ADRIANA
Advanced Digital Radiometric Instrumentation for Applied Nuclear Activities
Project lead: Prof. Malcolm Joyce

ADRIANA is a suite of digital radiometric instrumentation which forms part of the UK National Nuclear User Facility. It was funded and set up in 2014 and comprises three separate facilities at Lancaster University, the University of Liverpool and the UKAEA Culham Centre for Fusion Energy (CCFE).

Capabilities

ADRIANA was established to provide researchers in the UK and their collaborators worldwide with access to state-of-the-art digital radiometric detection and measurement instruments not otherwise widely available in the UK. It comprises:

- a digital neutron assay system (Prof. Malcolm Joyce, Lancaster)
- digital position-sensitive CZT/germanium detector array with mechanical cooler (Dr Laura Harkness-Brennan, Liverpool)
- digital systems for environmental radioactivity assay including a broad energy germanium (BEGe™) and small anode germanium (SAGe™) detector systems (Dr Chantal Nobs, CCFE).

The high-sensitivity Broad Energy Germanium detector with Compton Suppression capability. The detector is hosted and managed at the Culham Centre for Fusion Energy, Abingdon

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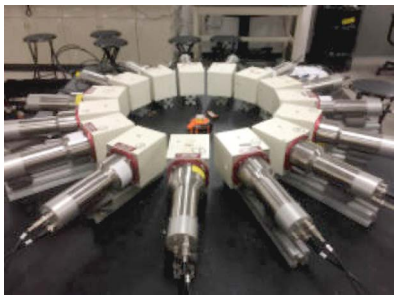


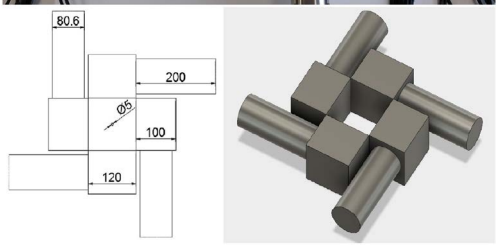
15 of the 32 liquid scintillation neutron assay system hosted and managed at Lancaster University. The image was taken during work at the Oak Ridge National Laboratory, USA, using a selection of their high-activity sources to measure neutron multiplicity

Example Uses

The digital neutron assay system at Lancaster comprises > 32 organic liquid scintillation detectors (EJ-309) and, given the frequent need to access sources of neutrons, this component of ADRIANA is portable. Users are responsible for shipping costs and arrangements (UK-based university researchers can apply to the **NNUF funded access scheme** to recoup shipping costs). The system can be used with its associated 32 channels of digital pulse-shape discrimination firmware to separate neutron events from γ-ray events and to explore coincidence phenomena or time-of-flight correlations between these events.

In the figure to the left, part of the system (15 detectors) is shown, courtesy of Elsevier, in use at the Oak Ridge National Laboratory, USA. In this set-up the system was used to record high-order neutron multiplicity events (triples and quadruples events) to investigate the angular distribution of these emissions from spontaneous fission in ^{252}Cf, for safeguards applications.

The broad energy germanium (BEGe™) and small anode germanium (SAGe™) detector systems have been used for a variety of trace-level analyses of environmental samples. For example, these systems have been used to assess the abundance of ^{241}Am in soils from contaminated land at legacy nuclear facilities, and to compare this to the contribution from other sources, such as that from the atmospheric nuclear weapons testing activities of the 1950s and 1960s. Trace assay of ^{241}Am can be used to infer minor actinide abundance and can be used to compare to complementary assessment techniques, such as accelerator mass spectrometry.



A photograph and drawings of a detector array used for the assessment of spontaneous fission neutrons from 0.3% wt. DUO2 in research utilising the ADRIANA facility at Lancaster University. The dimensions stated here (in mm) were used to verify simulation of the detector set-up in MCNP-6

Contact details

As a first step, please email either Lee Packer (**lee.packer@ukaea.uk**) or Chantal Nobs (**chantal.nobs@ukaea.uk**) for a discussion about the practical feasibility of your proposed research project.

Availability

The ADRIANA facility was open for external user access at the time of going to print. Up-to-date information about availability, in light of the COVID situation, is available at **https://nnuf.web.ox.ac.uk/adriana**.