High Flux Accelerator-Driven Neutron and Cyclotron Facilities

PI: Prof. Martin Freer

UNIVERSITY OF BIRMINGHAM

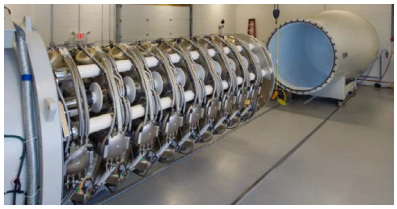
Birmingham is able to offer access to two facilities: a high flux accelerator-driven neutron facility will be available from spring 2022, and an MC40 cyclotron accelerator is available immediately.

UNIVERSITY OF BIRMINGHAM

BIRMINGHAM ENERGY INSTITUTE

A schematic of the new bunker that will house the accelerator

The University of Birmingham campus



The Neutron Therapeutics proton accelerator will be used for the generation of the neutrons

The High Flux Accelerator-Driven Neutron Facility will support the study of neutron interactions in materials for the nuclear sector, both fission and fusion. It will also offer a broader programme, extending to nuclear medicine and space.

This is the first UK neutron facility capable of providing fluxes for the characterisation of degradation of materials in the reactor periphery. It will also be the first UK facility to possess a dual beam ion facility capable of providing the necessary fluxes to easily simulate the damage incurred by highly irradiated components such as cladding in current generation plant or structural materials in Gen IV or fusion reactors.

The new irradiation capability of this facility will combine with the existing high-energy light-ion accelerator to create a single UK user irradiation facility. This will form the most intense accelerator-driven neutron source worldwide.

Nuclear materials

There has been a tendency to rely on the use of protons as a surrogate when studying materials degradation under neutron irradiation, but the validity of this is questionable. The present facility is targeted at materials which lie beyond the reactor pressure vessel, and would also support research associated with the UK nuclear defence programme.

Nuclear fission and fusion data

The measurement of a series of key reactions, many involving neutron capture with higher energy neutrons, will enable a more precise understanding of the nuclear processes associated with fusion and fission.

Nuclear waste management

The safe storage of nuclear waste requires a detailed understanding of the effects of nuclear radiations on the storage media.

High power targets

The development of many new facilities such as accelerator-driven subcritical reactors, or next generation spallation sources, involves development challenges around target design.

Medical physics

The radiobiology of neutron interactions is very important, from cancer therapy to the effect of nuclear radiation from industrial, medical and space environments. For example, the facility will be used to test drugs for boron neutron capture therapy treatment and to develop imaging modalities to better understand the doses delivered to patients.

Nuclear metrology

A well-calibrated and controllable neutron source will be useful for nuclear metrology, the testing of radiation monitoring systems, and the development and characterisation of radiopharmaceuticals.

Nuclear physics

Neutron capture reactions are an important tool in nuclear spectroscopy and nuclear astrophysics, particularly in mapping the s-process paths close to the valley of stability. The spectrum of neutrons produced will be very close to that in stellar environments.

The MC40 Cyclotron Facility is a particle accelerator capable of accelerating light ions (protons, deuterons, helium-3 and helium-4) to energies of up to 50 MeV. It performs a number of activities which range from materials irradiation and isotope production.

The **MC40 Cyclotron Facility** is available in advance of the new neutron facility being developed to support the NNUF science programme.

Contact details

Please contact **energy@contacts.bham.ac.uk** to discuss your potential project.

Availability

The High Flux Accelerator-Driven Neutron Facility, commonly referred to as the ADNIF, is currently scheduled to commence operations, and be available for access by external users, from spring 2022. Up-to-date information about the availability of the MC40 cyclotron, in light of the COVID situation, is available at **https://www.nnuf.ac.uk/high-flux-accelerator-driven-neutron-facility**.