Photon-Neutron Techniques for Magnetism in Carbon Nanomaterials

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This studentship will pioneer inorganic-nanocarbon structures studied using a novel technique that *combines Neutron spectroscopy with photon irradiation* (from microwaves to UV) in cutting-edge experiments for the design of hybrid tunable magnets.
Charge transfer and an enhanced exchange interaction at the interface between carbon molecules and 3d transition metals have resulted in an emergent magnetism that defeats even the Stoner criterion in copper or manganese. This spin ordering can be used to engineer metamagnets with novel functionalities: from non-corrosive magnets to spin polarised semiconducting layers.
In the case of 3d ferromagnets, the carbon-induced hardening can be used to tune the exchange and anisotropy; for example to increase BH product without the need for rare earths, or to open new paths to study the DMI interaction.
However, the analysis of these hybrid structures is hampered by the difficulty in distinguishing between the contributions of each layer in the structure.
Furthermore, combining magnetic with electrical and/or microwave signals will be essential to future technological developments –e.g. in molecular spin switches or low-dissipation devices with molecular magnets.
The work will include the development of capabilities such as ferromagnetic resonance-polarised neutron reflectivity (FMR-PNR) and optical irradiation during Neutron diffraction at ISIS Neutron and Muon Source. These methods will be combined with measurements at Leeds (magnetometry, FMR, spectroscopy, etc.) and possibly the use of other facilities (Xray and low energy muon spectroscopy with our collaborators at the ALBA synchrotron in Spain and PSI in Switzerland).