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Measurement and simulation of neutron beam fluence spectra

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Abstract content
   (Max 300 words)

Knowledge of fast neutron beam fluence spectra are of interest in various nuclear applications, such as radiotherapy for the treatment of cancer; radiobiology, studying the biological effectiveness of neutrons; and radiation protection at nuclear research facilities, such as IThemba LABS. In principle, these fluence spectra can either be calculated by Monte Carlo Methods or measured experimentally.

There are a number of difficulties that are involved in carrying out either the calculations or measurements. One in particular, which limits the accuracy of the predictions of the calculations, is the degree to which the required reaction cross-sections are known. This applies particularly to the energy region above 20 MeV where the non-elastic contribution to the reaction cross-section is significant and have either not been measured or are not correctly calculated by present nuclear models. There are a variety of methods that can be used to measure neutron beam fluence spectra. At energies above 20 MeV, the techniques include time-of-flight, recoil spectrometry, threshold (activation or fission) spectrometry and methods based on neutron moderation. Of these methods the time-of-flight is the most accurate and it is widely used for measuring neutron beam fluence spectra.

This paper reports on work done at the neutron time-of-flight facility at the IThemba LABS in South Africa. Neutron beams of energy up to ~ 64 MeV were produced by bombarding a pulsed beam of 66 MeV protons from the iThemba LABS separated sector cyclotron onto either a Li (1.0 mm) metal target or a Be (10.0 mm) metal target or a graphite (10.0 mm) target. The Li, Be and C neutron beam fluence spectra were measured with an NE213 detector using the time-of-flight tchnique. The results from the time-of-flight measurements were compared with Monte Carlo simulations using the MCNPX code.

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