NMI3: Integrated Infrastructure Initiative for Neutron Scattering and Muon Spectroscopy

Neutron scattering and muon spectroscopy are two important methods for investigating the structure and dynamics of materials at the atomic scale, including magnetic properties. One main objective of NMI3 is to allow European scientists access to the full range of neutron and muon instrumentation and expertise in Europe, so they can choose that which is best suited for their particular scientific problem. Another objective is to undertake joint technical development work that can significantly improve the capabilities of these research infrastructures.

THE ALL-PURPOSE ATOMIC SCALE RULER

To measure your hand, you can use a ruler. To measure the distance between atoms, or even inside an atom, you need a miniscule 'ruler' similar in size to the atom – and that is where neutron scattering and muon spectroscopy come in.

The subatomic particles known as neutrons offer unique possibilities for the study of solids and liquids – what physicists call 'condensed matter'. Unfortunately they are difficult to produce, needing either a nuclear reactor or a large particle accelerator, which is used to bombard a metal target with protons. As neutrons have no electric charge, they can penetrate deeply into materials and interact directly with the atomic nuclei or via their magnetic moment with microscopic magnetic fields.

Neutrons can be produced with the same range of wavelengths ('size') as the typical distance between atoms, and the same range of energies as typical atoms moving at room temperature, so they can tell scientists a lot about the nature of materials at the atomic scale. As neutrons are equally very susceptible to magnetism, they can also be used to explore the magnetic properties of materials.

Muons are exotic particles produced by the decay of other particles known as pions. They are like very heavy electrons, with a single negative charge, and exist for just two microseconds before they themselves decay. During this short life, however, they too make very useful atomic probes. They can be produced using the same proton accelerator that is used to produce neutrons.

Muon spin spectroscopy (μSR) uses a beam of what are called 'spin polarised' muons to examine the magnetic properties of atoms. As well as research into magnetism and superconductivity, μSR is useful in chemistry because muons can behave in a similar way to hydrogen ions.

In short, neutron scattering and muon spectroscopy are extremely useful basic tools that scientists can use to investigate many scientific fields. For example: condensed-matter physics, materials science and chemistry; biosciences; nuclear and elementary particle physics; engineering sciences. By integrating all aspects of both techniques in Europe, the NMI3 project is making significant contributions to the research base that underpins European technological development.

SEVENTH FRAMEWORK PROGRAMME

EUROPEAN COMMISSION

GIVING USERS A FREE CHOICE

One of NMI3's key focuses is to give researchers open access to the various neutron and muon facilities across Europe. The very specialised research community who use neutron and muons seeks to enlarge their community to scientists in other fields in order to promote the possibilities and advantages of their techniques. The first NMI3 project prepared the relevant dissemination tools and the continuation project in FP7 aims at building an even stronger user community. The European Neutron and Muon Portal (developed under FP6) serves as an information hub and is evolving into a communication platform within FP7.

Several technical solutions developed under FP6 have already found application in new instruments and hence have improved research possibilities for users. An NMI3 objective is also to prepare European Neutron Scattering and Muon Spectroscopy Research Infrastructures to meet the challenges posed by increased international competition through third generation neutron sources in the USA and Japan.

NMI3 has already made great progress in developing new technologies to further research, and work in this area will continue. Muon researchers will focus on redesigning several key elements of their instruments. Neutron researchers are looking into the benefits of polarisation and how this can be used to further the study of magnetic systems as well as small angle and ultra small angle neutron scattering.

All research results will be accessible to project members. Sharing results and networking between researchers is a key part of the neutron and muon spectroscopy infrastructure. Several workshops are planned to aid in the internal dissemination of results as well as the sharing of best practices between researchers and research centres.

Project acronym: NMI3

Funding scheme (FP7): Integrating Activities (IA)

EU financial contribution: €9 987 357
EU project officer: Christian Kurrer

Duration: 48 months
Start date: 1 February 2009
Completion date: 31 January 2013

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