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Fast neutron-induced reaction measurements with a laser-driven neutron source

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High-power lasers with ultrashort pulses are emerging as a promising alternative to conventional accelerators for the production of neutron beams. Laser-driven neutron sources (LDNS) are particularly attractive for nuclear physics applications based on the time-of-flight technique due to their short pulse and high instantaneous flux. However, the experimental conditions associated with this type of source are harsh and hence the response of the detectors commonly used for nuclear reaction measurements must be investigated.

In 2021, a study on the feasibility of nuclear reaction measurements was carried out in the complex environment of an LDNS at the DRACO laser facility of the Helmholtz Center Dresden-Rossendorf (HZDR) in Dresden, Germany, producing almost 1300 neutron shots in a high-power system in stable conditions. In addition to conventional scintillators and bubble detectors, multishot neutron production made possible to use a detector with low efficiency, i.e. diamond detector, to measure individual signals from fast neutron interactions, which is the first step towards experiments on fast neutron-induced reactions in an LDNS.

All the know-how obtained in DRACO was applied in October 2022 in a new experimental campaign at Centro de Láseres Pulsados (CLPU) in Salamanca, using the VEGA III laser facility with the objective of testing the performance of new detectors and carrying out the first neutron-induced fission cross-section measurements at a LDNS.

We report herein on both experiments, the preliminary results and the prospects for nuclear reaction measurements at LDNSs.

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