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DALTON CUMBRIAN FACILITY
NEWSLETTER

July 2021

WELCOME

Dear friends, colleagues and collaborators,

It is ever a time of challenge, change and growth in the life of a cutting-edge research institute such as DCF. As we cautiously move out of lock-down, I reflect that this is a particular time of regrowth and rebirth as we look forwards to DCF's return to full capacity in the months ahead.

It is a testimony to the dedication and professionalism of all of our staff that we have managed to continue operations at a very high level in spite of the covid-imposed challenge of having only 50% of our team on site at any time. Responding to this challenge has resulted in new and better ways of doing things which we will keep going forwards. One example is the deployment of a suite of cameras which allow users and operators to collaboratively monitor experiments remotely and ameliorate occupancy limits. I have already benefitted from this new capability several times, including during the first tests of our robotics and a new thin-sample handling system – you can read more about this development in the Equipment Development section below.

Our guest profiles illustrate long-standing relationships capable of meeting challenge in the nuclear industry and also of personal growth. Stephen Hepworth's profile is illustrative of the ever strengthening and mutually beneficial relationship we have with Sellafield and the wider nuclear industry. This relationship is further illustrated in the profiles of Darryl Messer and Alex Potts, two of our outgoing PhD students who are now moving into key roles in the nuclear sector. Whilst we are sad to see them leave, and we thank them for their contribution to DCF, we are also glad to see their professional progression and look forward to continuing to work closely with them in their new roles.

The theme of growth continues as we happily welcome 2 new members of staff to our team at DCF:

Sally Wilson joined in May as a Laboratory Technician for Maternity cover. Sally has a degree in Genetics and a BA in Business Management, she enjoys fell walking, mountain biking, skiing and yoga along with meeting new people and is delighted to be selected for this temporary contract.

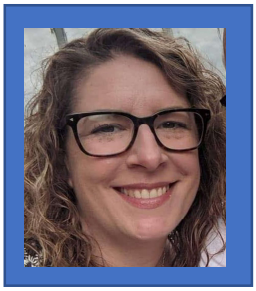
Amy Johnson joined us in June as a Research Programme Administrator working between DCF and REEL. This job is somewhat of a career change for Amy as she previously provided administrative support for Theatre by the Lake in Keswick Workington Town Council; she has a Masters in Contemporary Fine Art and still dabbles in photography and exhibitions occasionally.

I was reminded of DCF's growth and research diversity at the recent Association for Radiation Research's annual meeting. A good friend of and regular visitor to DCF, Steve Walters, really set the scene with his plenary talk 'The big wide world of radiation chemistry' which showcased the diverse applications of radiation chemistry from processes out in space, through to subterranean concerns of deep geological repositories for long term nuclear waste. DCF provided 5 talks at this 3-day meeting on topics such as radiolytic processes at oxide interfaces (2 talks), gamma-induced modification of 2D crystals, how irradiated nanoparticles can improve cancer therapy and a showcase of the unique capabilities DCF offers the UK's radiation science research community.

Challenge, change and growth are themes present in the recently published 'Nuclear energy for net zero: a strategy for action' which we highlight in the final article of this newsletter. We look forward to working with many of our stakeholders to meeting these challenges. It has been a long time since we have been able to meet collectively face-to-face as the community of DCF-stakeholders to discuss overcoming such research challenges. As we emerge from lockdown, I am optimistic that we will soon be able to re-instigate our stakeholder meetings. We are just starting to plan this now so watch this space and stay safe.

Fred Currell
Director of DCF

Lian Murdoch
Editor

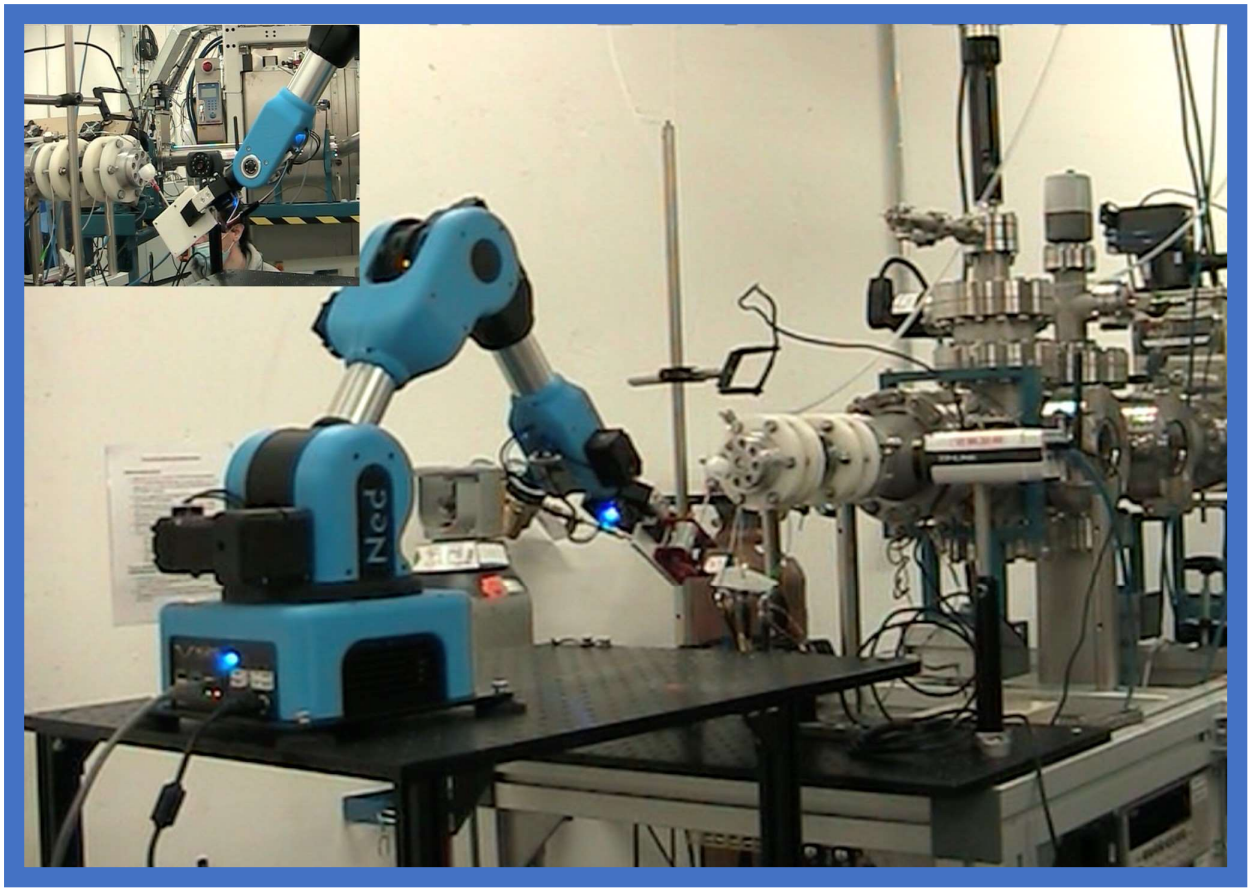


EQUIPMENT DEVELOPMENT

New Equipment: Niyro Ned Robotic Arm

We are pleased to introduce new equipment capabilities to DCF, the acquisition of a robotic arm for use in experiments.
This arm can be used for precision placement and adjustment of samples, the samples are held onto the end of the arm with a specific holder tool attached to the hand of the robotic arm.
The arm then uses reverse kinematic algorithms to place the hand in a user specified position or on a user specified trajectory. This arm opens up a whole new world of sample handling solutions on the ion beam, particularly on the radiation chemistry beamline.
The arm can place its hand anywhere in a 40 cm radius hemisphere to within a millimetre, it can also trace out pre-programmed routes through this area, to the same accuracy.
The arm has multiple interchangeable hand tools, which include a gripper, a suction cup, and an electromagnet, these are used to hold samples.

The images below are of the arm being used to place a new thin liquid sample holder into position on the ion beam, on the radiation chemistry beamline.



GUEST PROFILE'S

Stephen Hepworth
The Senior Scientist, Sellafield Ltd

How long have you worked at Sellafield Ltd?
Since 2002, though I first entered BNFL in 1986.

Tell us about your career so far.
I began my career as a Medical Physicist in Radiotherapy at Poole in Dorset after completing a PhD researching 3D polymer gel dosimetry for use in conformal radiotherapy.

Moving into a routine clinical setting was a shock and frankly quite dull so I soon moved and spent 2 years writing War-games for the MoD. This was interesting but too much screen time and I really wanted to move back into Physics, so I got a job as a Radiometric Physicist at BNFL Instruments. I stayed in this role for a few years but wanted more diversity, so I moved over to join the main Sellafield BNFL business (now Sellafield Ltd) as part of a Decommissioning Technical Development team.

I knew early on that this was a good move and for the first time in my career I had some serious motivation. For several years I became more involved in many aspects of R&D from aerial vehicles, laser cutting, decontamination, virtual environments, and robotics and of course Radiometrics, taking on management and lead roles along the way.

After some years I was asked to lead a scientific and engineering study called the Ground Environment Management Scheme [GEMS for short] essentially leading the development of a scheme for reducing, measuring and dealing with leaks from the MSSS. This move gave me more exposure to additional areas of the business and allowed me to lead a multi-disciplined team on a really important aspect within Sellafield which lead to me being asked to take over the role of Head of Technical Standards and Assurance after just 2 years, my most responsible role to-date!

I learnt a lot during the years I was leader of R&D at Sellafield Ltd, however I soon realised that I really enjoyed and missed R&D, and so started planning my journey back to my current role as Senior Scientist.

Tell us a bit about your role now, what is most rewarding?
The primary part of my current role is to establish and broker links between academia and the Sellafield science community, and to put activities in place that gain better value for both the academic institutions and for those involved at Sellafield. I'm getting more scientists involved in more academic interactions. I see this as really important because it benefits them in that it increases their capability and provides fresh perspectives for them.

In addition to my main job I am also the Physics Scheme Leader for those on the graduate scheme, or indeed any other employee working towards a qualification with the Institute of Physics.

The most rewarding part of my job is helping earlier career people to achieve their ambitions, such as being awarded a PhD or perhaps a move to a different role in another department.

What do you do when you aren't working?
I love scuba diving and fell walking. I've dived on shipwrecks all around the UK from the remaining German High Seas fleet in Scapa Flow to battleships in the English Channel. My favourite dive destination is Lyme Bay of the South Coast where there are over 400 known shipwrecks. As for fell walking, I often go in the evenings during the week when they are deserted.

Darryl Messer
Former DCF PhD Student

When I was studying for my PhD at DCF my project investigated the radiation-induced reactions that occurred inside the gas headspace of store plutonium canisters. Of course, as someone with very little experience in a radiation environment it was not possible for me to get my hands on some of the good stuff (real plutonium) so instead my project was designed around using the DCF Co-60 Irradiator and surrogate materials.

I did the majority of my work at DCF mixing different compositions of H_2, O_2, N_2 and Ar to mimic the different gas phase environments between the different types of stored plutonium, and then observed the consumption of H_2 and O_2 after irradiation to investigate the mechanisms of reaction.

I was also lucky enough to be the first person (and hopefully not the last) able to use Thoria (ThO_2) at DCF and was able to observe some interesting effects such as anomalous consumption of O_2 which was not the result reactions with H_2.

I am now working as a Nuclear Consultant for Tuv-Sud Nuclear Technologies in the Waste Management and Decommissioning team. I provide insight and expertise into projects working with the likes of Sellafield Ltd, NNL and the NDA, I've even managed to use skills from my PhD to secure work in the form of literature reviews! This job helps me get the best of both worlds by applying my academic knowledge to problem solving on an industrial level as well as offering me a wide breadth of experience across multiple projects and disciplines across the nuclear industry.

I thoroughly enjoyed my time at DCF and I'm glad that I'll only be down the road and can pop in for a natter whenever. Unfortunately for the team at DCF this isn't the last time you'll hear from me (or Five Days North).

Alex Potts
Former DCF PhD Student

I started my PhD in 2016 at the Dalton Cumbrian Facility (DCF), investigating how radiation, Gamma in particular, influences the properties of concrete. Cement and concrete are used throughout the nuclear industry, ranging from waste encapsulation and radiation shielding to structural buildings. Given the ubiquitous nature of concrete throughout modern day life, it remains a complex and fascinating material to research.

My research had two distinct areas. The first area concerned laboratory-made cement samples that were subjected to accelerated gamma radiation doses, which is the most common method used for research in this area. This series of experiments examined gamma radiation alongside carbonation, showing that gamma radiation changed the type of carbonate formed with a new hypothesis as to the cause of this presented to the community.

My second area of research involved characterising decades-old samples, from Sellafield Ltd, including samples produced during the construction of a highly engineered interim nuclear waste store. This area was of particular interest to Sellafield Ltd. due to the interim waste store potentially having to operate past its initial design life. Understanding of the material, and any changes that have occurred over its lifetime, is vital in assessing whether operating past the design life is feasible. This real-world applicability of the research encouraged a strong sense of synergy with the nuclear industry. Characterisation showed radiation only had small effects on the microstructure of the retrieved concrete samples, and the results could be used by Sellafield Ltd as a contribution to the safety case, as part of a larger body of work, to extend the life of the interim waste store.

Having enjoyed the industrial aspects and the sense of contributing towards the U.K. nuclear industry, I decided to pursue a career in the nuclear industry upon finishing my PhD. Having specialised in radiation effects on cement and concrete, I joined NNL's Immobilisation Science and Technology team in October 2020. Since starting, I have worked on several different projects, including developing potential encapsulant formulations for emerging nuclear waste streams, Sellafield focussed decommissioning projects and as part of the EU funded PREDIS project, which is developing waste treatment methods which have applications across the international nuclear community.

A STRATEGY FOR ACTION

On 15th June 2021, The Dalton Nuclear Institute launched a position paper on the possible role(s) of nuclear energy, particularly Advanced Modular Reactors, in net zero:

Nuclear energy for net zero: a strategy for action

Net zero by 2050 is huge challenge for this country and as an impartial academic community we have a responsibility to support our colleagues in government and industry. This paper, co-authored by William Bodel, Gregg Butler and Juan Matthews, provides a roadmap detailing the eight key actions required to assess the role of nuclear energy in the UK's net zero future objectively.

The report examines the potential roles for nuclear energy in the context of net zero by 2050, making a number of recommendations to support a fully informed, evidence-based approach to decision making in selecting the most appropriate decarbonisation options.

Research at DCF will continue to underpin our collective understanding of the behaviour of materials and processes in nuclear energy environments, providing information essential to the development of the technologies that can provide the firm power, district heating and high temperature heat required. We look forward to working with our whole research community in making net zero a reality.

You can read Francis Livens', Director of the Dalton Nuclear Institute, piece outlining the recommendations of the roadmap in the Policy@Manchester blog here.