ISOL-SRS Project Status

“Internal Spectrometer” → CARME on CRYRING

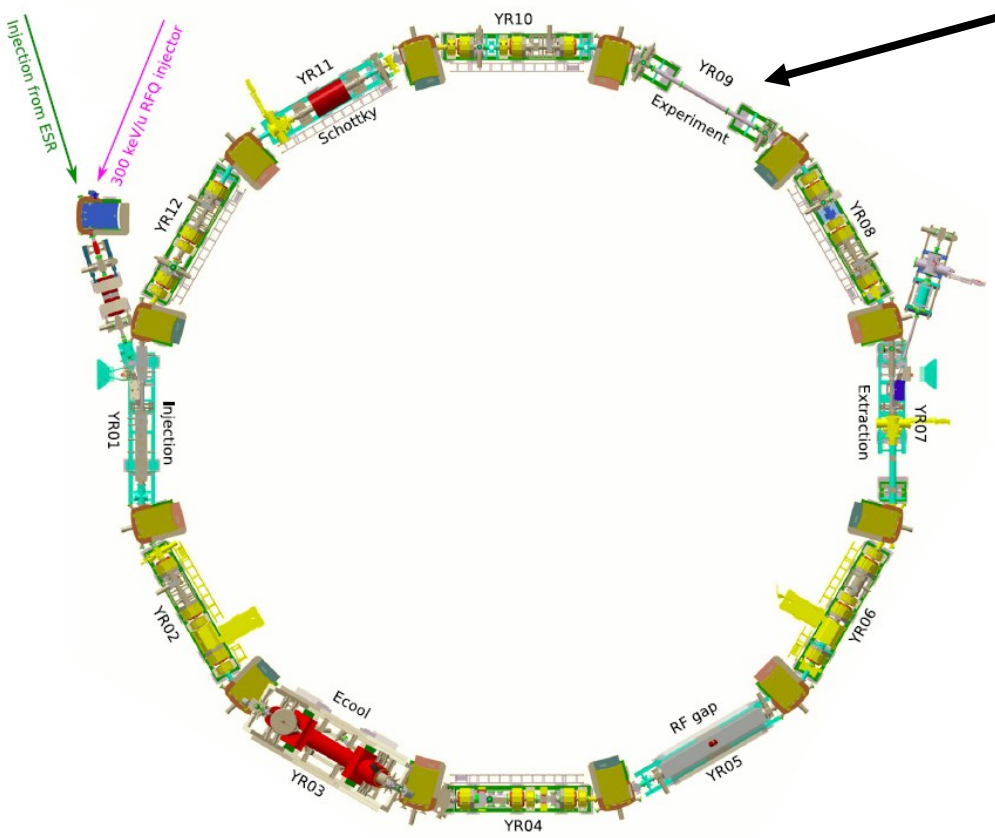
“External Spectrometer” → ISOLDE Solenoidal Spectrometer

Project end date 31/3/2020

CRYRING
PART OF FAIR PHASE 0

- Energy range: ~hundreds of keV/u to ~10 MeV/u
- Vacuum: 10^{-11} – 10^{-12} mbar

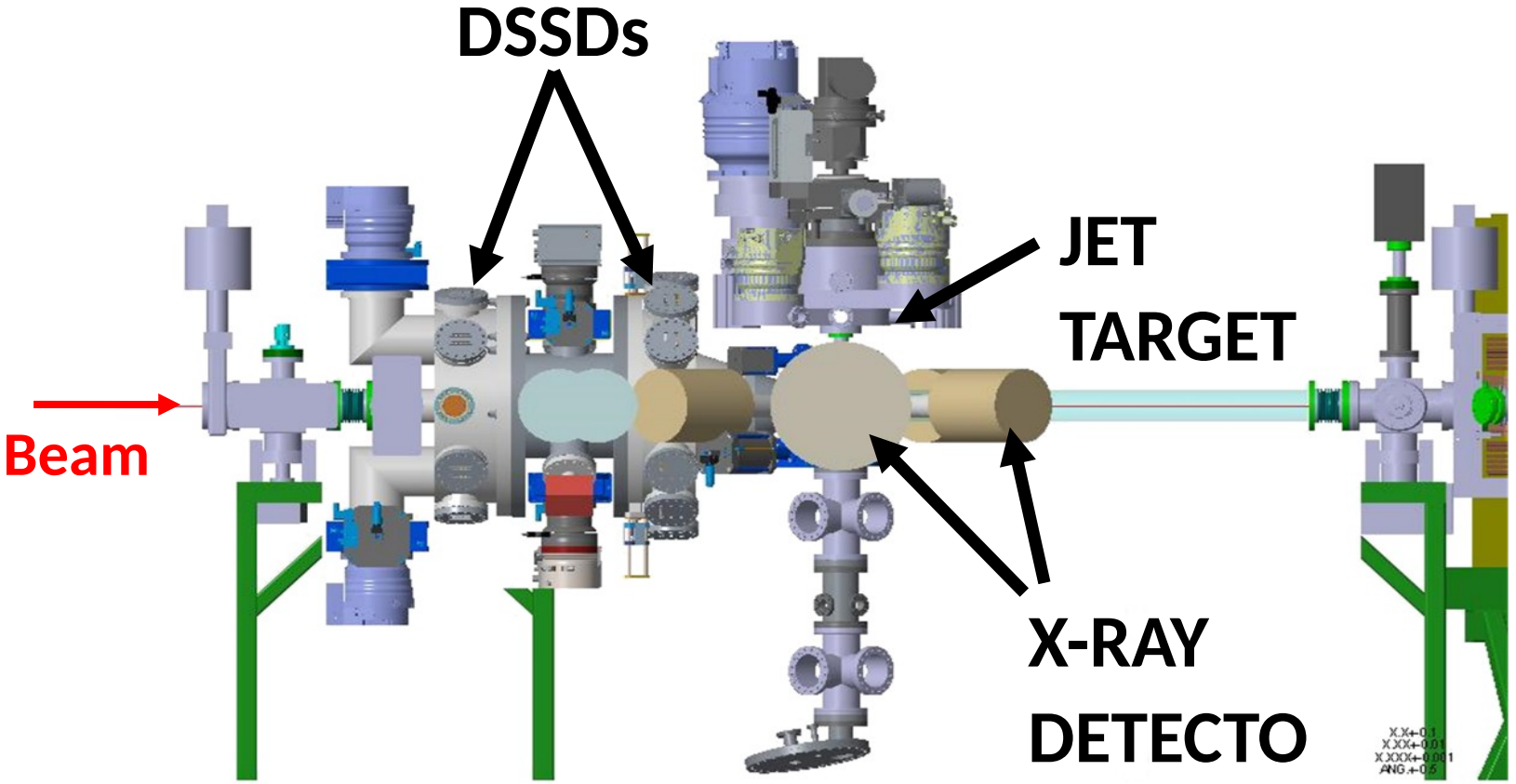
Section YR09



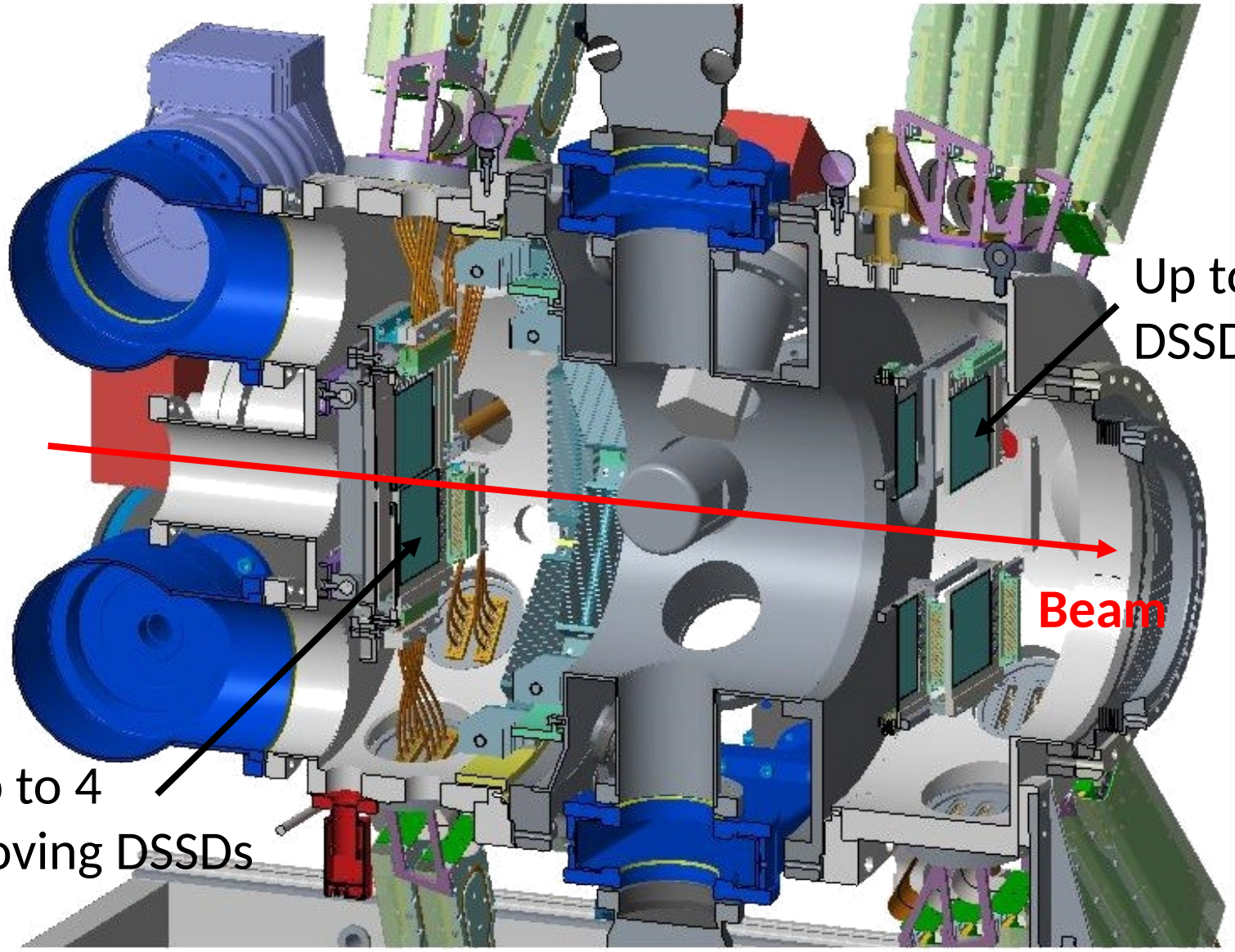
CARME

CRYRING ARRAY FOR REACTION MEASUREMENTS

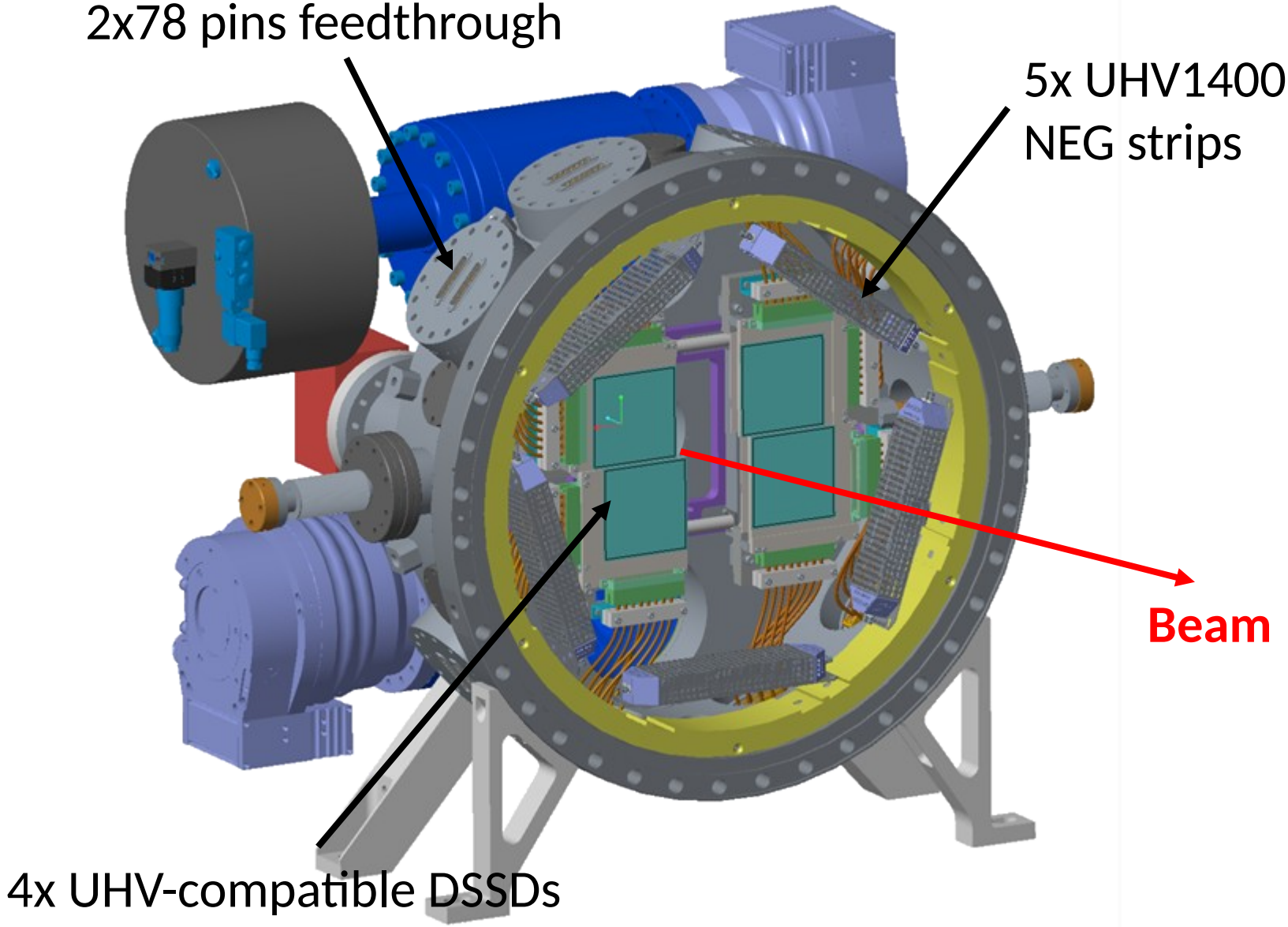
- **Two** chambers mounted downstream, upstream, or both
- Allows combined nuclear and atomic physics measurements
- Fully funded by UK STFC. **TDR approved GSI**.
- To be mounted on the CRYRING in Summer 2020



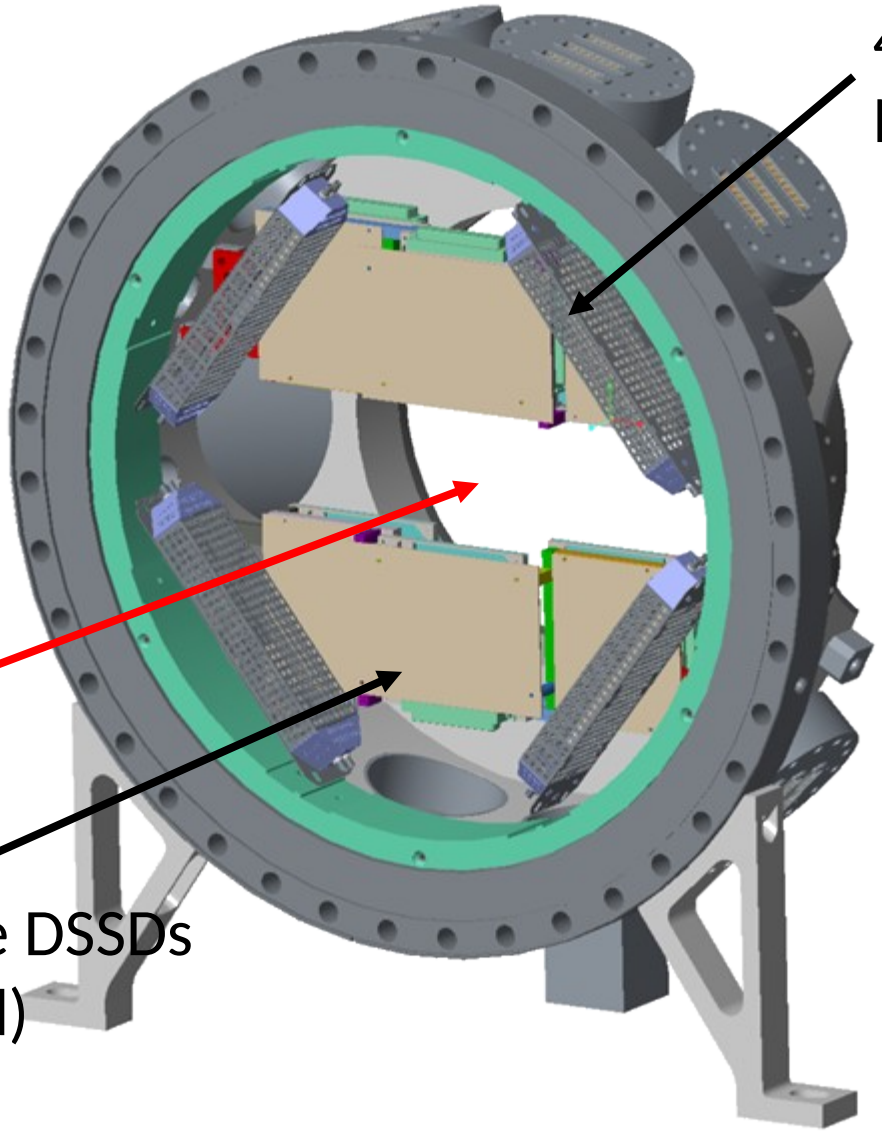
UPSTREAM CONFIGURATION



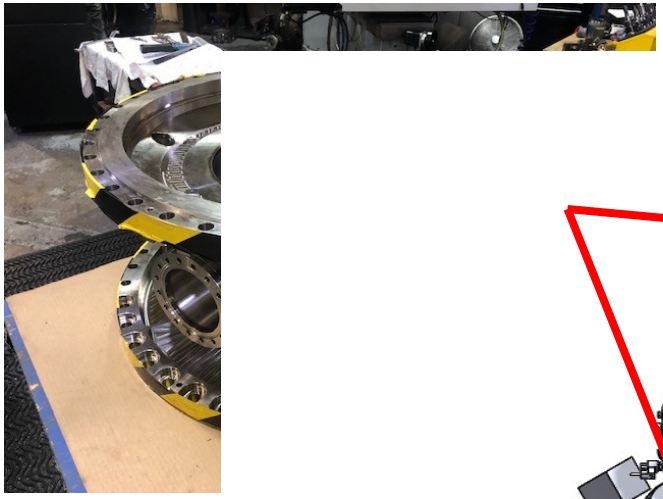
MOVING DSSDS SECTION

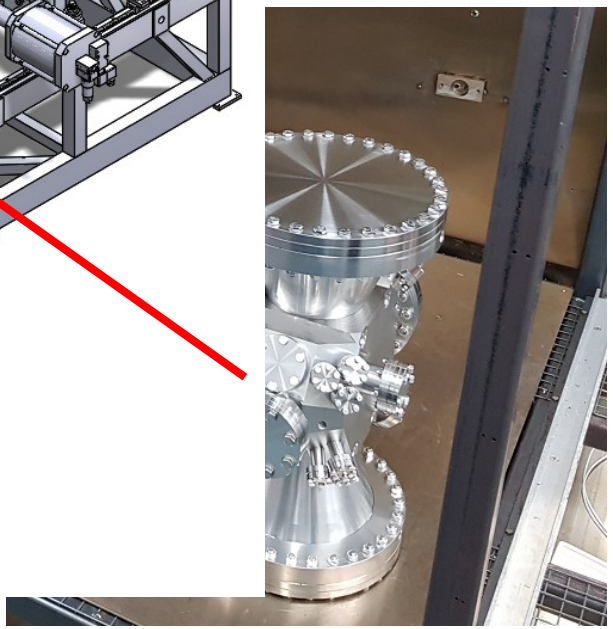


THE DSSD WALL



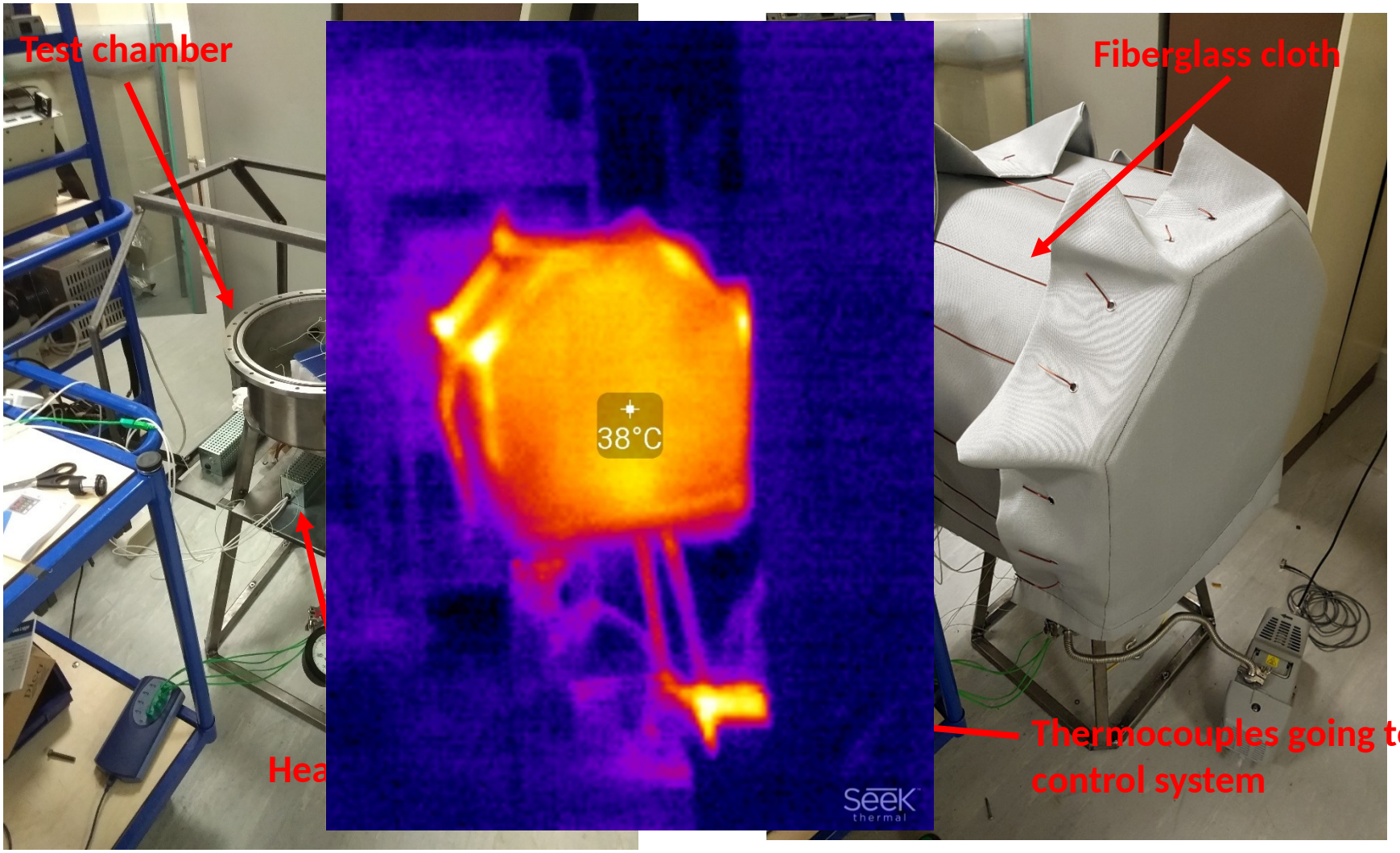
VACUUM VESSELS





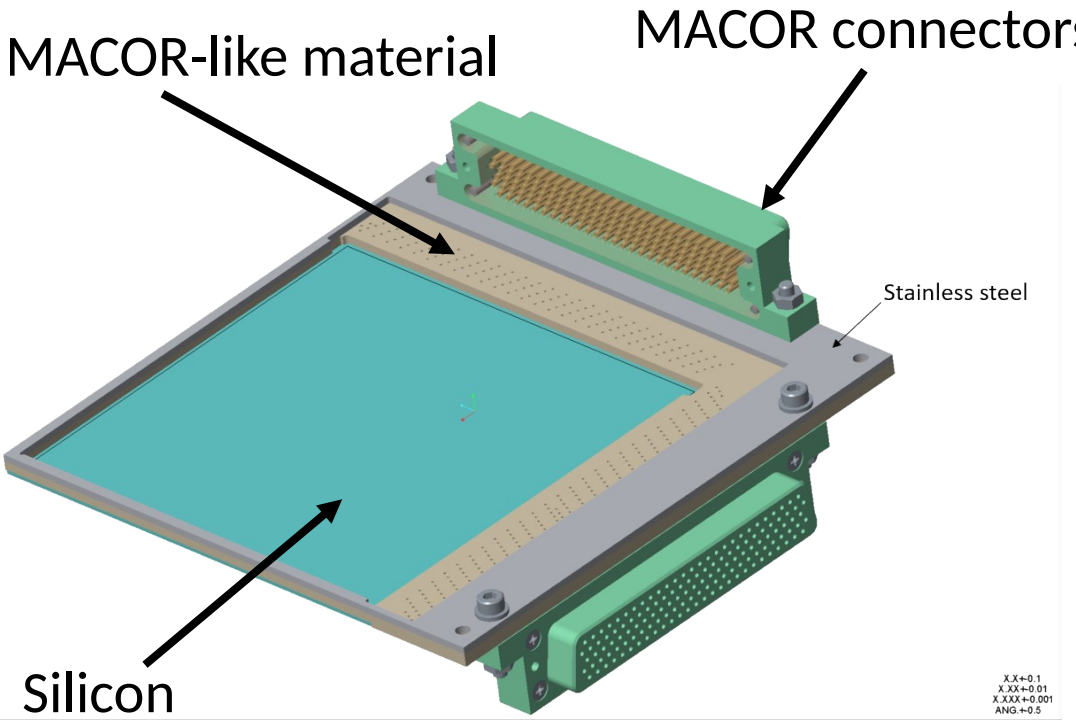
BAKING TENT

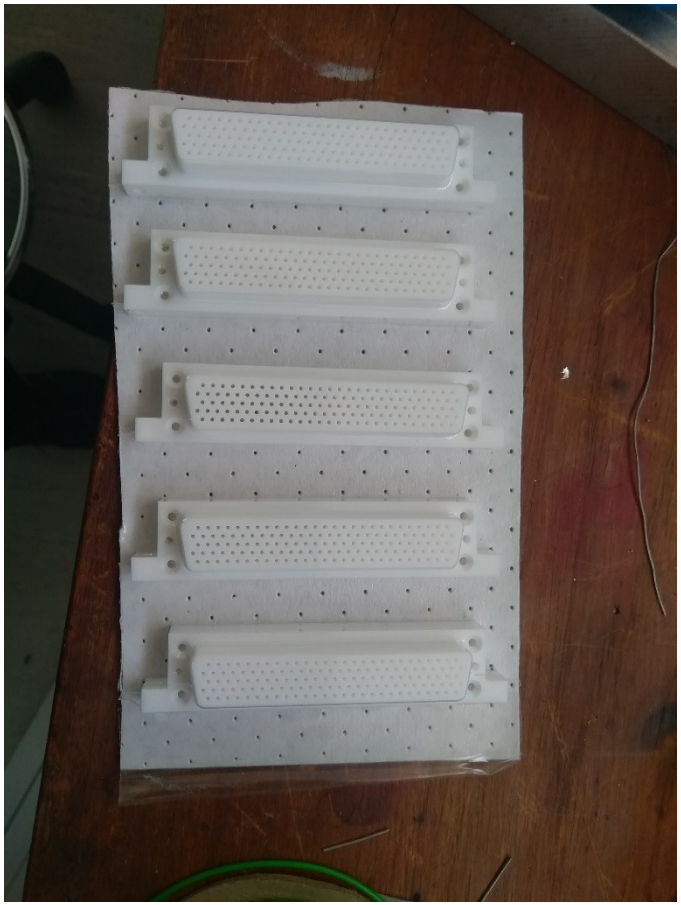
Could not source commercially. Built in Edinburgh from scratch. Commissioned in the last few weeks.



XHV-COMPATIBLE DSSDS

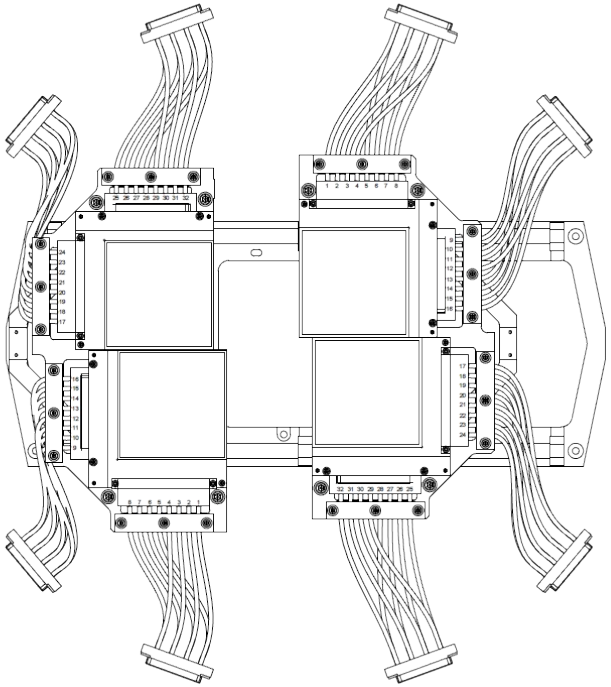
- Highly segmented Double-sided Silicon Strip Detectors (DSSDs)
- 128x128 strips
- All materials compatible with XHV environment
- Four DSSDs to be produced (by MSL)

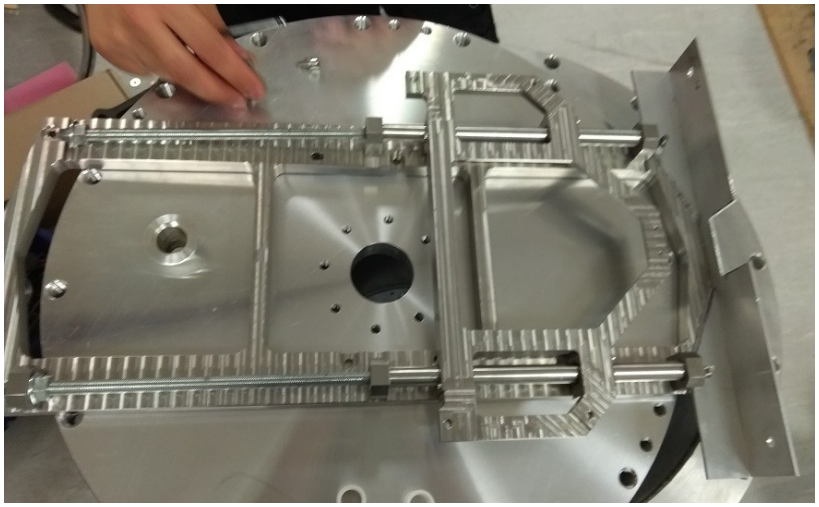




MOTION SYSTEM FOR DSSDS

- Some DSSD move in/out of beam axis before/after beam cooling
- Motion system commissioned in Edinburgh
- Can withstand up to ~3000 repetitions.
- Now looking to upgrade the design based on experience acquired





PUMPS, FLANGES, SUPPORT FRAMES,

- NEG getters, NEG/ion pumps, mag-lev turbo pumps **arrived**
- XHV flanges and bellows **arrived**
- Temporary steel frame built. Aluminium frame **being sourced**
- Beryllium windows, vacuum sensors, etc. **bought**

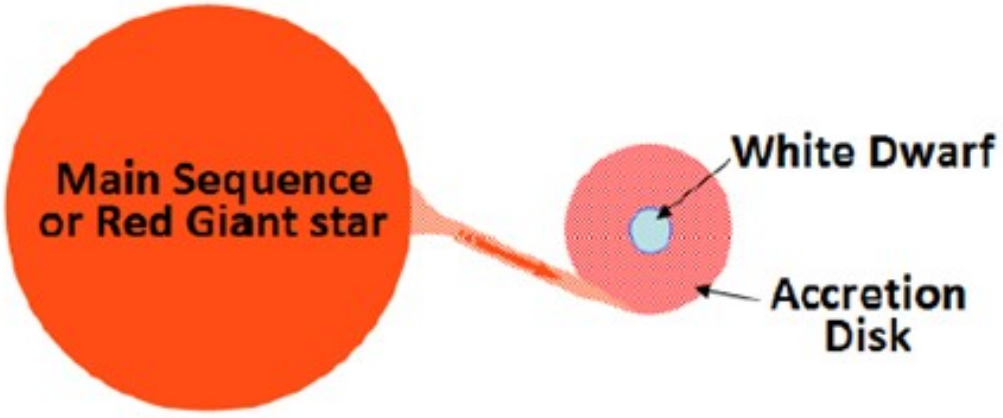
SCIENTIFIC AIMS

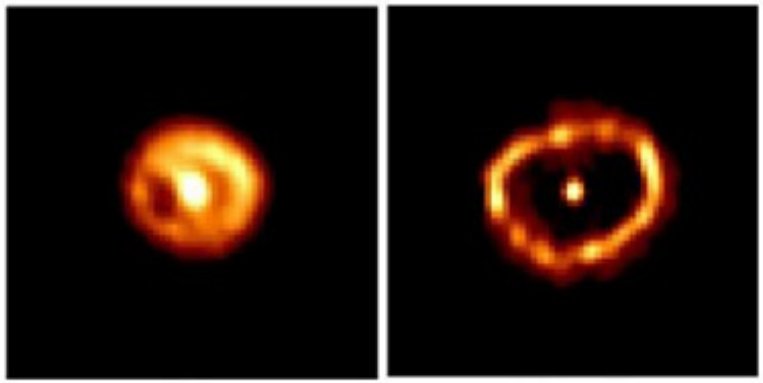
This system will be used for **high resolution** charge particle reaction studies for nuclear astrophysics including:

1. Direct astrophysical reaction measurements e.g. (p,α)
2. Indirect reactions probing key resonance properties e.g. (d,p)

Atomic physics used to provide nuclear cross-section normalisation

First measurement approved: **^{30}P(d,p)^{31}P** (S461_Bruno)
→ Relevant for modelling nucleosynthesis in novae explosions

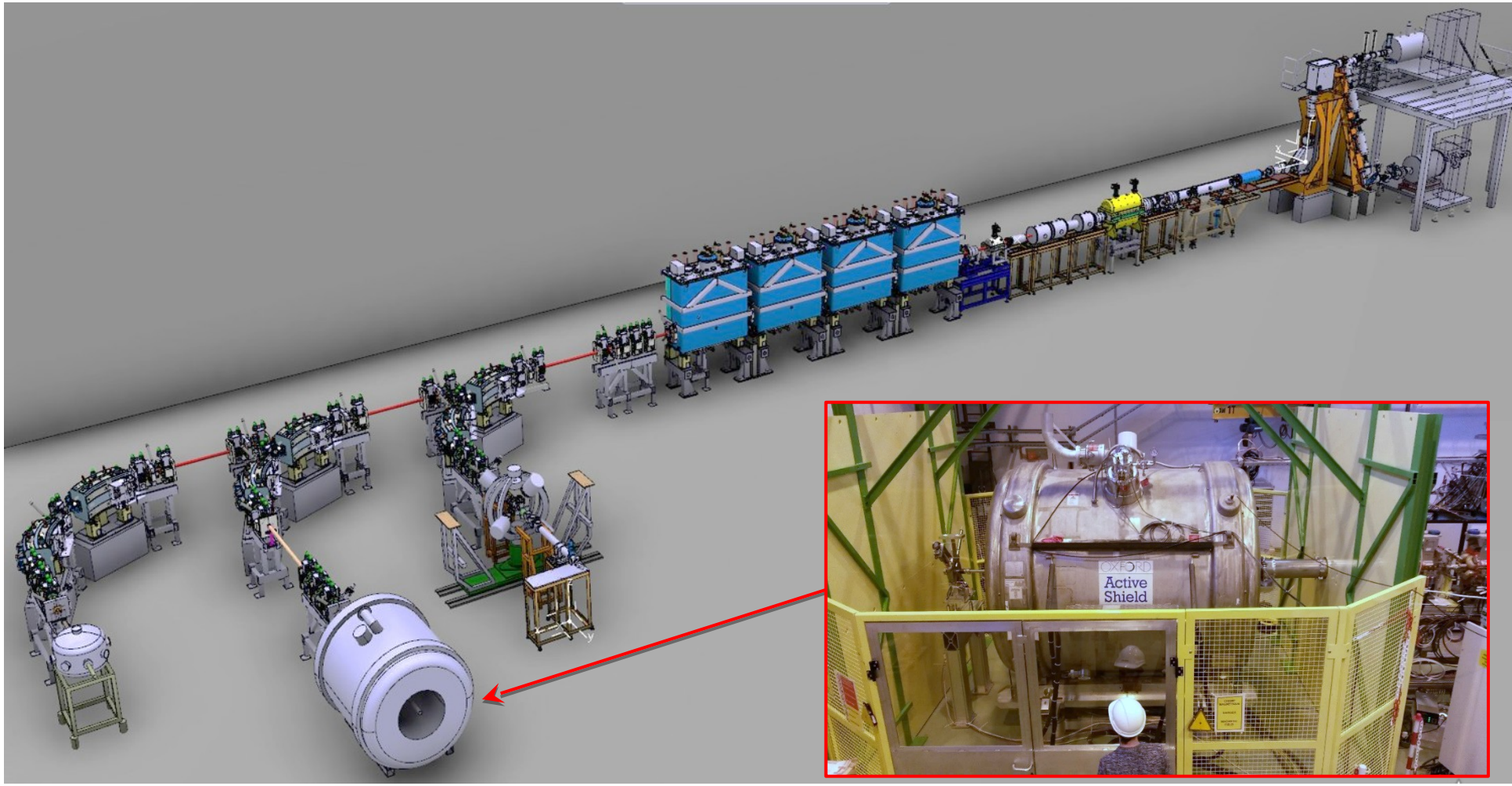




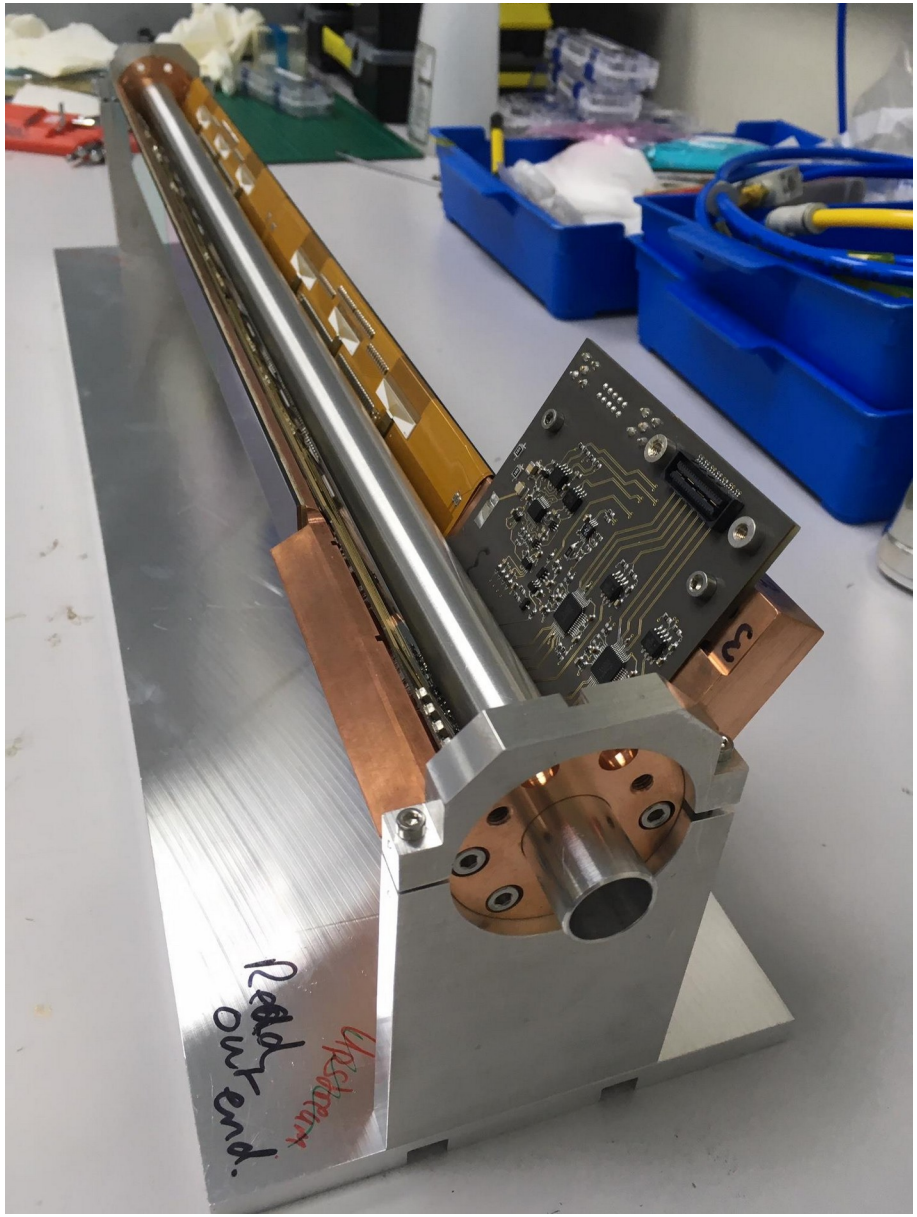
ISOLDE Solenoidal Spectrometer

- Detector module tests
- Detector assembly status
- Early Physics experiments
  - ^{28}Mg(d,p)
  - ^{206}Hg(d,p)
- ISS workshop in Liverpool
- Recoil gas detector

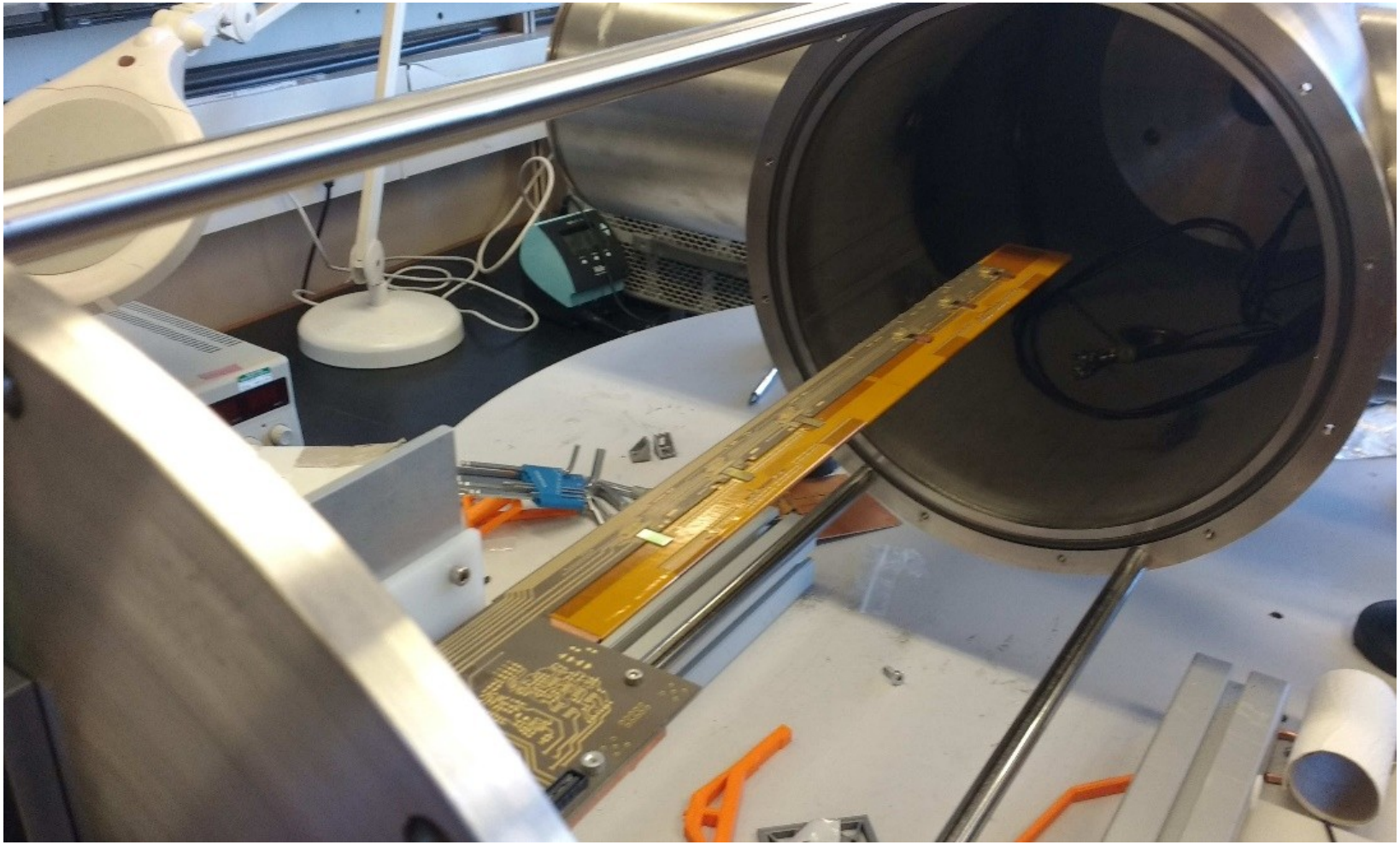
ISOLDE Solenoidal Spectrometer



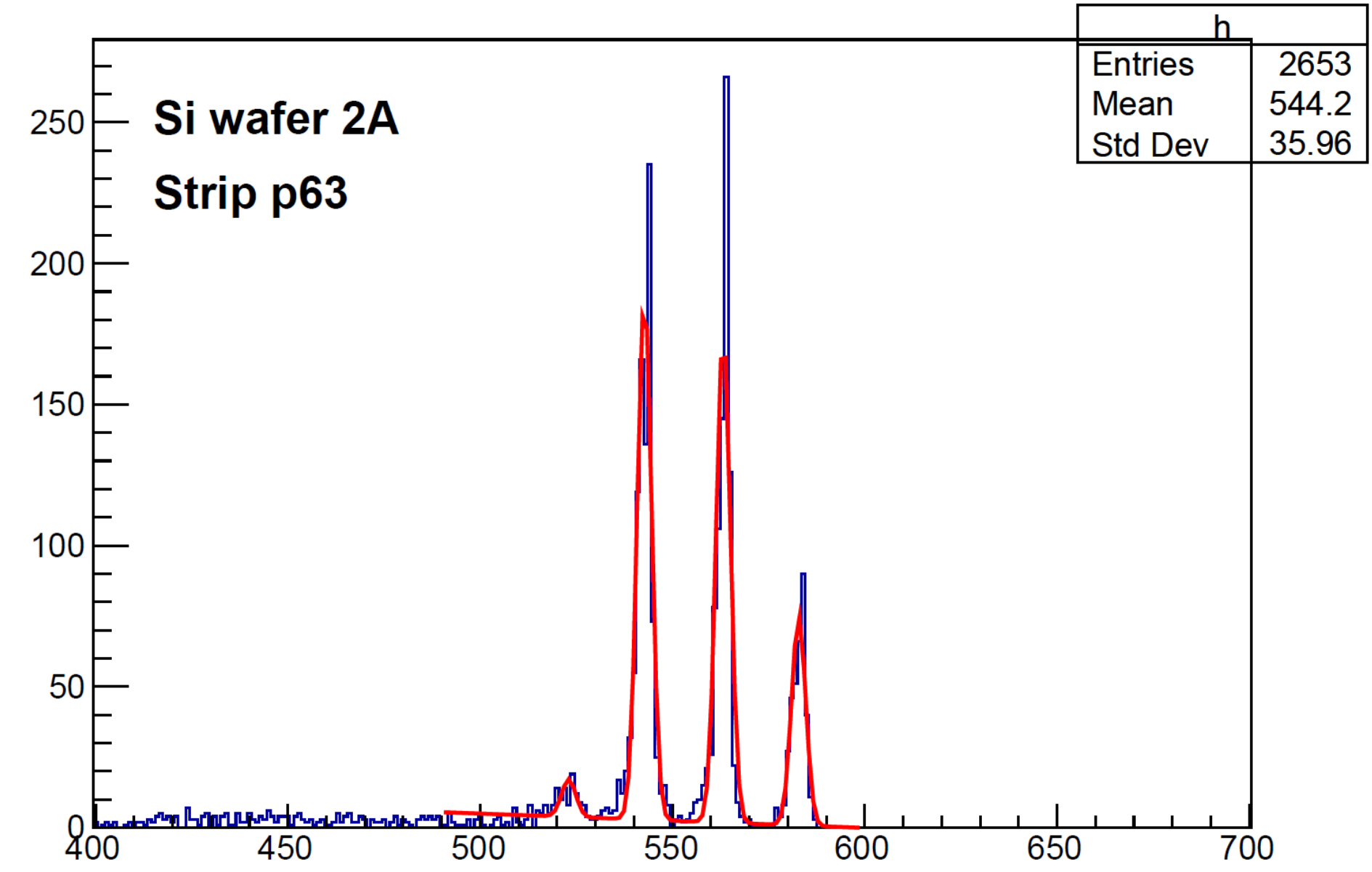
Detector modules completed – June 2019



Vacuum test chamber

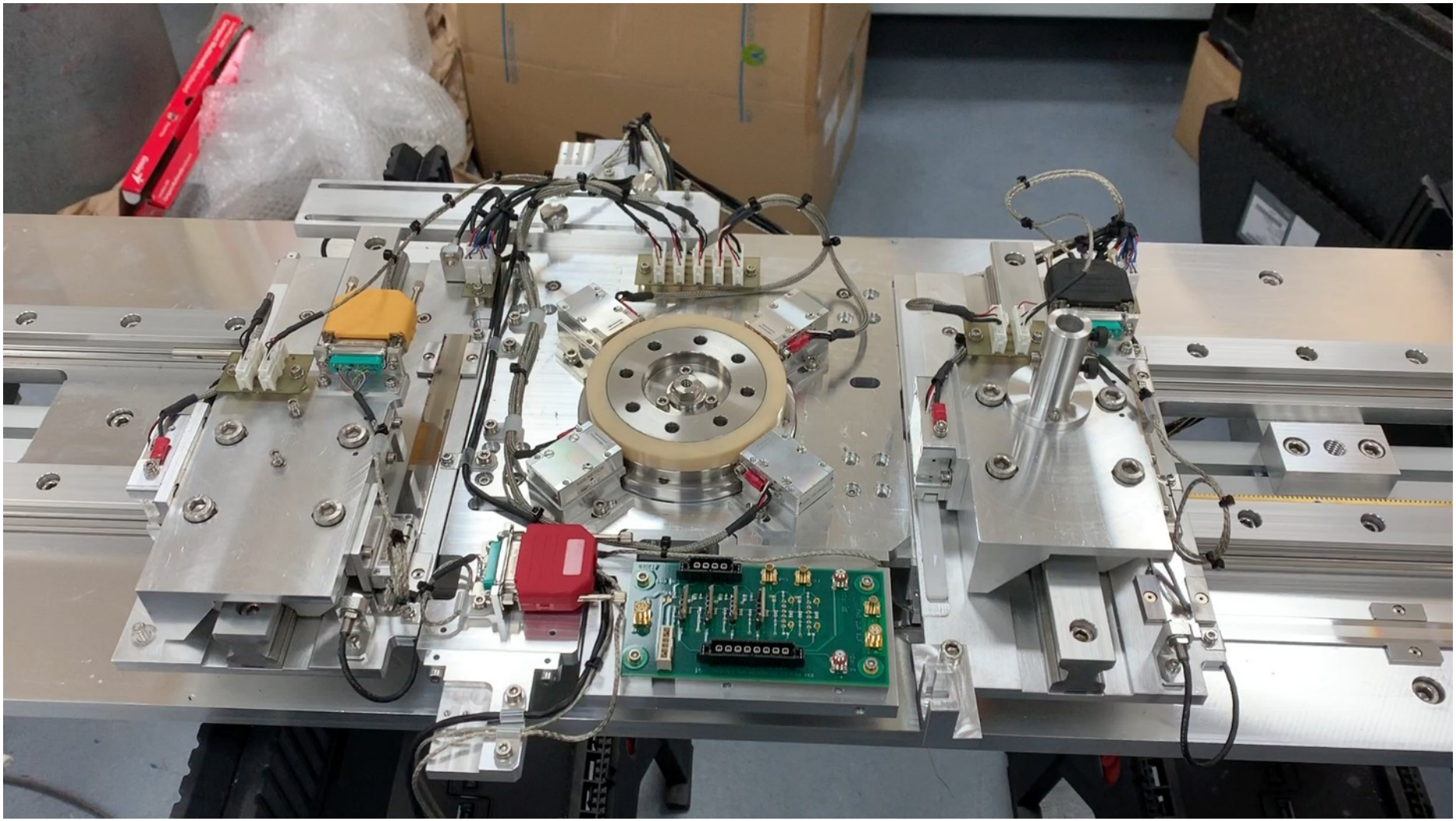


Alpha-source tests – all strips working

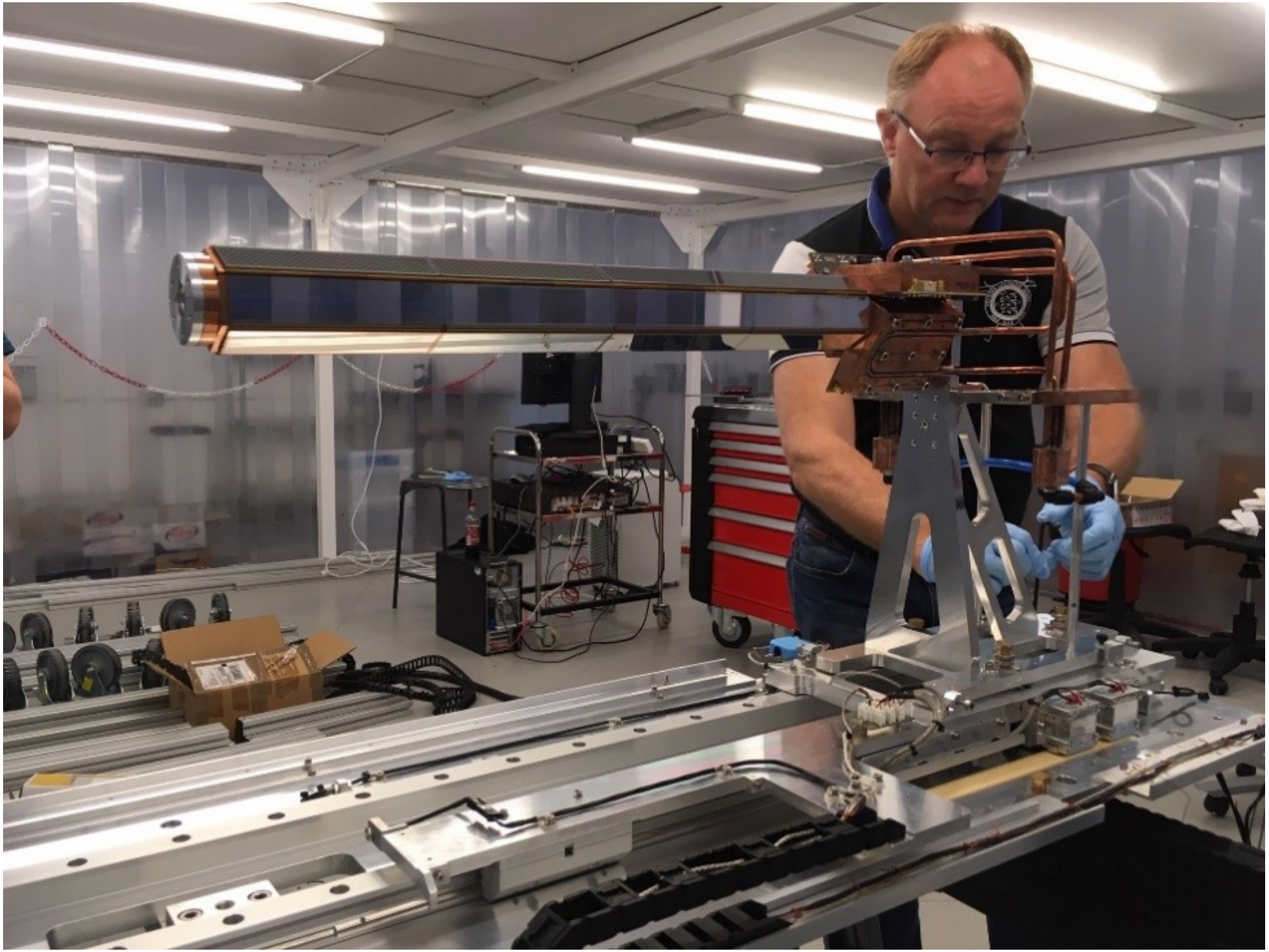


Detector assembly completed – June 2019

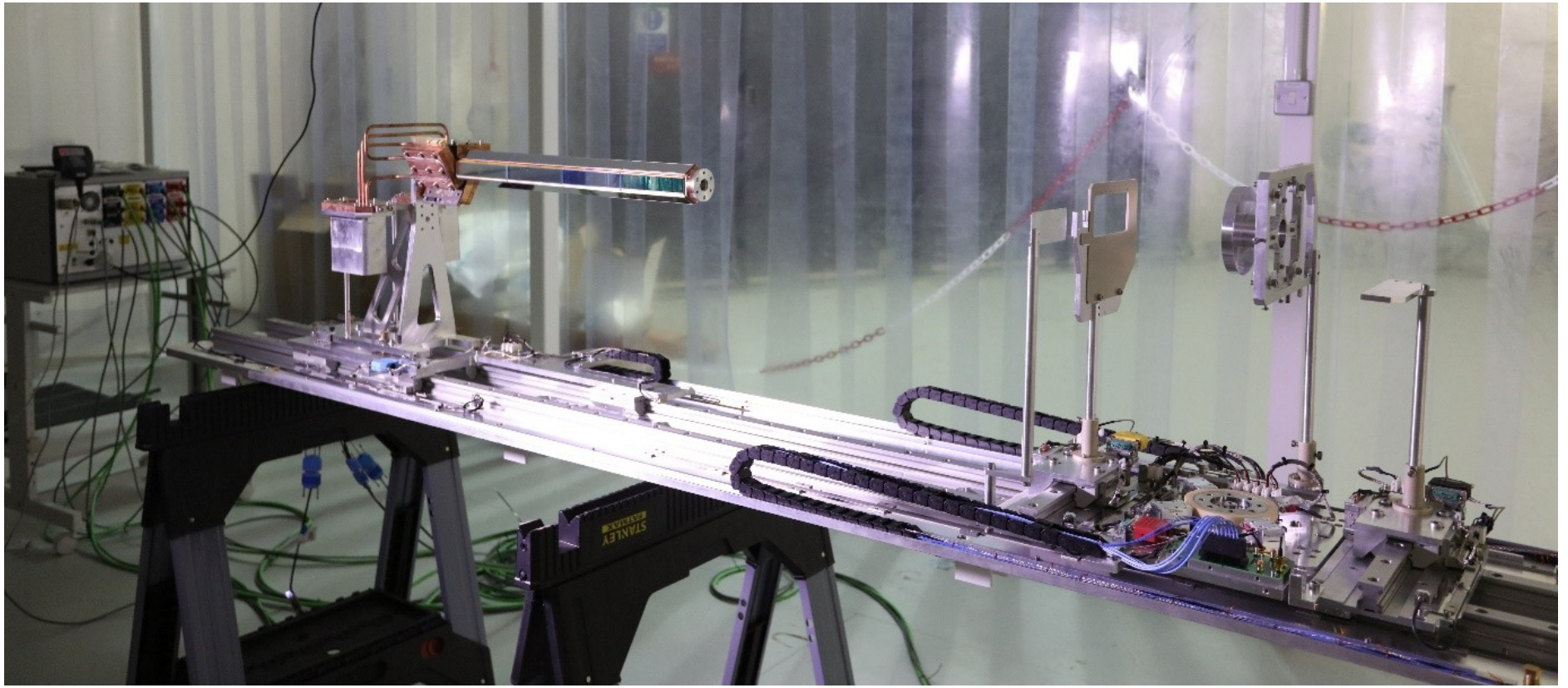
Target assembly drive system



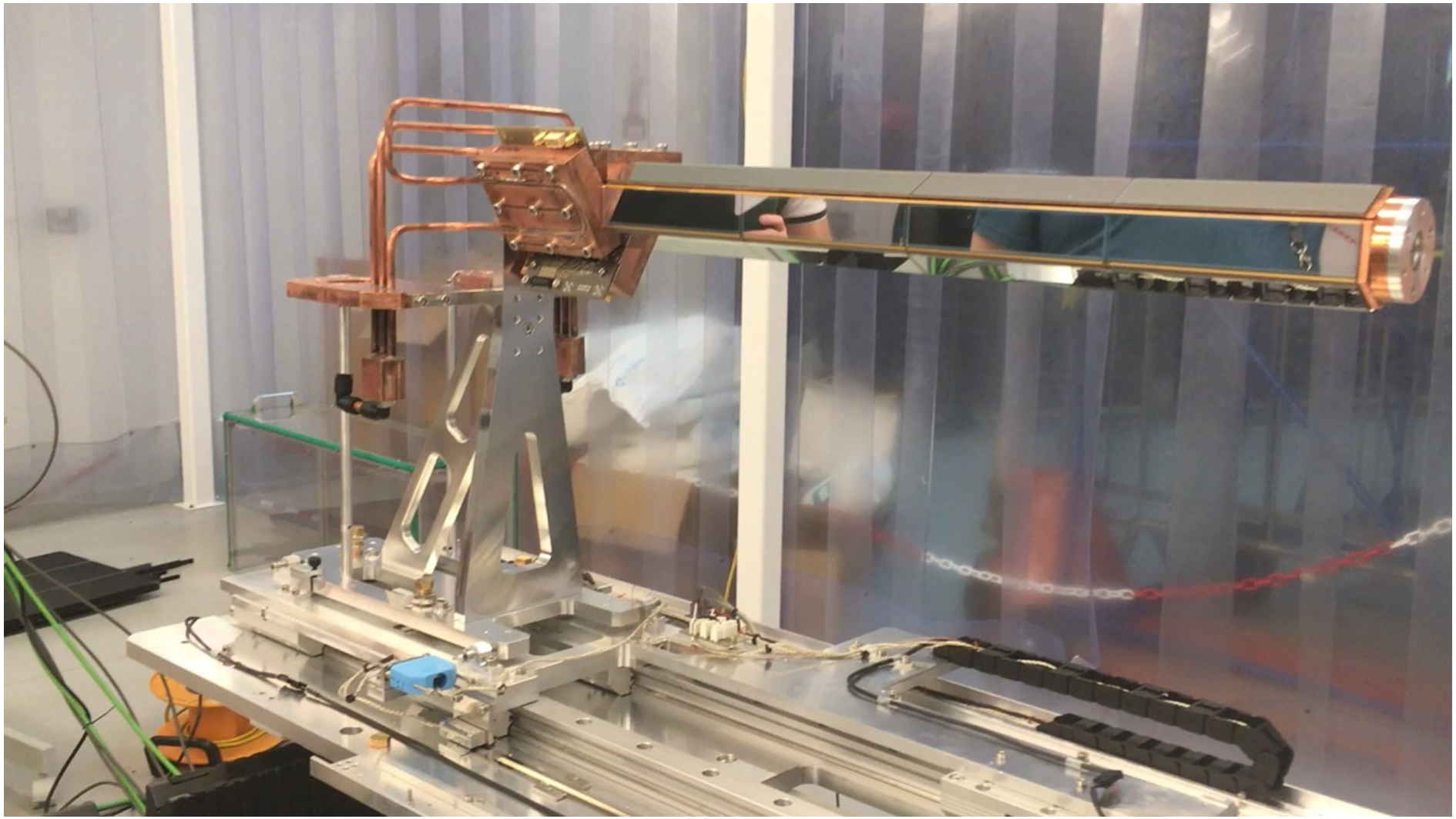
Mounting detector on drive system



Detector on drive system



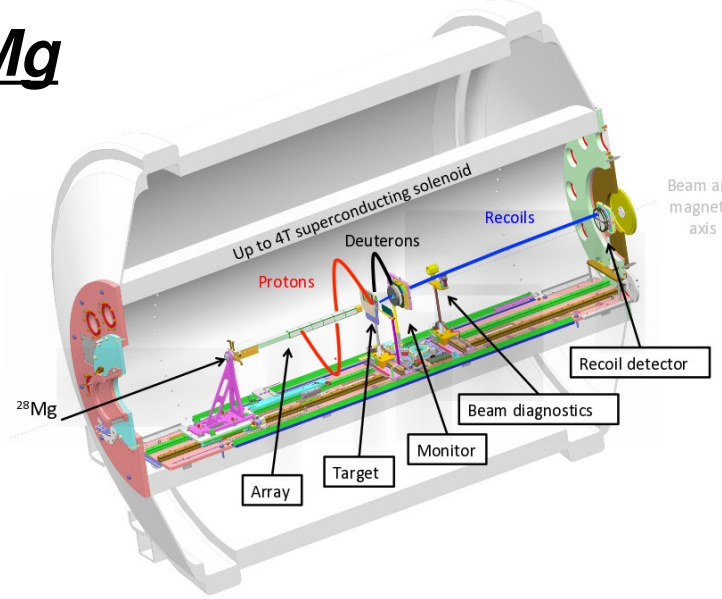
Detector on drive system



Detector at ISOLDE, CERN

ISOLDE Solenoidal Spectrometer

Exp 1 - ^{28}Mg(d,p)^{29}Mg



10^6 pps 9.473 MeV/u *(dE/E = 0.3%) beam of ^{28}Mg –* ***highest HIE-ISOLDE RIB beam energy per nucleon****.*

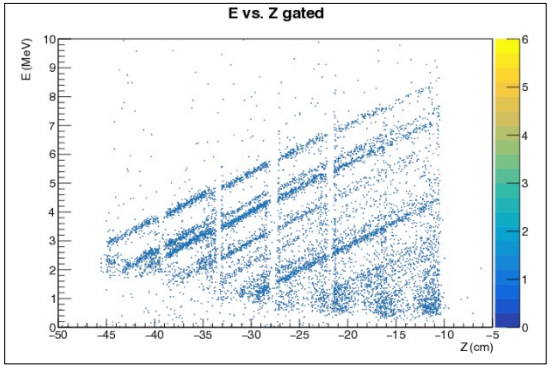
Particle energy FWHM ***<140keV*** *(including all detectors).*

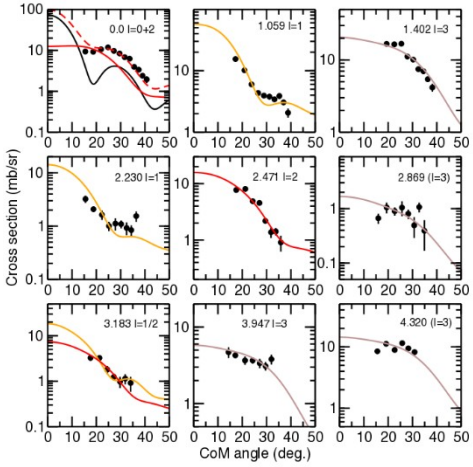
Angular distributions extracted for 10 states ***up to 4.32 MeV*** *(1 doublet and 2 unbound).*

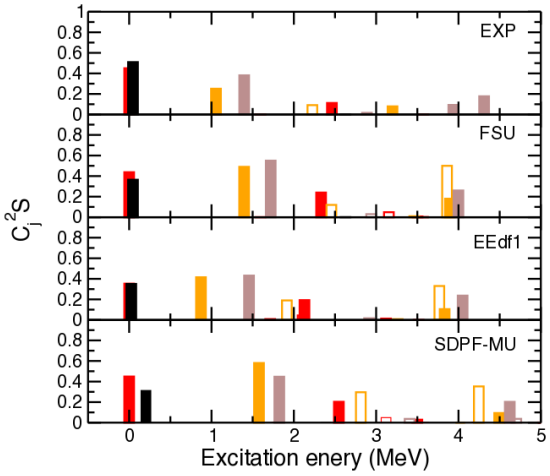
Compared to ***DWBA*** *calculations to make* ***preliminary / assignments****.*

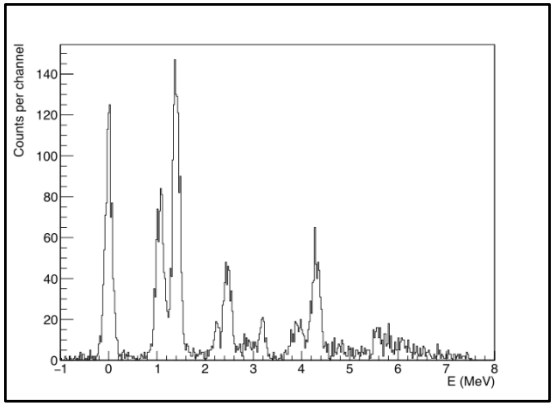
Comparison to SM calculations using the ***SDPF-MU, FSU*** *and* ***EEdf1*** *interactions.*

Publication in preparation for submission to PRL.



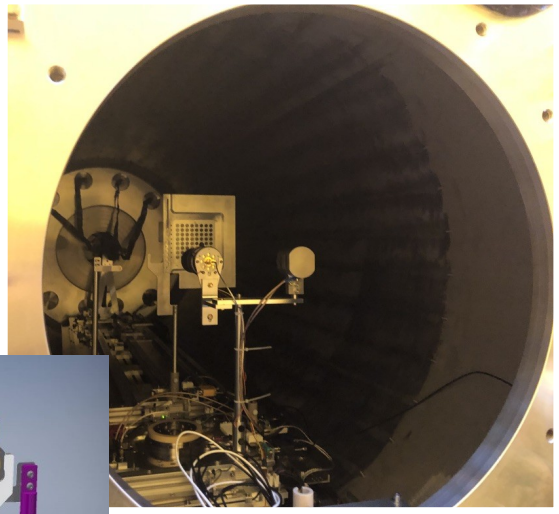






ISOLDE Solenoidal Spectrometer

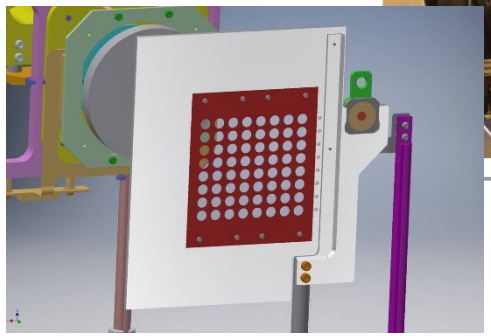
Exp 2 - ^{206}Hg(d,p)^{207}Hg



5x10^5 pps 7.4 MeV/u *(>1.5 GeV total energy) beam of* ^{206}*Mg –* ***highest total energy HIE-ISOLDE RIB beam.***

Measured in singles mode ***with >98% beam purity****.*

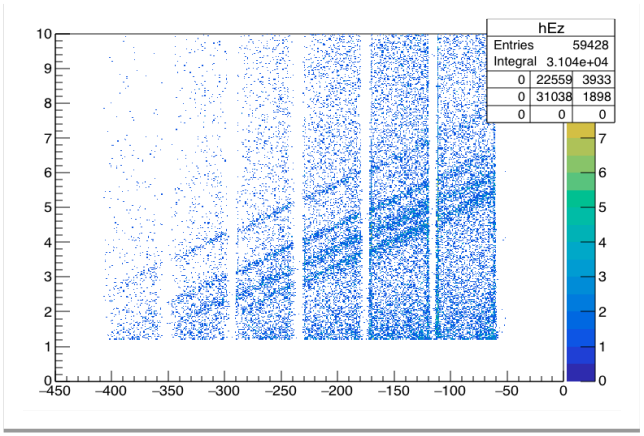
Used ***>30 deuterated polyethylene targets.***

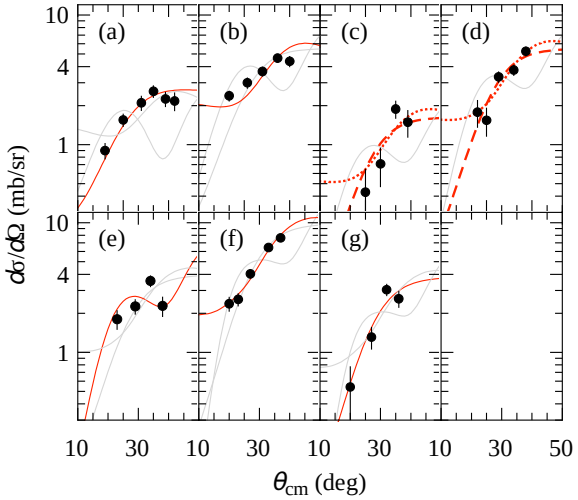


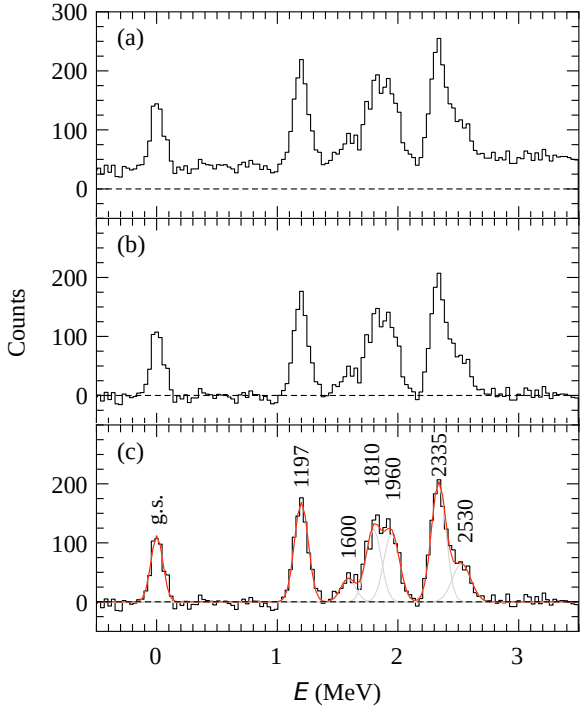
First spectroscopy of ^{207}*Hg in the region south-east of doubly-magic* ^{208}*Pb.*

The bulk of the ***0g$_{9/2}$, 2d$_{5/2}$, 3s$_{1/2}$, 2d$_{3/2}$, and 0g$_{7/2}$ strength*** *identified.*

Publication submitted to PRL.







First accepted ISS publication!!!

APS physics | Journals | Physics Magazine | Help/Feedback | Journal, vol, page, DOI, etc.

PHYSICAL REVIEW LETTERS

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Accepted Papers

Section

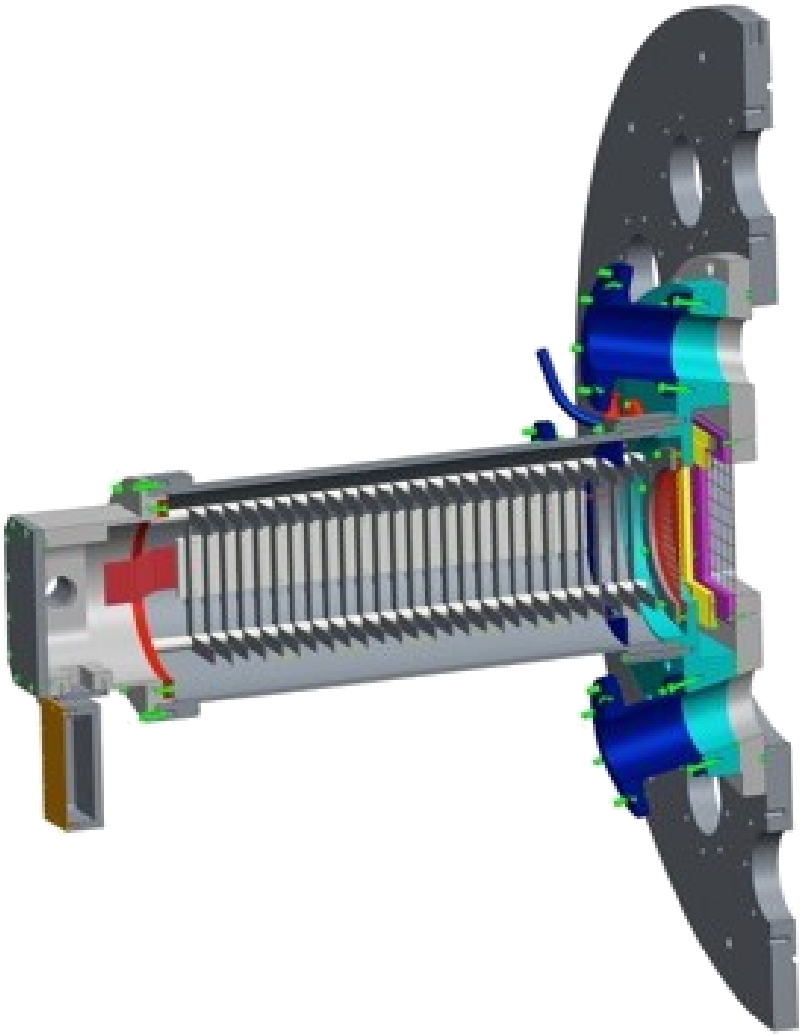
- [ ] ALL
- [x] Nuclear Physics (95)

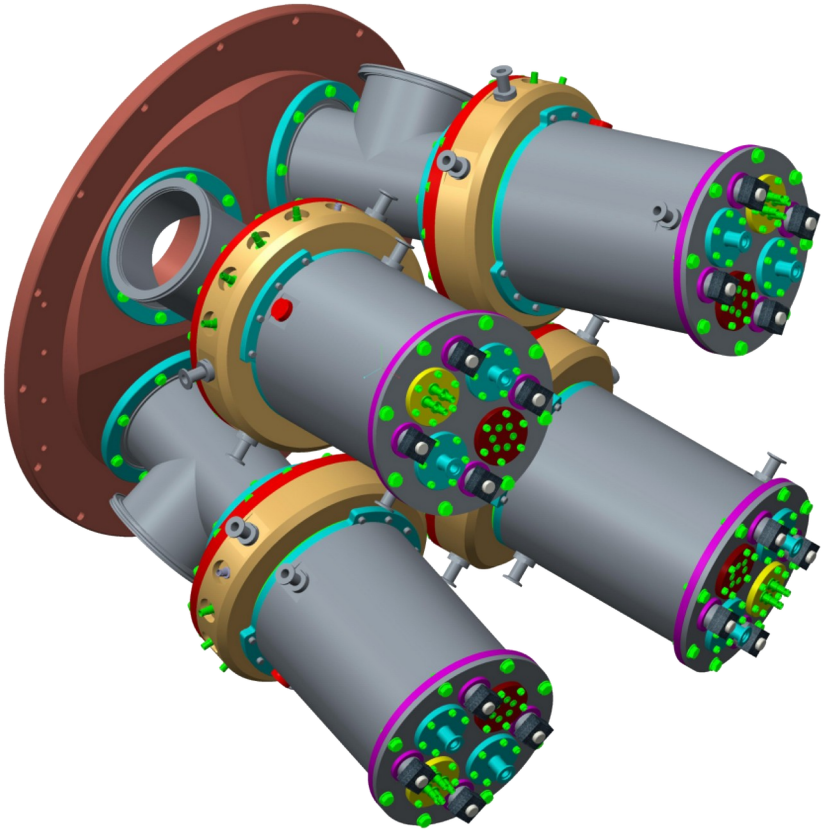
First exploration of neutron shell structure below lead and beyond $N = 126$

T. L. Tang *et al.*

Accepted 2 January 2020

Fission fragment & recoil gas detectors





Liverpool ISS workshop

28th – 29th August 2019

ISS commissioning & status
Early implementation experiments
HIE-ISOLDE during LS2 & beyond
HELIOS & SOLARIS
SpecMAT
Ge detector tests

Transfer reaction ideas
Fission studies

Collaboration structure & MoU

Liverpool ISS workshop