

The University of Southampton (UK) and the Institut Laue-Langevin (ILL, Grenoble, France), jointly invite applications for a three-year PhD programme focusing on the

Inelastic neutron scattering of endofullerenes

Fullerenes are a remarkable range of materials consisting of closed symmetrical cages, entirely composed of carbon atoms. It is possible to trap small molecules inside the cages by chemical means. Substances with molecules trapped inside the fullerene cage are called *endofullerenes*. Each encapsulated molecule behaves as a "particle in a box" according to the laws of quantum mechanics. Furthermore, if the molecules contain nuclear or electron spins, then these spins may interact with the quantized motion of the molecules in the cages in an interesting way. In some circumstances, this interaction leads to greatly enhanced nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI) signals, leading to potential applications in materials science and clinical medicine.

The Department of Chemistry in Southampton (UK) hosts one of the few laboratories in the world with the expertise and facilities for making endofullerenes. We have already studied endofullerenes with hydrogen molecules, water molecules, and hydrogen fluoride molecules trapped inside the carbon cages. In our new project, we will trap single helium atoms in the cages, and also larger molecules such as methane, ammonia, and molecular oxygen. This has not been done before so no-one knows how these substances will behave and what properties they will have. Neutron scattering is important since it makes visible the quantized energy levels in a way that other methods cannot.

This project will give the successful candidate the opportunity to take part in a highly interdisciplinary basic science project which has promising long-term applications. As well as the neutron scattering work at the ILL, the project student will interact with NMR and infrared spectroscopists based at Southampton and elsewhere. No synthetic chemistry will be required of the project student. An interest in molecular physics, quantum mechanics, and chemistry will be of value.

The PhD project will be located in Southampton (UK), and at the ILL. The successful candidate will be employed for a period of up to three years, with a gross salary of around 2350 €/month, together with other benefits depending on the student's social status (for more details see: <https://www.ill.eu/careers/all-our-vacancies/phd-recruitment/phd-work-at-the-ill/>). A team of experts, including Professors Malcolm H. Levitt and Richard J. Whitby at the University of Southampton, and Dr Stéphane Rols at the ILL, will supervise the work of the PhD student.

Applicants should have a degree in a relevant physics or chemistry discipline. Academic knowledge of quantum mechanics, molecular physics, or magnetic resonance, will be appreciated.

Supervisors: Malcolm H Levitt (University of Southampton), Richard J Whitby (University of Southampton) and Stéphane Rols, ILL (Grenoble).

Contact information:

Malcolm H Levitt, (+44) 23 8059 6753, mhl@soton.ac.uk
Richard J Whitby, (+44) 23 8059 2777, R.J.Whitby@soton.ac.uk
Stéphane Rols, (+33) 4 76 20 78 25, rols@ill.eu