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Development of the high count-rate neutron detector SoNDe

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Modern neutron sources deliver high fluxes of neutrons. Most current detector technologies therefore need to shield the primary beam, or cannot use the full dynamic range of the neutron flux. Therefore we created the Solid-State Neutron Detector (SoNDe).
SoNDe is a project for the development and construction of a high-flux capable neutron detector. The development focuses on the following specifications:
• high-flux capability, capable of handling the peak-flux of up-to-date spallation sources (>20 MHz/m2)
• high-resolution of 3 mm by single-pixel technique, below by interpolation
• high detection efficiency of 80 % or more
• strategic independence of 3He
• time-of-flight (TOF) capability, necessary to exploit maximum flux, with a time resolution in the µs regime
• modularity, improving maintenance characteristics of today's neutron detectors
In order to achieve those goals, a pixelated scintillation detector with a multi-anode photomultiplier (MaPMT) readout was designed. This design allowed us to increase the achievable count-rate both per pixel and per area considerably. Additionally, in this fully modular setup it is possible to use each single 5 × 5 cm2 as an independent detector, therefore allowing a multitude of different detector geometries.
This project includes partners from France (Laboratoire Léon-Brillouin), Norway (IDEAS) and Sweden (ESS and Lund University) and Germany (Forschungszentrum Jülich).
Detectors such as this are required to be able to use high flux neutron sources as the FRMII or the upcoming European Spallation Source (ESS) to capacity. They will enable outstanding research on a range of neutron instruments allowing research in areas such as physics, chemistry and biology ranging over material science medical and pharmaceutical science.
In SoNDe this is reached by using a pixelized scintillation detector based on multi-anode photomultipliers.

References

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Authors: JAKSCH, Sebastian (Physicist); Dr FRIELINGHAUS, Henrich; ENGELS, Ralf (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS), 85748 Germany); KEMMERLING, Günter (Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science (JCNS), 85748 Germany)

Presenter: JAKSCH, Sebastian (Physicist)

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