NEUTRON CROSS-SECTION MEASUREMENTS AT THE n_TOF FACILITY AT CERN

The n_TOF Collaboration

Abstract

New ideas and developments in Nuclear Technology have recently raised the practical need for high-accuracy neutron data. In particular, requests exist for experimentally determined capture, fission and (n,xn) cross-sections on several radioactive isotopes, mainly actinides and long-lived fission frangments, aimed specifically at the design and understanding of the behaviour of innovative Accelerator Driven Systems (ADS) for energy production and nuclear waste incineration. Furthermore, advances in laboratory measurements of neutron cross-sections are required for improving the understanding of neutron capture nucleosynthesis in evolved stars and supernova explosions. Finally, new access to fundamental information on nuclear matter can be provided by additional data on neutron-induced reactions.

With the aim of allowing high-accuracy measurements of neutron cross-sections, an innovative neutron Time-of-Flight facility (n_TOF) has recently been set-up at CERN. Neutrons in the wide energy range 1 eV - 250 MeV are generated by spallation of 20 GeV/c protons on a lead target. The high instantaneous neutron flux, low duty cycle, high resolution and low background make this facility unique for cross-section measurements relevant to Nuclear Technology, Nuclear Astrophysics, and fundamental Nuclear Physics.

The n_TOF collaboration has undertaken a vast experimental program on capture, fission and (n,xn) reactions. The main objective is the determination of long needed neutron cross-sections of primary importance for the design of Accelerator Driven Systems (ADS), currently being considered for nuclear energy production and nuclear waste transmutation. Studies of capture reactions relevant to Nuclear Astrophysics will also benefit from the innovative characteristics of the n_TOF neutron beam.

In this talk, the characteristics of the n_TOF facility will be described, together with the main features of the high performance detector and acquisition systems used for cross-section measurements. The results of the first measurement campaign, performed in 2001, have confirmed the innovative aspects of the facility, in particular the high instantaneous neutron flux, the high resolution and low background.

The experimental program of the n_TOF collaboration will be briefly illustrated, in particular with regard to implications for ADS and Nuclear Astrophysics. Preliminray results on isotopes relevant to energy production and nuclear waste transmutation will be presented.

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