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Resolution function in deep inelastic neutron scattering using the Foil Cycling Technique

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Abstract

New perspectives for epithermal neutron spectroscopy are being opened up by the development of the Resonance Detector (RD) and its use on inverse geometry time of flight (TOF) spectrometers at spallation sources. The most recent result is the Foil Cycling Technique (FCT), which has been developed and applied on the VESUVIO spectrometer operating in the RD configuration. This technique has demonstrated its capability to improve the resolution function of the spectrometer and to provide an effective neutron and gamma background subtraction method. This paper reports a detailed analysis of the line shape of the resolution function in Deep Inelastic Neutron Scattering (DINS) measurements on VESUVIO spectrometer, operating in the RD configuration and employing the FCT. The aim is to provide an analytical approximation for the analyzer energy transfer function, an useful tool for data analysis on VESUVIO. Simulated and experimental results of DINS measurements on a lead sample are compared. The line shape analysis shows that the most reliable analytical approximation of the energy transfer function is a sum of a Gaussian and a power of a Lorentzian. A comparison with the Double Difference Method (DDM) is also discussed. It is shown that the energy resolution improvement for the FCT and the DDM is almost the same, while the counting efficiency is a factor of about 1.4 higher for the FCT.

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