

## The neutron Time-of-Flight facility, n\_TOF at CERN: Status and perspectives

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n\_TOF, at CERN, is the neutron time-of-flight facility dedicated to the study of neutron-induced reactions for fundamental and applied nuclear research. With high-precision neutron cross-section data, n\_TOF plays a crucial role in addressing key questions in nuclear astrophysics and for innovation in advanced nuclear technologies. In nuclear astrophysics, experiments performed at n\_TOF provide essential insights on the nucleosynthesis processes, such as the s-process responsible for the formation of chemical elements in stars. In nuclear technology, n\_TOF contributes to the study of isotopes relevant for reactor design, nuclear waste transmutation, and radiation shielding. Furthermore, the facility investigates aspects linked to medical and space applications, including neutron therapy and radiation effects on electronics.

Established in 2001, n\_TOF utilizes a high-intensity, pulsed neutron beam produced by spallation reactions, where 20 GeV/c protons from the CERN Proton Synchrotron (PS) impact on a lead target. The resulting neutron flux spans a wide energy spectrum, from thermal to GeV energies, enabling measurements with high accuracy and resolution over an extensive range. n\_TOF is the only facility in which measurements from thermal up to few GeV are possible.

The facility features two areas suitable for time of flight measurements. EAR1, with a 185-meter flight-path, is optimized for high-resolution measurements. EAR2, with the 20-meter beam-line, is designed for high-flux applications, fundamental for low mass and short-lived radioactive samples or reactions with low cross sections. These complementary stations allow for different experimental conditions optimized for specific measurements, such as neutron capture, neutron-induced fission, elastic, inelastic and charged-particle emission reactions. NEAR is the novel experimental area, placed at about 3 meters from the spallation target, designed for spectral-averaged cross section measurements via activation, when a time-of-flight measurements are not possible.

Recent developments at n\_TOF include upgrades of the spallation target to enhance neutron production efficiency, improvements in experimental techniques, and expanded research programs addressing emerging scientific challenges.

In this contribution, an overview of the status of the facility, the ongoing experimental activities and the planning of future projects will be presented with a focus on the activities induced by high energy neutrons.

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