The University of Manchester
Dalton Nuclear Institute

Dalton Cumbrian Facility
Paid Summer Research Placements

Start date: From mid-June 2023 (dates negotiable) **Duration:** 6 weeks

Location: Dalton Cumbrian Facility (DCF), Westlakes Science Park. Those taking up the placements will have an opportunity to engage in using our world-leading radiation equipment and purpose-built facilities situated in the exceptionally scenic West Cumbrian countryside. This is a stunning and very special environment in which to work, with a low cost of living and easy access to the coast and Lake District National Park. The successful candidate must have their own accommodation in West Cumbria for the duration; own transport would be advantageous but is not essential.

General requirements:

- Applicants should be studying a STEM subject at University or recently graduated from the same and also be eligible to work in the UK. A-Level students may be considered in exceptional cases.
- Good laboratory/computer and analytical thinking skills.
- Patience, dedication, time management skills and the ability to work under one's own initiative.
- Effective communication skills and the ability to work as part of a team.

Salary: The successful candidate will be paid £10.93 per hour based on a 35-hour working week.

How to apply: To apply, please send a current CV (2 pages at the most), a list of the projects you wish to apply for in order of preference, your preferred start and finish dates and a single paragraph outlining what qualities you have which will make you particularly successful in your time with us.

See pages that follow for a description of each project. Applications should be sent by email to dcfreception@manchester.ac.uk with the subject header <Summer Placements> by 5pm on Wed 17th May.

Shortlisted candidates will be invited to interview in mid to late May. Dates can be flexible to accommodate exams and other commitments. Interviews may be in person at the Dalton Cumbrian Facility or via an appropriate digital platform, e.g. Zoom or Teams.

We embrace and celebrate difference, respect and support each other, and act with integrity to benefit society and the environment by transforming and enriching lives. As an equal opportunities employer, we welcome applications from all suitably qualified persons and all appointments will be made on merit. As we are committed to the principles of the Race Equality Charter Mark, we would particularly welcome applications from the Black, Asian and Minority Ethnic (BAME) community who are currently under-represented at this level in this area. We also welcome applications from couples or other socially network groups of applicants who might aspire to work and socialise together in West Cumbria over the summer.

Projects available:

1. Tracking Radioactive Decay of a multi-isotope inventory

Summary: At DCF, we have the capability to transmute elements to make short-lived radioisotopes of medical interest using protons or alpha particles. We are currently developing the necessary infrastructure to manufacture these isotopes and process them chemically towards making new nuclear medicines. As part of this infrastructure, we wish to create a software tool through which we can create records of the amounts of several isotopes which will be created during transmutation events and then track the activity as the isotopes decay. In some cases, the isotopes will decay down a short decay chain before forming stable isotopes. The software tool will need to access a database of the possible transmutations and produce reports of the predicted radioisotope inventory at any time with a simple and convenient user interface. An important aspect of the project will be providing well documented validation, which will be achieved through testing again a set of known scenarios. This project would be well suited to someone with a computer science/programming background with instruction being given in the relevant physics of radioactive decay if necessary.

2. Inhomogeneous radiation chemistry

Summary: When ionising radiation interacts with liquids, nanometer-scale pockets of highly reactive radicals, ions and electrons are created which can then react together. The resulting chemical kinetic system is a highly inhomogenous with the spatial distribution of the various species dictating the outcome. The chemical yields are very sensitive to the details of the reaction mechanism and hence they represent a key challenge for chemical kinetic modelling. Furthermore, the understanding produced by such modelling is key to underpinning both safe handling of nuclear energy and the treatment of cancer patients by radiotherapy. Drawing on the methods of theoretical quantum chemistry, working in collaboration with the Mathematics department, we are currently developing a new approach to modelling radiation chemistry reactions. The student undertaking this project will be simultaneously introduced to new mathematics and the relevant computer coding techniques through a series of graded challenges whilst literature survey and ongoing interactions with members of the Currell-Webb inhomogenous chemistry research group will provide a grounding in the background theory. Once these new skills are in place, the student will be able to develop their own novel simulation in a subfield of their own choice, relevant to either nuclear energy or radiation-based cancer care.

3. Biobox development

Summary: This project is concerned with the development of Biobox – an experimental setup designed for automated handling of irradiated RNA and other biological samples within a protective casing. For example, the development of this modular system requires programming of the robotic arm accommodating the motor and mounted "spinning wine glass" (https://doi.org/10.3390/app112311081). This project is particularly suited to someone with expertise and interest in any of automation, control, robotics and Arduino programming.

4. Automating Radiation Synthesis of Metal Oxide Nanoparticles for Applications in Nuclear Medicine

Summary: This project involves further development and testing of a new platform for an automated synthesis of metal nanoparticles. More specifically, you will synthesise, both radiolytically and in conventional chemical manner, a series of zirconium oxide nanoparticles under various conditions. This approach will allow for a systematic investigation into the factors controlling the morphology and chemical composition of produced zirconia nanomaterials. A particular feature of this project is that in addition to the student involved being able to perform the synthesis manually, they will also trial nanomaterials' fabrication using a fully automated radiation chemistry synthesis module able to do the same under computer control. A team of Engineering (EEE) students has developed and commissioned this synthesis module earlier this year. The student conducting this project will be able to test and characterise the various components of this system, finally using the full implementation to conduct automated synthesis, to be compared with the manual counterpart.