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"The n_TOF facility at CERN: upgrade of the new target and the new NEAR Station"

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Abstract

The neutron time-of-flight (n_TOF) facility at CERN was designed and constructed with the aim of measuring accurate neutron-induced reaction cross-sections data and the related physical quantities in a wide energy range. Since the startup of the facility in 2001, the measurements and instrumental developments led to more than 160 publications in refereed journals in several fields. The results of the measurements are continuously disseminated to the scientific community through the EXFOR (Experimental Nuclear Reaction Data) database with more than 116 data sets. Such datasets are often adopted for cross section evaluation by the major nuclear data libraries, such as JEFF (Joint Evaluated Fission and Fusion File), ENDF (Evaluated Nuclear Data File) and JENDL (Japanese Evaluated Nuclear Data Library). Along the years, the n_TOF physics program has been wide-ranging and, at present, covers several fields. The data provided by n_TOF, the theoretical investigations and the applied studies have been of interest in nuclear astrophysics, in advanced fission technologies with several cases covering large energy ranges, in fundamental physics and in medical investigations.

During the CERN's Long Shutdown 2 (LS2), several upgrades of the n_TOF facility have been carried out to improve the performances of the existing experimental areas and further exploit their potentials. The most important one is the construction and installation of a new third-generation spallation target. A thorough commissioning of the target and the experimental areas with beam is therefore proposed. In the first phase, the performance of the new target assembly under proton irradiation at different intensities will be studied in order to complete the target commissioning. In a second phase, a complete characterization of the neutron beam in the two experimental areas will be carried out. The upgrades of the facility will allow increased flexibility in the respective configurations of the collimator and moderator systems in both experimental areas.

In addition, a new experimental area will be available in 2021. Taken advantage of the revision of the n_TOF target pit shielding, it has be done now movable and allows direct access to the target assembly. This modification has opened the possibility of exploring the potential for a near-target irradiation as well as for a measuring station close to the spallation target (NEAR station). This would take advantage of the extremely high instantaneous neutron fluence available close to the target, few centimeters, and also at around three meters from the target. The first step in this new development would be the commissioning of the new shielding around the target with beam. NEAR station will be dedicated to studies on neutron effects on materials, electronic devices, and detectors. Also, studies on nuclear astrophysics by means of the activation technique will complement the possibilities at EAR1 and EAR2 by the TOF technique.