Development of a High-Resolution Alpha Spectrometer (HRAS) Detector System

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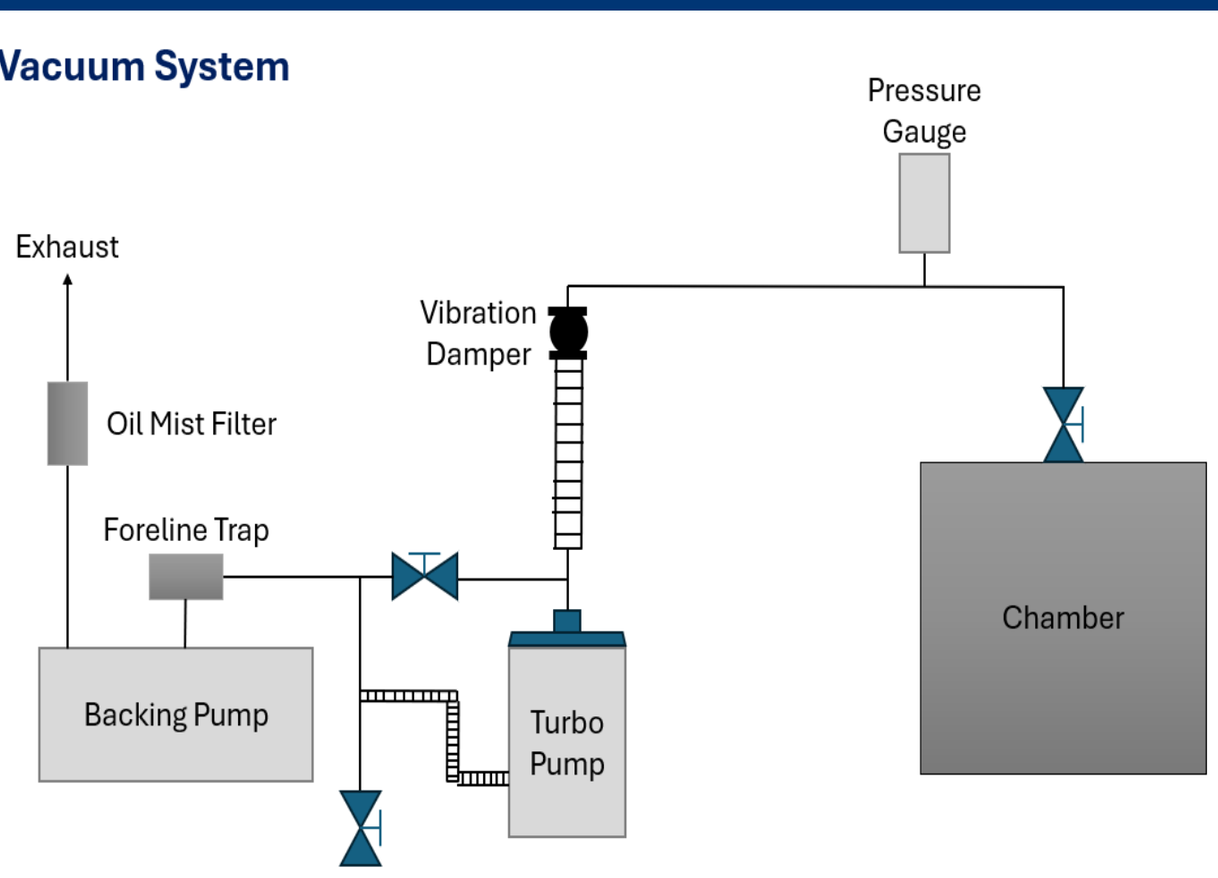
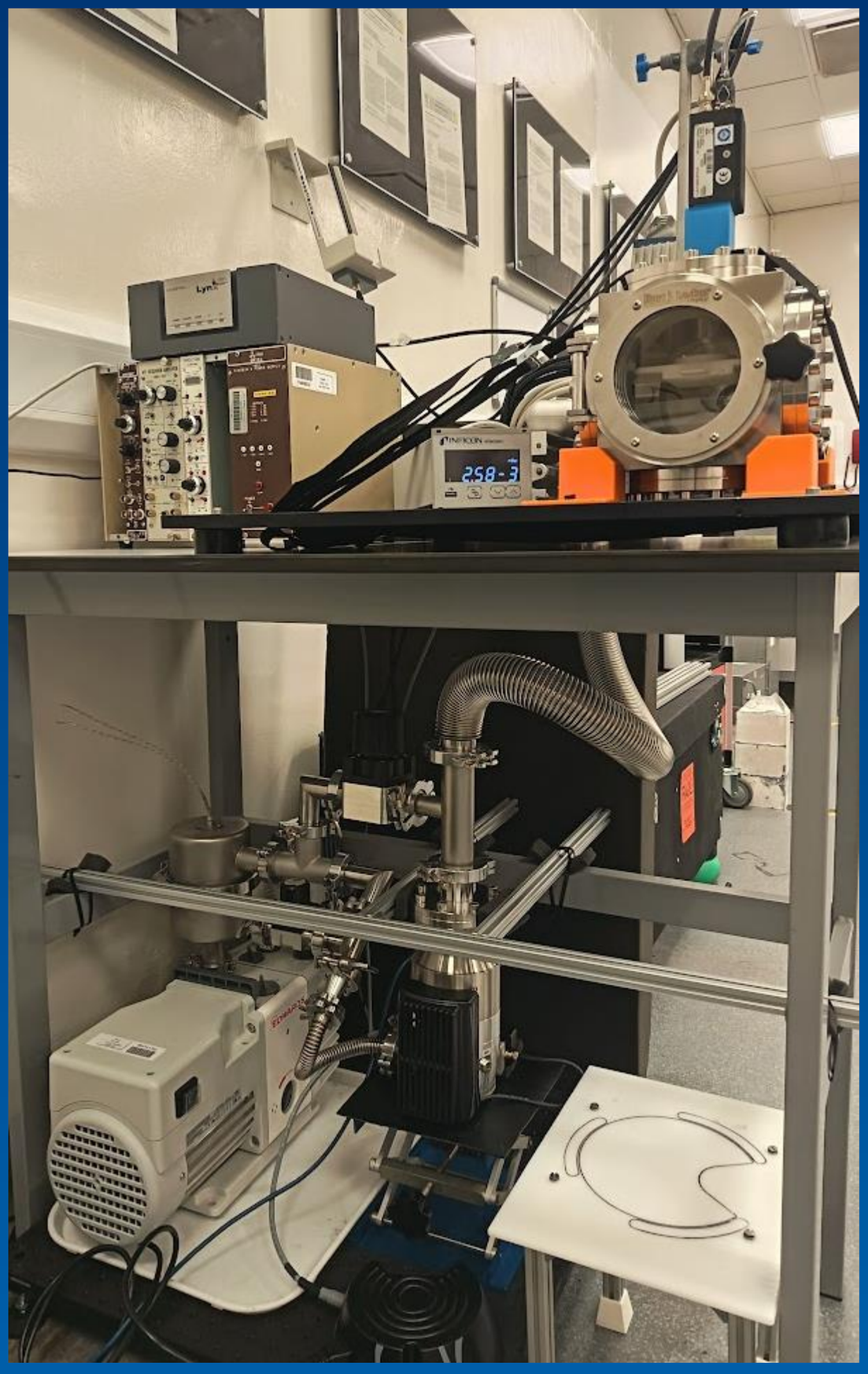
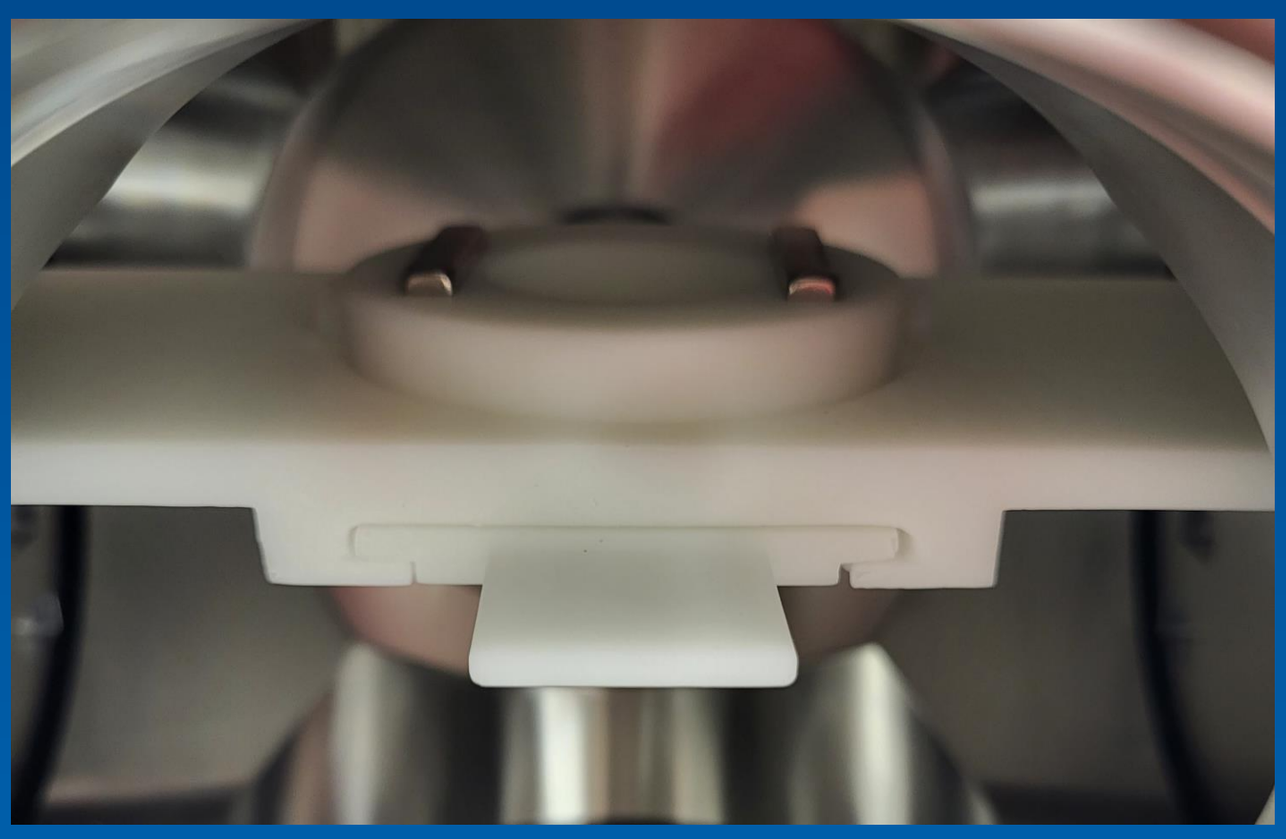
Abstract

Measurements by alpha spectrometry are required for a number of applications, including: nuclear forensics, nuclear decommissioning, environmental monitoring, nuclear medicine, and refining nuclear data. Low-resolution alpha spectrometer systems are widespread, but often the resolution is too poor to accurately determine activities of sources or identify contaminants in an unknown sample. High-resolution alpha spectrometry can resolve these issues. However, whilst it is possible to purchase high-resolution Passivated Implanted Planar Silicon (PIPS) detectors, suitable detector chambers are not commercially available. The Joint Research Centre (JRC), Geel, and The Centre for Energy, Environmental and Technological Research (CIEMAT), Madrid, are known to have developed custom detector systems suitable for making high-resolution measurements. This work describes the work done to build the new HRAS system at NPL, which will be used to develop accurate and precise alpha-particle emission intensity data for medical and forensic relevant radionuclides. This will contribute to the national challenge of developing confidence in the data being used in pre-clinical and clinical studies for cancer treatment and nuclear forensics.

Vacuum System







Features

- Ion-Implanted-Silicon Charged-Particle Detector with 25 mm^2 active area
- Backing pump: Edwards RV5 Turbo pump: TURBOVAC 90 i DN 63 CF
- Vacuum pumps and chamber positioned on separate vibration dampening platforms
- Fine mesh O ring filters near vacuum pumps, outlet and pressure gauge
- Inficon HPG400 ATM to High-Vacuum Gauge pressure gauge
- KF40 pipes used, except from when connecting to pump inlets (KF-25 / KF16) and at venting valve
- Valve positioned behind the chamber to allow for source changes without venting the whole system
- Diaphragm valves used venting outlet and chamber to prevent shock venting
- MCS: Lynx™ Digital Signal Analyzer
- Minibin HV used due to fault with Lynx
- Bespoke 3D printed sample holder with removable draw for easy access
- Bar magnets positioned around sample to reduce noise from electron emissions

MCP-004, Issue 1, July 2025

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