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Report on the Multi-Blade Prototype Detector delivered for the employment on the ESS Test Beam Line.

The Multi-Blade (MB) boron-10-based neutron detector is the chosen technology for three instruments at the European Spallation Source (ESS): the two ESS reflectometers, ESTIA and FREIA, and the Test Beam Line (TBL). The MB is a modular detector and bundling a larger area detector is simply possible by adding extra units, the so-called blade assemblies. The MB for the TBL has been built and tested. The MB for TBL consists of 14 units, resulting into an active area of $140 \times 260 \text{ mm}^2$ with $0.5 \times 3 \text{ mm}^2$ spatial resolution.

The built includes the whole ESS readout electronics chain that is based on the VMM3A ASIC. The chain includes the front-end assisters (FEA) (for the VMM3A hybrids) and the readout master module (RMM). The data is also sent to the event-formation-unit (EFU) for event processing and consequently to Kafka for the data reduction.

This detector will serve the ESS TBL to image the neutron moderator through a pin-hole from the first neutrons and later to monitor the stability of the beam. The MB offers a high-rate capability and high spatial resolution. During the tests it has been shown that the MB can cope up to 13 kHz/mm^2 locally and 2 MHz over a $10 \times 10 \text{ cm}^2$ area. The spatial resolution has been measured and it is $3 \times 0.5 \text{ mm}^2$.

During the tests, the detector has been commissioned by exposing it to neutrons. Three are the type of measurement carried out to validate the functionality of the detector and its readout chain: the measurement of the direct beam and of a Boron-Nitrate (BN) mask, the measurements of standard samples with well-known features, the measurements of the direct beam as a function of the increasing neutron intensity.

The TBL MB detector is the first of three MB detectors for ESS. This experience is invaluable for the future construction, installation and commissioning of the upcoming detectors.



1. Figure 1: Multi-Blade TBL detector, as constructed for operation on the TBL, clock-wise: CAD-model, bare vessel, ESS mask reproduced with neutrons, internal 14 units mechanics, the whole detector with electronics but without electronics box.