NEUTRONS FOR SOCIETY

ILL and ESS bring together global neutron science community to tackle society's biggest challenges

11th October 2018: Grenoble, France – Institut Laue-Langevin (ILL) the world's flagship neutron facility, hosts the global neutron community in its hometown to discuss the future of neutron science in Europe and highlight cutting-edge research in the field.

Neutron science is critical to Europe's scientific impact. The ILL has enabled globally significant research in this field for over 50 years, where academics and industry have supported global efforts to tackle some of society's greatest challenges; paving the way for better health, greener energy solutions and improved technology. The approaching commissioning of the European Spallation Source (ESS) neutron science facility further demonstrates the continuing importance of the field and the demand for next generation facilities with diverse capabilities and supporting expertise.

The strength of neutron scattering relies to a major extent on the fact that large scale facilities offer a highly specialised set of investigation tools to the community of scientific and industrial users. To enable the closest possible dialogue and showcase the latest developments made possible by neutrons across a diverse range of research areas, ILL and ESS will meet their user community at a major event on 10-12th October. The ILL-ESS User Meeting will be a platform for collaboration, exchanging ideas and techniques with the aim of shaping the services of the future.

The ILL's powerful neutron source feeds some 40 state-of-the-art instruments that are constantly being developed and upgraded to meet advances in the field and the evolving needs of its users. In fact, a total of €132 million euros across three modernisation programmes has been invested to date since 2000, with a further €40.3 million planned by 2023. This forum will also be used to present the achievements of ILL's current instrument modernisation programme, Endurance and present plans for its next phase focusing on instruments and auxiliary infrastructure to satisfy the expectations of the user community far into the next decade.

Just a few of these exciting stories include:

- **Recreating the origins of life on Earth** – How life started remains a mystery. To understand how it all began, we need to take a look at the conditions that might have led to the first living cell. Researchers are recreating the same harsh, volcanic environment of the early Earth in the lab, establishing the first ever laboratory dedicated to answering the question of the perfect conditions to foster life. Neutrons from sources like ILL, will enable close monitoring of how life evolves in these environments.[1]

- **Measuring the impact of air pollution on our lungs –** Neutrons are a necessary non-disruptive tool to see how membranes and cells are organised. In order to identify how the cells in our bodies are impacted by poor air quality, researchers have used state of the art instruments at ILL to analyse how low levels of pollutants like carbon nano-particles affect the lining of the lungs.[2]

- **Understanding the mechanisms behind Alzheimer's disease** – Alzheimer's disease impacts on over 30 million people around the world. It is associated with the build-up of tissue, or 'plaque' in the brain, which researchers are trying hard to understand. Only with a clear description of how

[1] Maikel C. Rheinstadter, McMaster University
[2] Katherine Thompson, Birkbeck, University of London

this tissue behaves can scientists then look to develop drugs to help prevent the development of this debilitating disease. Neutrons are playing a significant role in allowing researchers to look at and monitor this process, and learn about the structures at play.[3]

- **Better engineering solutions through the use of neutrons** – We rely on materials used in extremely harsh environments and conditions; just take engines of aeroplanes or nuclear powers stations, which have to perform at either extremely high temperatures and / or very aggressive environments. Without an in-depth understanding of how these materials perform from the atomic level to whole component scale, 'over-engineering' of components, i.e. making them bigger than probably necessary, is inevitable. In a time when we are trying to make transport more fuel efficient and reduce the carbon footprint, the size of these parts need to be optimised, without reducing safety. Researchers are using world-leading instruments at ILL and other neutron scattering facilities to perform such analysis, even on full-size components of aircraft engines.[4]

- **Revealing the secrets of magnetism** – The intriguing impact of magnetism has played a huge role in modern day society, no less because it has revolutionised how we store data. The study of multi-ferroics – the ability to control magnetism not just through electric currents, but voltage – is particularly important in this day and age as it could hold the secret to better, more energy efficient storage for computers. Neutron scattering holds the key to unlocking new levels of understanding magnetism.[5]

- **Exploring new materials to assist better drug design** – Membrane proteins are key in directing future drug design, yet are difficult to study since they frequently lose both structure and function if removed from their surrounding environment. New methods that involve capturing the protein within a lipid-polymer nanodisc, combined with advances in neutron scattering experiments, will help to study these proteins in a way not possible before – potentially leading to not only new advances in drug discovery, but in the development of more efficient pesticides too.[6]

- **Finding the best materials for energy storage –** Energy storage is a must for renewable options such as wind and solar power and plays a key role in the development of more efficient, electric vehicles. In order to store this energy in practice, however, we need to be able to adequately predict the lifetimes of the materials used, such as those found in lithium ion cells that electric cars run on. Neutrons are enabling researchers to analyse the materials and processes involved in future batteries, in real-time.[7]

- **Designing more effective HIV drugs –** HIV-1, the virus that causes AIDS, is a serious health challenge worldwide. HIV-1 protease, an enzyme responsible for the maturation of the virus, is a key target for drug design for HIV-1 as, without the activity of this enzyme, the HIV-1 virions remain non-infectious, halting the development of AIDS. The design of these drugs has been led by knowledge of the structures of HIV-1 protease as determined by both X-ray and neutron crystallography, with the latter research conducted using resources at the ILL and ORNL. With a

[3] Maikel C. Rheinstadter, McMaster University
[4] Michael Preuss, University of Manchester
[5] Markus Braden, Universitat zu Koln
[6] Karen Edler, University of Bath
[7] Helmut Ehrenberg, Karlsruhe Institute of Technology (KIT)

more detailed portrait of the drug binding to this enzyme, researchers now have new ways of enhancing binding and reducing resistance of the enzyme.[8]

Professor Helmut Schober, Director of the ILL, said, “Neutrons are an important tool for researchers around the world. They are non-destructive and can explore deep inside matter, so they are an ideal probe for most materials and therefore useful for a broad range of applications, from energy to health. Involving our users in discussions on how best to shape our future tools will ensure we meet their needs and deliver the best scientific outcomes for Europe and beyond. This meeting is therefore an exciting opportunity for the neutron community, whether scientific or industrial users, to design the way neutrons will continue to support scientific and technological developments in the areas of highest societal relevance.”

Professor Dr. Andreas Schreyer, Director for Science at ESS, said ”As we are in the process of building the next generation research facility, this meeting is a valuable opportunity for us. It provides a good platform to interact with a large number of highly qualified scientists, discussing their needs, ensuring that the instrument suite we are developing meets the needs of future science. The meeting and discussions also provide important input to make sure the next set of instruments being planned adds maximum value and unique possibilities for the science community. We are a facility developed together with the users, for the users. This first joint user ILL - ESS user meeting is a great success and we are looking forward to hosting the next one in two years.

About ILL - the Institut Laue-Langevin (ILL) is an international research centre based in Grenoble, France. Funded by France, Germany and the United Kingdom, in partnership with 10 other European countries, it has led the world in neutron-scattering science and technology for almost 40 years. ILL operates one of the most intense neutron sources in the world, feeding beams of neutrons to a suite of 40 high-performance instruments. Research conducted at ILL covers a wide range of disciplines such as biology, (green) chemistry, materials science, condensed matter physics, as well as fundamental and nuclear physics. Within the framework of FILL2030 (a project funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 731096), the ILL is designing its new business model to support the neutron users community with optimised services and financial resilience beyond 2030. www.ill.eu

About ESS - the European Spallation Source (ESS) is a multi-disciplinary research facility based on the world’s most powerful pulsed neutron source. ESS is a wide European collaboration, currently under construction in Lund, Sweden. This next-generation research facility will deliver transformative capabilities and extend the technique to new domains of science. ESS interacts with the international research community in order to ensure that the instrument suite meets the needs of science, enabling scientific breakthroughs and addressing some of the most important societal challenges of our time. www.europeanspallationsource.se

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[8] Andrey Kovalevsky, Oak Ridge National Laboratory