

Neutron Detector Development for the Instruments for the ESS

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Abstract

ESS, The European Spallation Source, is currently in the design update phase and will soon move into the construction phase. The facility will become operational in 2019. At that time, it is envisaged that 7 flagship instruments will be available for users. Another 15 instruments will be completed in the following 6 years. Development of new detector technologies is now underway in order to provide the upcoming 22 instruments with the systems necessary for thermal and cold neutron detection. The current shortage of He-3 severely restricts the use of this well-known and proven neutron converter, especially for detector arrays with sensitive area of tens of square meters. As the total detector area of the ESS instruments will exceed 200 m², with approximately half of this value required already by 2019, alternative technologies are essential.

To meet these requirements, a number of parallel research and development efforts are underway in form of international collaborations, in-kind work package and instrument contributions. The main directions in this development can be identified as: large-area detectors, medium-area detectors with high spatial resolution and imaging detectors. The replacement of He-3 by other converter isotopes, in particular B-10 and Li-6, creates new challenges due to lower cross section for thermal neutrons and the fact that neutron conversion now takes place in a solid converter rather than gas, however, research so far has shown that detectors can be constructed with a good balance of efficiency, number of readout channels and cost. Furthermore, dedicated beamlines are being prepared for detector tests in environment comparable to that foreseen at the ESS instruments. A compilation of ESS instruments and their detector requirements, progress in detector development and results from prototypes are presented in this paper.