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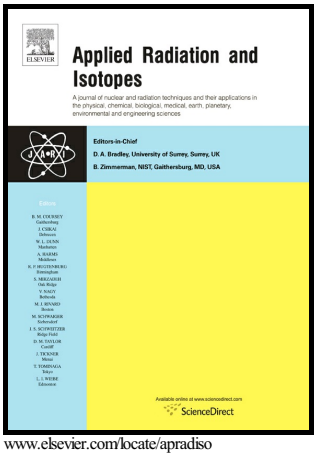

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Measurements of neutron transport of well defined silicon filtered beam in lead

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Abstract:
The correct description of neutron transport in lead is an essential task for correct description of tritium production in the DEMO (DEMOnstration Power Station) breeding blanket because some concepts deal with lead as a major component: namely the WCLL (water cooled lithium lead blanket), HCLL (helium cooled lithium lead blanket), and DCLL (dual cooled lithium lead blanket). Concerning the improvement of the knowledge about the transport of fast neutrons in lead, a set of experiments and calculations was carried out to study this problem with a well-defined neutron beam. The neutron flux behind various lead arrangements positioned along the beam axis was measured using a stilbene scintillation crystal (10 mm × 10 mm) with neutron and gamma pulse shape discrimination. The measurement was performed along the beam axis and in the case of the thick target also above the axis, to estimate the neutron angular scatter in lead. The calculations were realized using MCNP6 with various nuclear data libraries. Discrepancies in the angular distribution description in the energy region of about 1 MeV were discovered by these experiments.

1 Introduction

Lead is an important material in the nuclear industry. For example, it is planned as a coolant in the Lead Fast Reactor (LFR) system technology. It is also an important material in fusion reactors, as it is a major part of the neutron breeding blanket in DEMO technology – the tritium is produced by the neutron capture of ^{6}Li dissolved in lead. The correct knowledge of the lead cross section even in lower energies than assumed in fusion technology is necessary to correctly describe the tritium breeding properties in the blanket.

A series of experiments was realized at Research Centre Rez, especially in isotropic neutron field formed by fission neutrons. As the neutrons in tritium breeding blanket are directionally oriented, the experiments in the beam geometry could improve the description of neutron transport and slowing down in lead. The experiments were carried out in quasi-monoenergetic neutron beam created by a thick (1 m) silicon monocrystal placed in the horizontal channel of LVR-15 reactor. Experiments were compared with Monte Carlo calculations using a precise model of the experimental arrangement and neutron beam going out from the reactor.