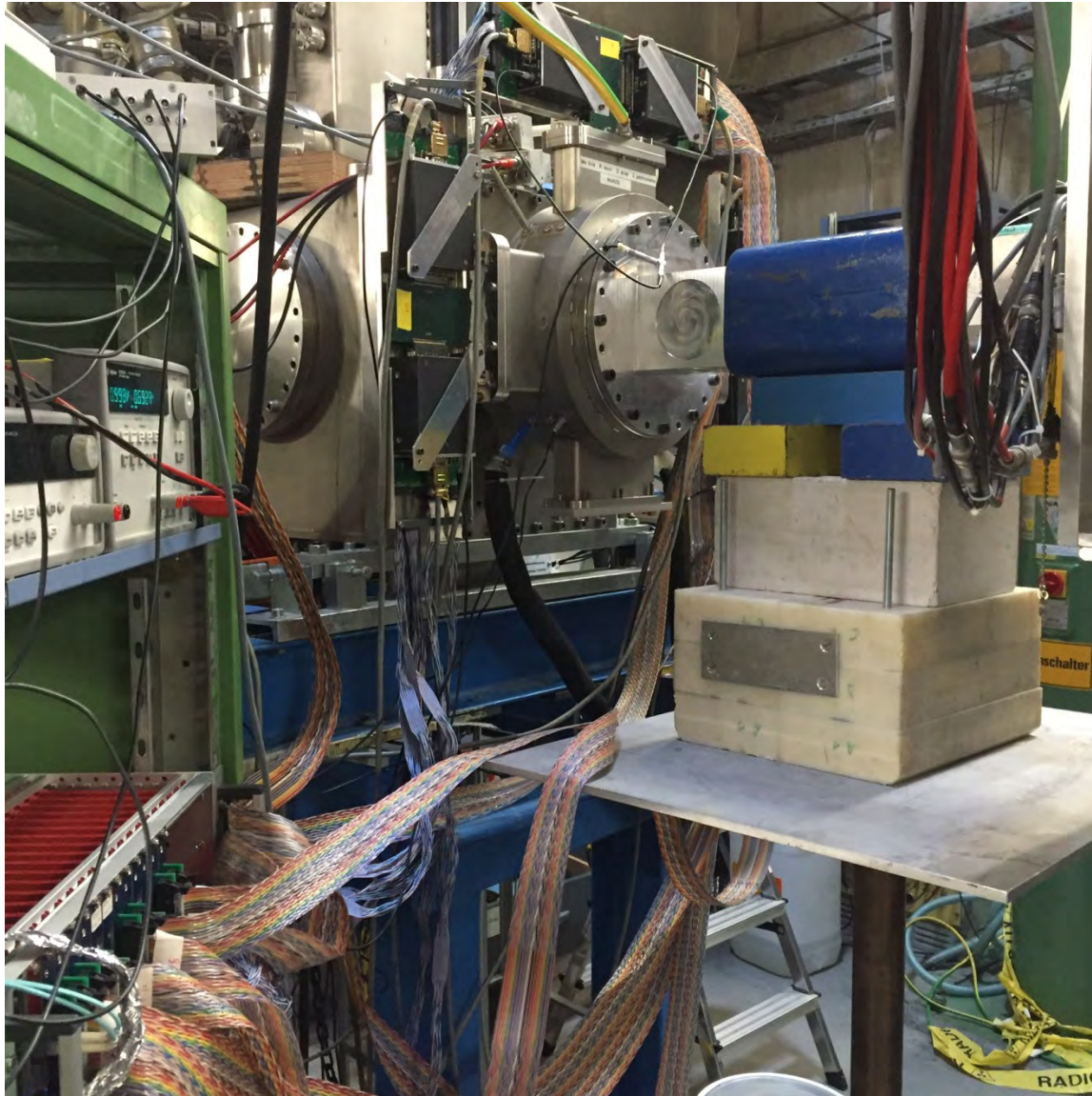


Setup at SHIP



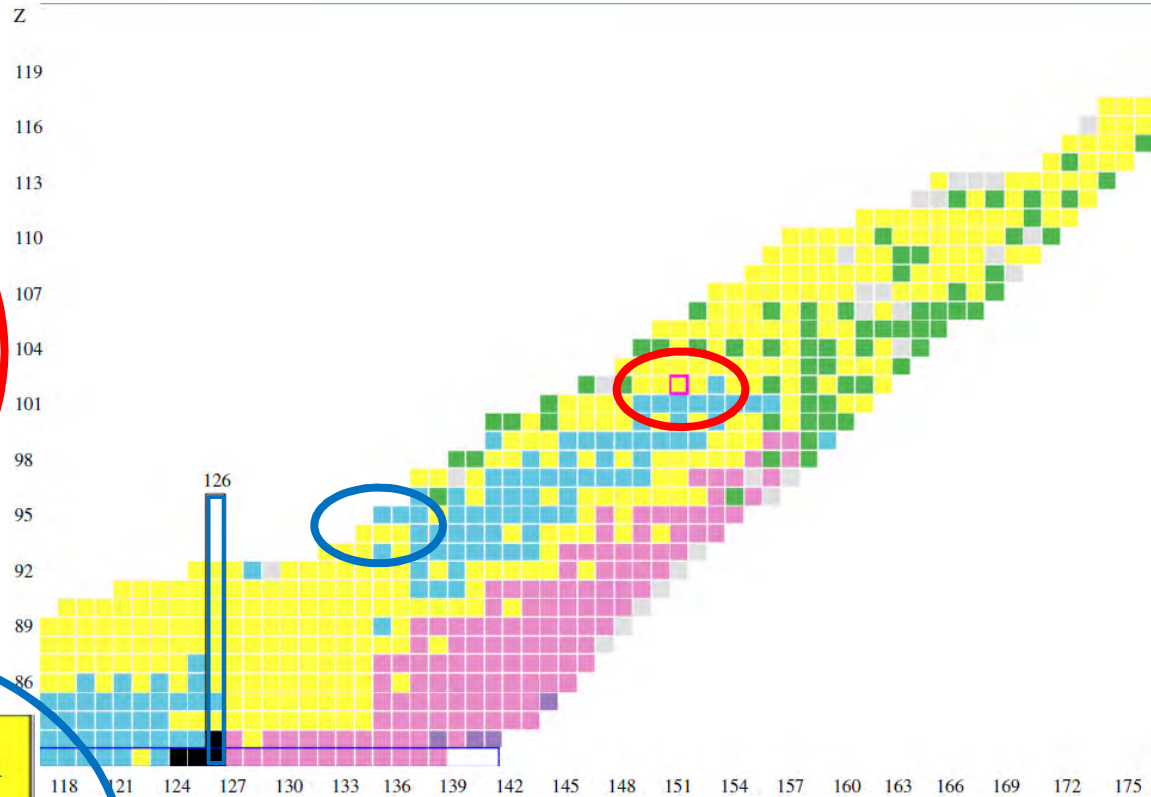
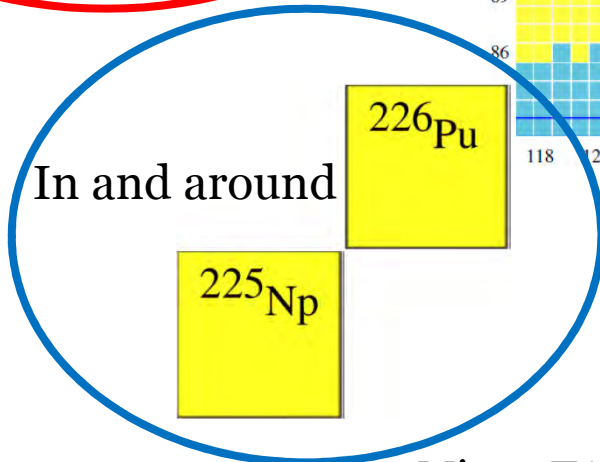
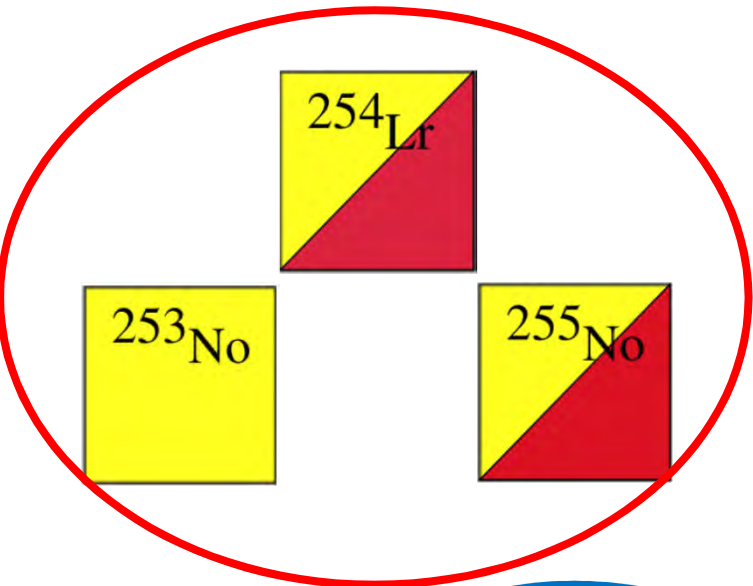
Andrew Mistry TASCA Workshop, Oct 2015

Setup at SHIP



Andrew Mistry TASCA Workshop, Oct 2015

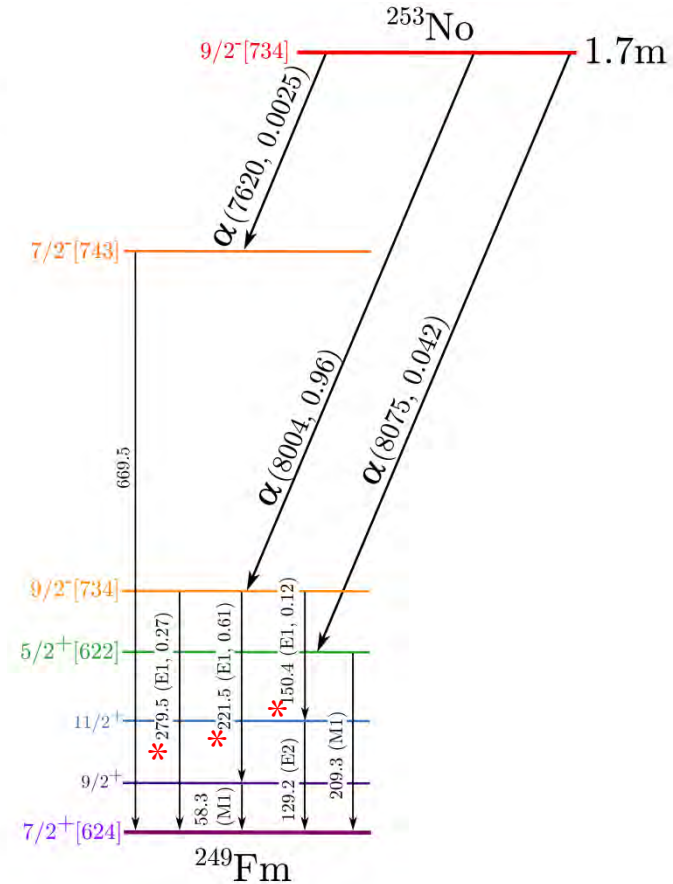
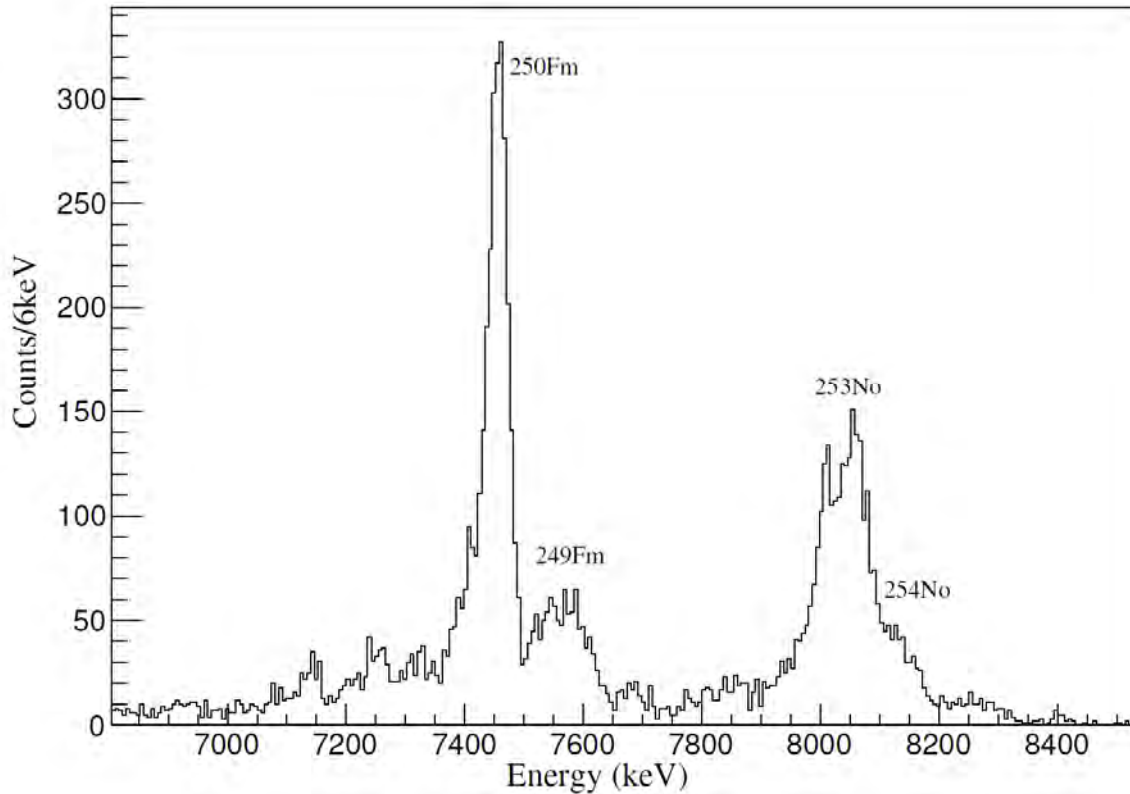
Areas of exploration during the test run



All measurements preliminarily!!!

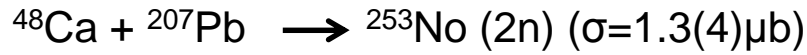
^{253}No alpha-gamma

$^{48}\text{Ca} + ^{207}\text{Pb} \rightarrow ^{253}\text{No} (2n) (\sigma=1.3(4)\mu\text{b})$
 ~ 2200 ^{253}No alpha decays in 38.25 hours, $I_{\text{beam}} \sim 3\mu\text{A}$

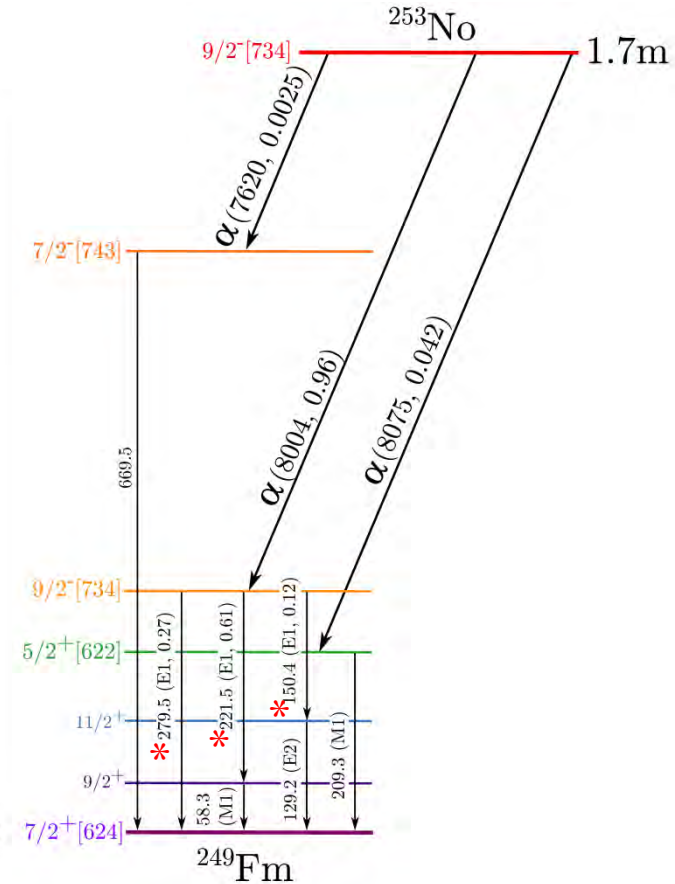
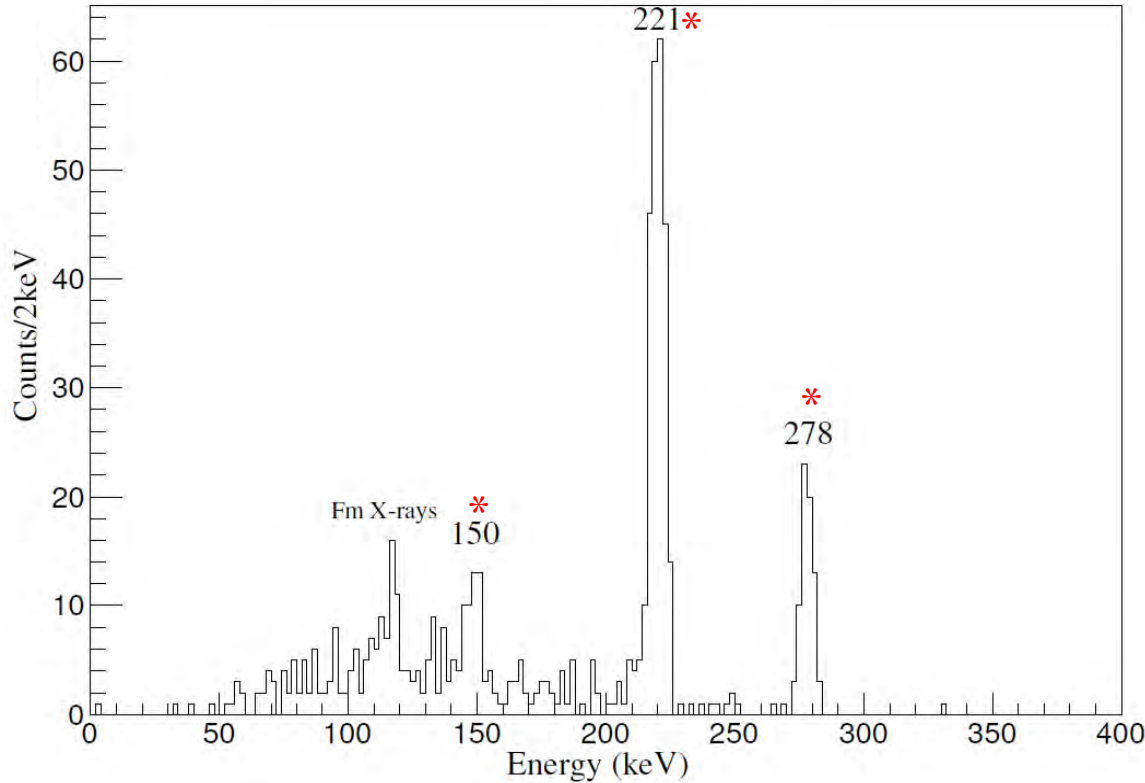


F. Hessberger *et. al.* EPJ A 48 1 (2012)

^{253}No alpha-gamma



~ 2200 ^{253}No alpha decays in 38.25 hours, $I_{\text{beam}} \sim 3\mu\text{A}$



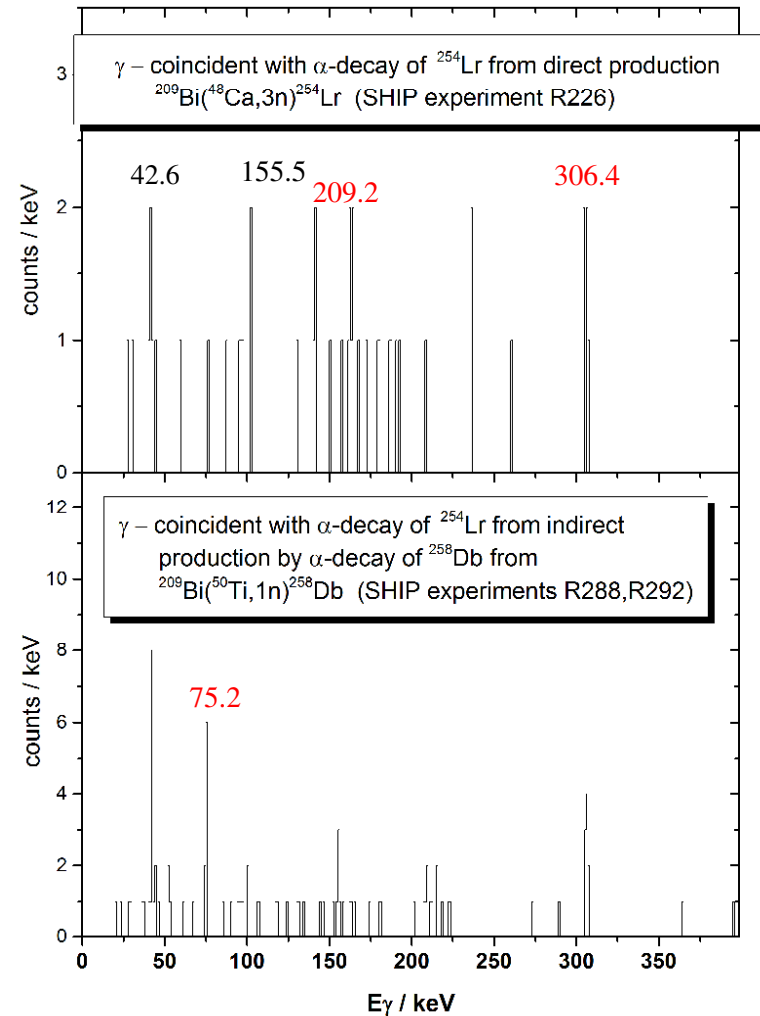
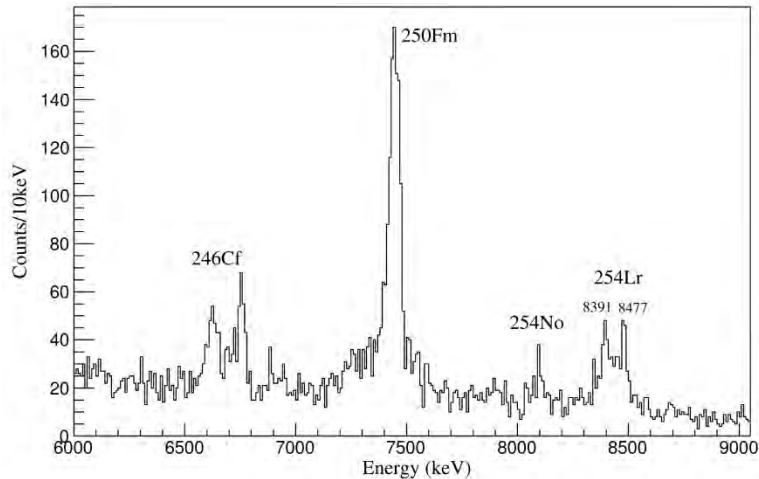
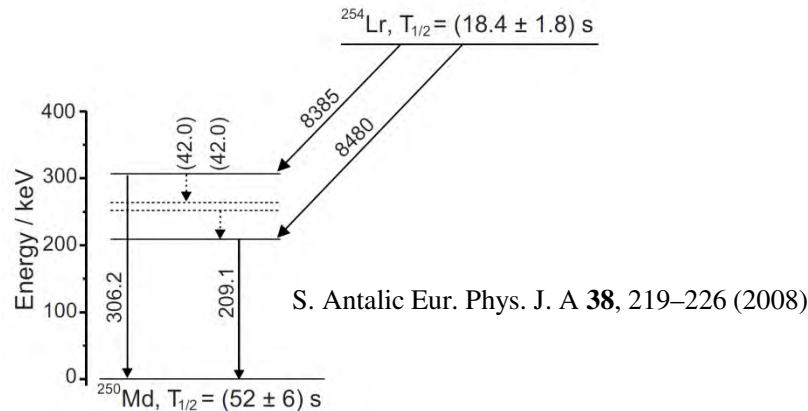
F. Hessberger *et. al.* EPJ A 48 1 (2012)

^{254}Lr alpha-gamma



~ 450 ^{254}Lr alpha decays in 86 hours, $I_{\text{beam}} \sim 3\mu\text{A}$

Courtesy of F.P.Hessberger

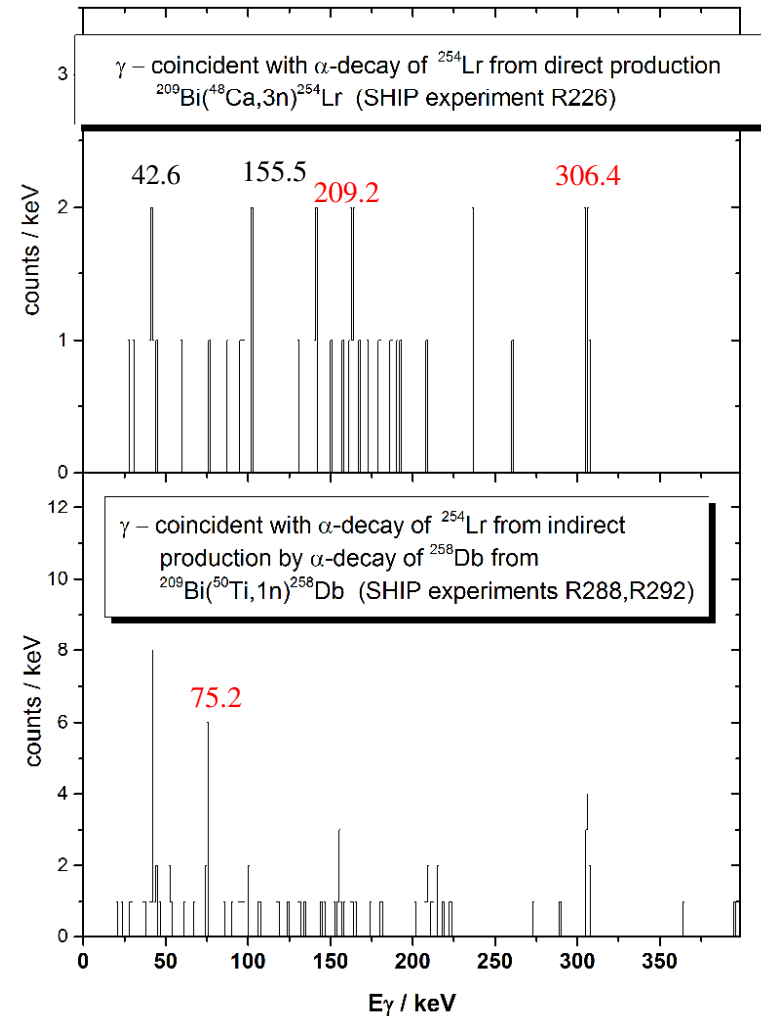
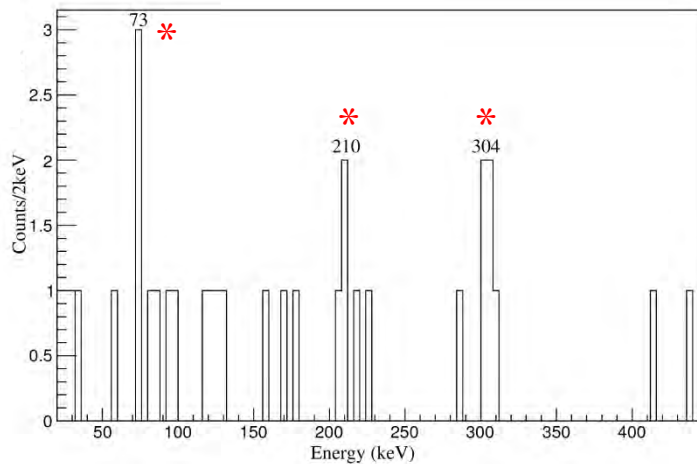
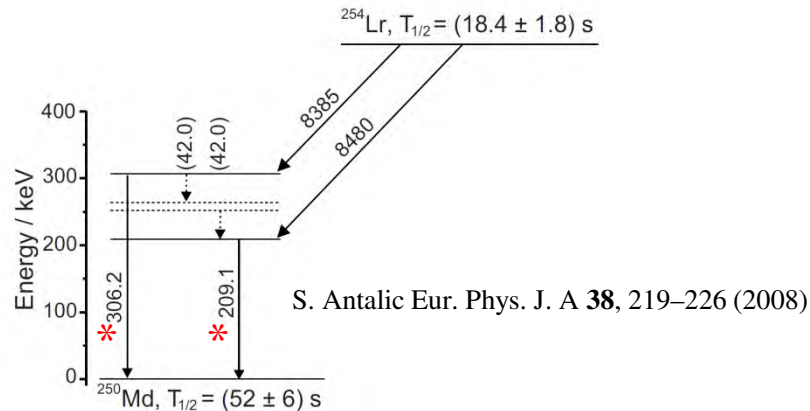


^{254}Lr alpha-gamma

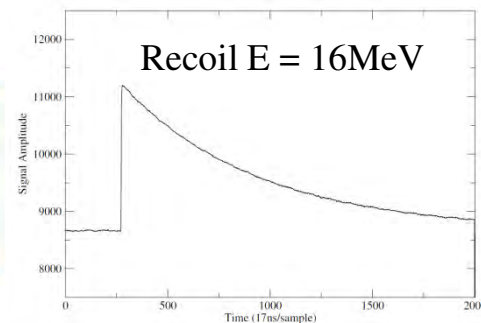
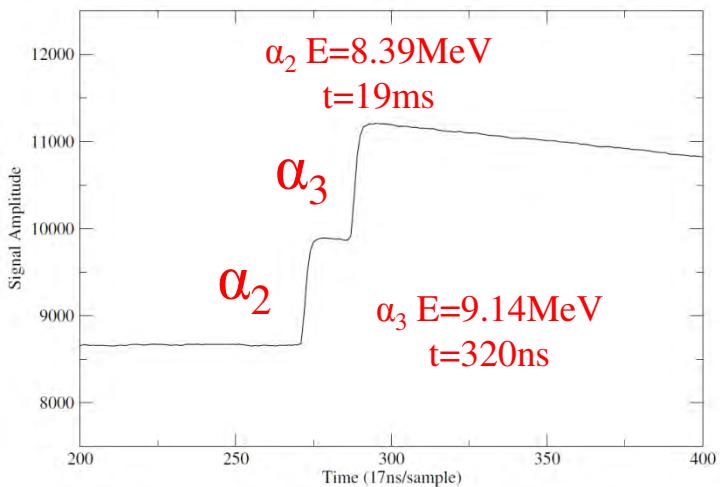


~ 450 ^{254}Lr alpha decays in 86 hours, $I_{\text{beam}} \sim 3\mu\text{A}$

Courtesy of F.P.Hessberger



^{226}Np chain

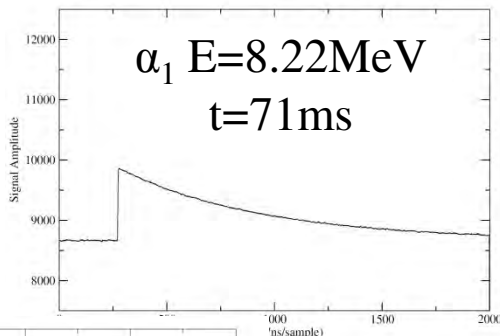


^{226}Np
8.0 MeV
31ms

α_1

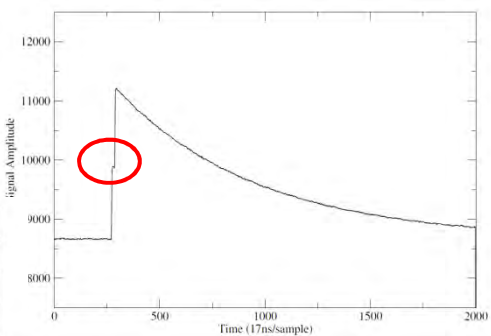
Pile up in FPGA

^{222}Pa
8.21 MeV
4.3ms



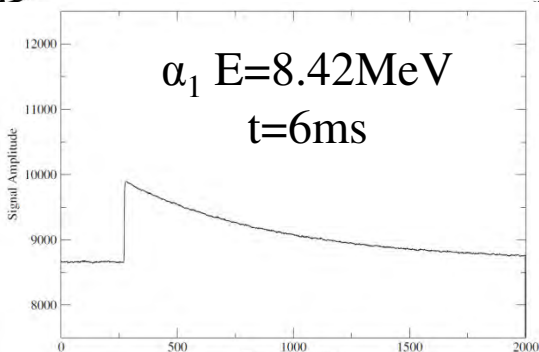
α_2

^{218}At
9.205 MeV
1.1 μs

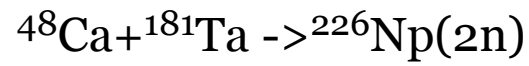


α_3

^{214}Fr
8.4/8.5 MeV
3.35/5ms



α_4



Continuing work

- Measurements on ^{255}No
- Installation of W target -> go towards neutron deficient U isotopes
- Offline analysis, use of software based pulse shape analysis, event by event correlations
- Software for use in all experiments: online/offline
- Analysis of data acquired

Conclusion

- SHIP focal plane detector undergoing commissioning
- A variety of nuclei explored (^{253}No , ^{254}Lr , ^{225}Np , ^{255}No ...)
- Testing the capability of the system
- Online analysis points towards the device working correctly
- ^{257}Rf as a next goal

Collaborators

GSI, Darmstadt:

F.P. Hessberger, J. Hoffmann, N. Kurz, J. Maurer

HIM, Mainz:

M. Block, J. Khuyagbaatar

GANIL, Caen:

D. Ackermann, M Vostinar

Comenius University, Bratislava:

S. Antalic, B. Andel, P. Mořat'