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Technology Development for Cold Neutron Spallation Science

Geoffrey L. Greene

Abstract

This is the final report of a Laboratory-Directed Research and Development (LDRD) project at the Los Alamos National Laboratory (LANL). The purpose of the activities supported by this project were the development of new techniques; both experimental and theoretical that will allow more effective exploitation of spallation neutron sources.

Background and Research Objectives

Spallation neutron sources are accelerator based which typically provide intense pulses of neutrons. This is in contrast to continuous neutron sources such as reactors. One can more effectively utilize spallation neutron sources by increasing the peak intensity of the pulse or by designing apparatus that can more efficiently utilize the pulsed nature of the spallation source. It was the goal of this work to investigate technologies that address both of these issues.

Importance to LANL's Science and Technology Base and National R&D Needs

LANL has determined that the spallation neutron source at LANSCE is one of the major strategic thrusts of the institution. In addition, DOE has committed to building a major new spallation source (SNS) at Oak Ridge. The development of new technologies to exploit spallation neutron sources will have an impact on the programmatic work at LANSCE as well as the utilization of the SNS as a national user facility.

Scientific Approach and Accomplishments

The purpose of this project is to identify and develop novel technologies that enhance and exploit the unique capabilities of pulsed (spallation) cold-neutron sources. The use of spallation neutron sources can be enhanced by increasing the "useful" intensity of the neutron pulse. This can be done in two ways: The first approach is to make the incident proton pulse more intense. The second approach is to make the target/moderator

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system more efficient or more appropriately matched to the experiment. DOE/Defense Programs is currently supporting a major upgrade to the Los Alamos Neutron Science Center (LANSCE) spallation source using the first approach.

Our LDRD project has supported moderator studies to address the second approach. The work involved the application of Monte Carlo codes to assess the performance of cryogenic neutron moderators. The project also supported the development of novel technologies that exploit pulsed neutron sources. An essential feature of a pulsed source is the high phase-space density of the pulse. We have developed a new method to allow the high intensity of the short pulse to be transformed into a very narrow range of neutron momenta for neutron reflectometry. The technique involves the rapid (20-Hz), extremely well controlled (less than 1 arc-minute accuracy) oscillation of the reflectometry sample in synchrony with the spallation target. A detailed engineering study of the technique has been carried out. The final design (including fabrication drawings) of an apparatus to demonstrate the method has been completed and will be tested in FY99.