Low Background Screening UK

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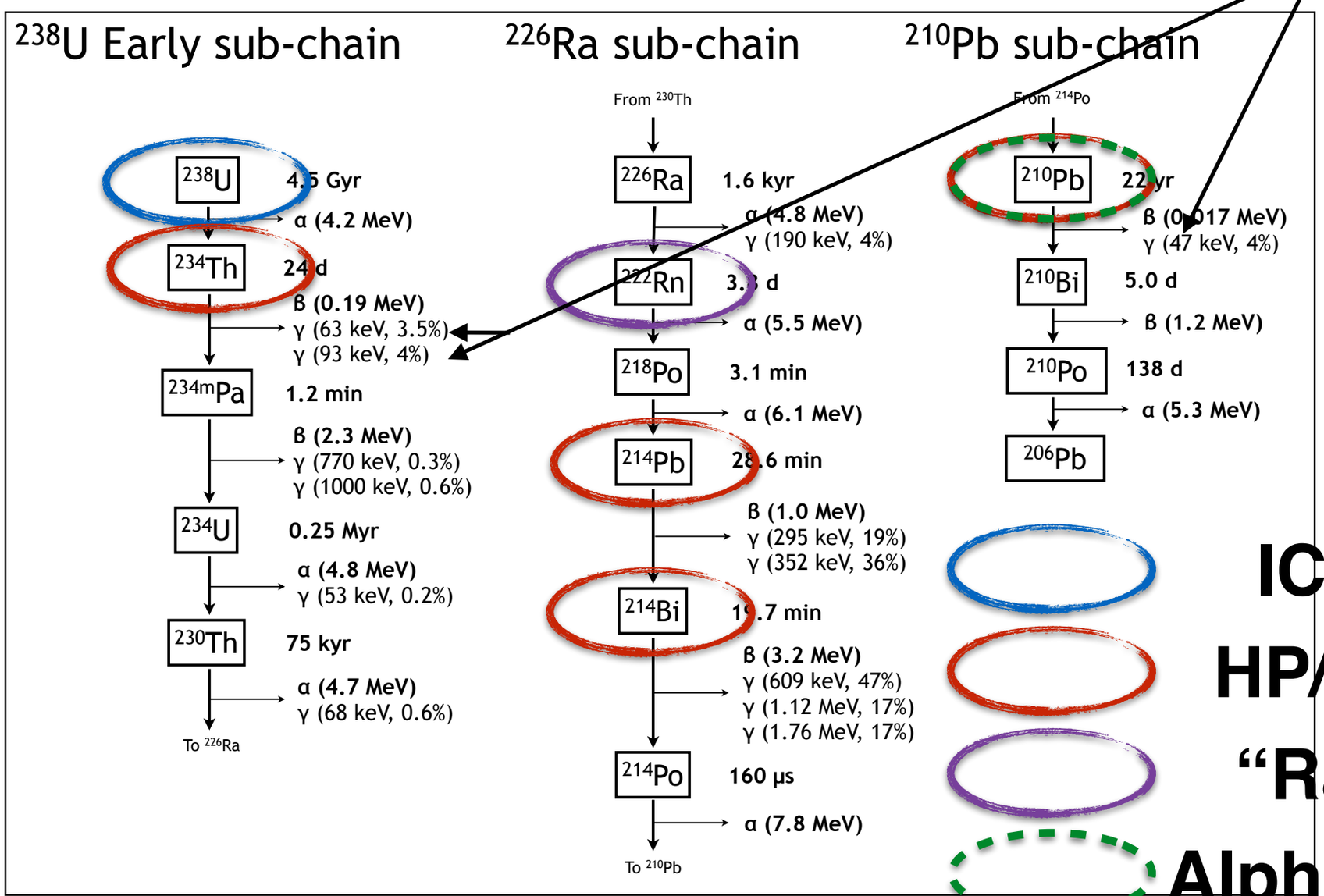
Overview

- UK screening facilities intended to support experiments:
  - Dark Matter - LZ, DEAP/CLEAN, DRIFT
  - Neutrinos - SuperNEMO
- Screen for U238, U235, Th232, K40, Co60, Cs137, Rn222 and any unknowns
- Covering three main areas
  - Germanium - based in Boulby - Higher contaminations and large components
  - ICP-MS - based at UCL/Edinburgh - Most sensitive for small components
  - Radon screening - based at UCL - designed to measure outgassing

U238 Example

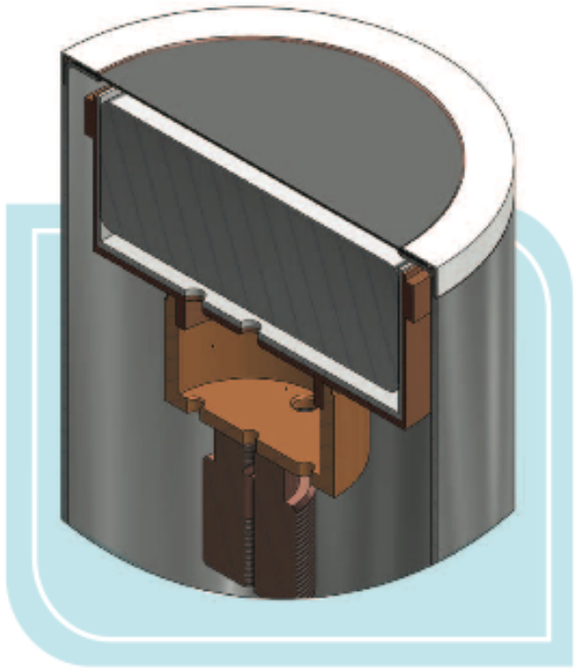
Only BEGe
Not HPGe

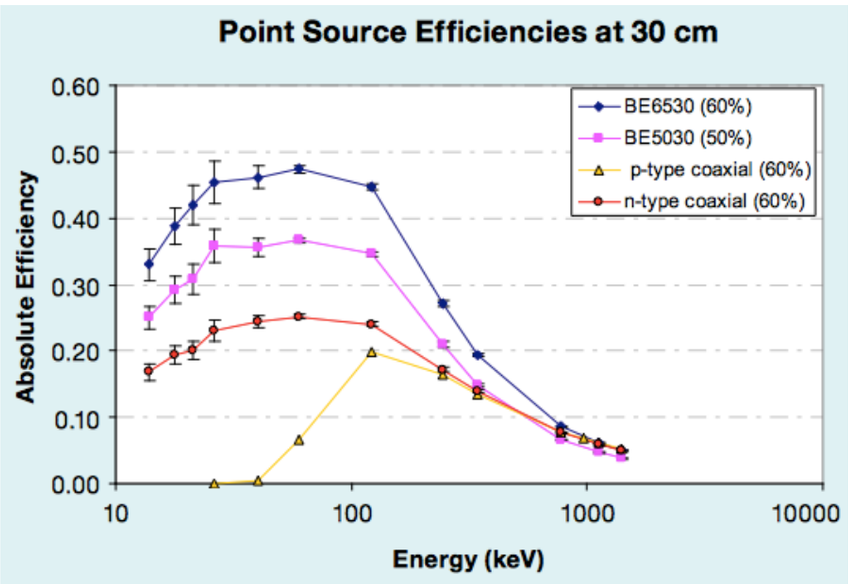


ICP-MS
HP/BE-Ge
“Radon”
Alpha Spec?

Germanium

- 2x detectors initially installed at Boulby
- BEGe - smaller crystal, incredible resolution and no dead layer at crystal face - currently have a loaner but brand new detector due next few weeks
    - Resolution ~2 keV FWHM @ 1333 keV
    - measures down to several keV
    - 800g crystal - 43% Relative Efficiency
- Custom shielding currently under construction
- Only facility currently using a BEGe detector for screening
- Suggestion that <100 counts per day in 50-3000 keV is achievable
    - Allows MDA of <100 ppt U/Th



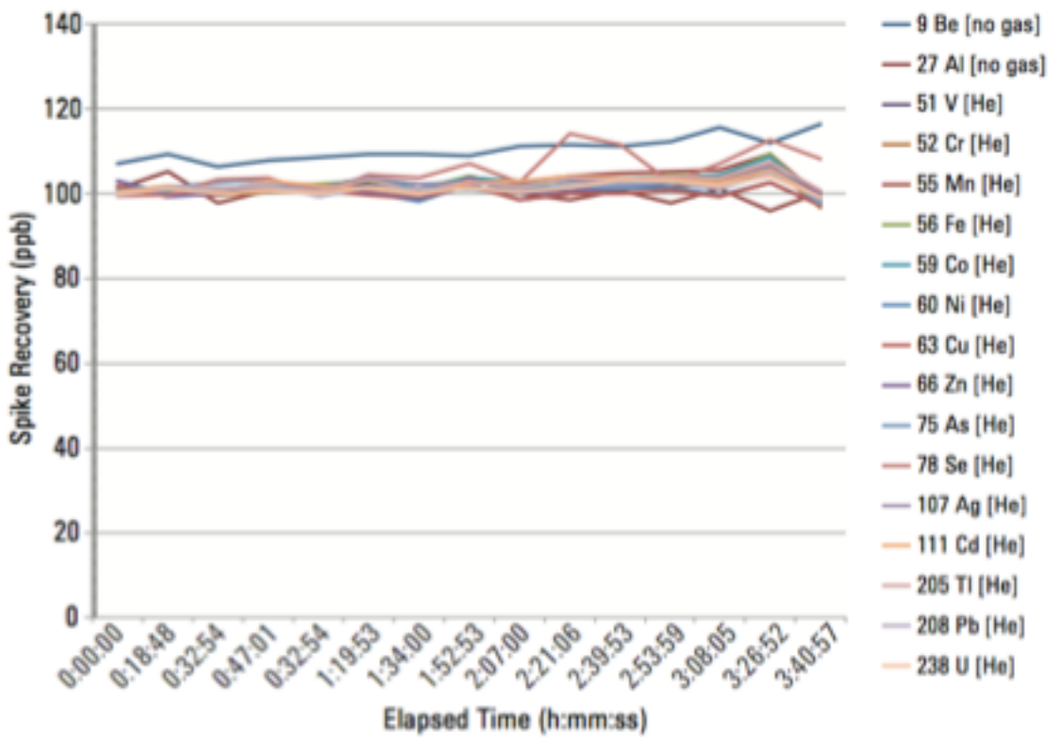


Germanium

- HPGe detector also installed at Boulby
    - Complements precision of BEGe with high efficiency
    - ~2kg p-type crystal. 90% relative efficiency
- Fully refurbished to include low background cryostat and new neck to avoid line of site
- Both HPGe and BEGe serviced by single LN2 supply
    - Also used to purge shielding
    - Prevents Rn welling
    - Only ~2 Bq/m^2 Rn at Boulby c.f. 100s Bq/m^2 at LNGS (although mitigated)
- New cleanroom to be certified soon
- Advanced simulation/analysis package under development for BE/HP-Ge detectors
    - Designed to simplify experience for all users

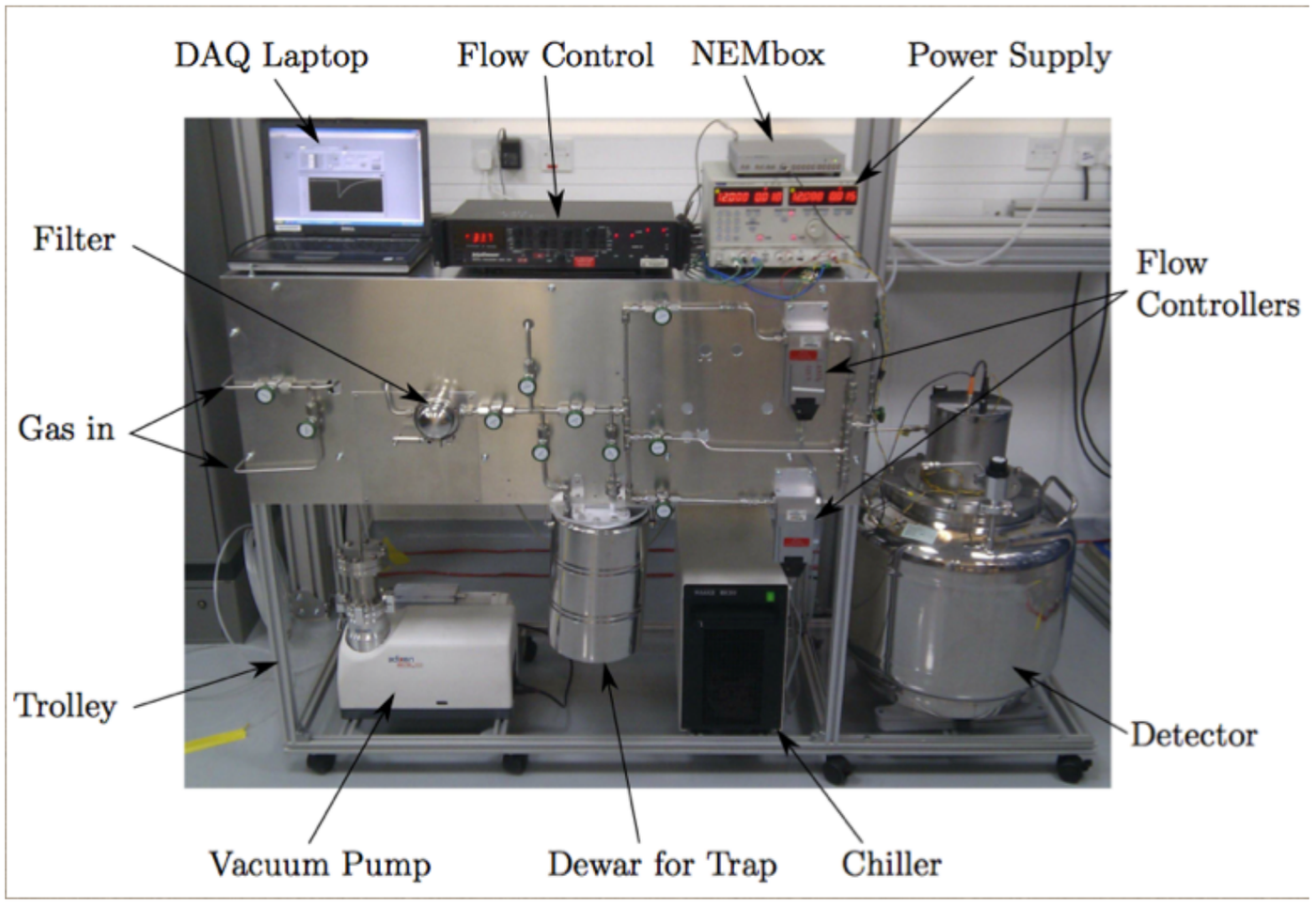
ICP-MS

- Inductively Coupled Plasma - Mass Spectrometry
- Can directly measure U/Th contamination to ppt level
- Sample preparation method is key to sensitivity
- Results available in a few days - quicker sample turnover than BE/HP-Ge
- Must also consider sample preparation time - requires human!
- Agilent 7900 procured for use at UCL - control systematics



Radon Screening

- Any radon backgrounds cannot be “fiducialised” away
- Equally important for all low background experiments!
- Radon emanation system at UCL developed for SuperNEMO reaches 0.12 mBq MDA
- Silicon PIN diode detects alpha decays from Rn progeny (+ve charges drift to -ve detector)



Conclusion

- Ultra low background components are critical to the success of many rare event search detectors
- UK screening abilities increased from single HPGe detector (with high background) to a whole suite of assay techniques
- BE/HP-Ge detectors should be operational by end of summer at the latest
- ICP-MS detector to be installed in refurbished lab at UCL
- Rn studies using SuperNEMO setup already underway
    - Additional system under design at UCL
- Should have interesting results by next DMUK meeting