

ATTRACT TWD Symposium: Trends, Wishes and Dreams in Detection and Imaging Technologies



Contribution ID: 156

Type: **not specified**

Trends towards Ideal Thermal Neutron Detectors: How good can it get?

The Helium-3 crisis, which started in 2009, has by now become the Helium-3 reality, has spawned an intensive R&D effort for replacement technologies for neutron detectors. Neutron Scattering, which made up ca. 40% of Helium-3 demand prior to the crisis was particularly hard hit. These development efforts, along with several new facilities present under construction, including the European Spallation Source in Lund Sweden, have also revitalised the search for better performing neutron detectors that enhance the ability of the next generation of neutron instruments, by allowing the instrument to assert higher performance requirements on the detector technology. This quest for replacement technologies has been a pan-disciplinary effort, and has already almost achieved equivalence with the performance of Helium-3 detectors.

Neutron detector performance is primarily characterised by the neutron converter, which interacts with the neutron via a nuclear reaction to produce daughter products which are detectable. To identify the trends over the next decade, and in the spirit of this search for better performing technologies, viable converters and their realistic limits of performance are determined.

With a survey of present day state of the art, an outlook is given on the potential “headroom” in improved technology performance that could be achieved with a development programme in the coming decade, given present technology trends. Spatial resolutions of such sensors could improve from mm to microns, neutron rate performance by more than a factor of 1000, timing resolution by more than a factor of 100, larger areas are possible, and background levels could be reduced by at least 1 or 2 orders of magnitude. A broad canvas of technological improvements in micro-mechanics, electronics, mechatronics, integration and data utilisation will be required to achieve this.

Such improvements will significantly impact present neutron interrogation techniques, and also open the doors to this miniturisation of instrumentation utilising neutrons, which is a wider technological trend in society. The quantum leap in performance which could be afforded by such a development programme also allows wider application of neutrons to industrial and societal challenges of the coming decades.

Summary

The wish for better thermal neutron detectors is examined, to identify possible trends in performance that a development programme might yield over the coming decade. For most performance metrics, orders of magnitude improvement are theoretically possible. Such powerful instrumentation would greatly enhance the diagnostic potential of neutron interrogation, with great societal impact both for present fields of application as well as opening up future ones.

Primary author: HALL-WILTON, Richard (ESS - European Spallation Source (SE))

Co-authors: PFEIFFER, Dorothea (CERN); DIAN, Eszter (Centre for Energy Research); RESNATI, Filippo (CERN); Dr PISCITELLI, Francesco (European Spallation Source ERIC); CROCI, Gabriele (Universita & INFN, Milano-Bicocca (IT)); GORINI, Giuseppe (Universita & INFN, Milano-Bicocca (IT)); PERREY, Hanno (Lund University); Dr STEFANESCU, Irina (European Spallation Source ERIC); FREITA RAMOS, Judith (European Spallation Source); Dr FISSUM, Kevin (Lund University); Prof. KIRSTEIN, Oliver (European Spallation Source ERIC); THUINER, Patrik (CERN); KITTELMANN, Thomas (ESS - European Spallation Source (SE))

Presenter: HALL-WILTON, Richard (ESS - European Spallation Source (SE))