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Radiation Transport Modeling of Beam-Target Experiments for the AAA Project: Quaterly Report

William Culbreth
University of Nevada, Las Vegas, william.culbreth@unlv.edu

Quarterly Report
(Second Quarter)
AAA/UNLV University Participation Program

Title:

Radiation Transport Modeling of Beam-Target Experiments for the AAA Project

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Principal Investigators: William Culbreth, Ph.D.
Department of Mechanical Engineering
University of Nevada, Las Vegas
4505 Maryland Parkway, Las Vegas, NV 89154-4027
(702) 895-3426, culbreti@clark.nscee.edu
FAX: (702) 895-3936
http://culbreth.me.unlv.edu

Collaborators: Raymond Klann, Ph.D.
Argonne National Laboratory
9700 South Cass Avenue
Building 362, Room B-113
Argonne, IL
(630) 252-4305
FAX: (630) 252-5287
klann@anl.gov

Denis Beller, Ph.D.
UNLV/ATW University Liaison
Harry Reid Center for Environmental Studies
4505 Maryland Parkway, Las Vegas, NV 89154-4009
(702) 895-2023,
beller@lanl.gov
FAX: (702) 895-3094

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1. Project Description

The national development of technology to transmute nuclear waste depends upon the generation of high energy neutrons produced by proton spallation. Proton accelerators, such as LANSCE at the Los Alamos National Laboratory, are capable of producing 800 MeV protons. By bombarding a lead/bismuth target, each proton may generate 500 or more neutrons that can activate fission products or induce the fission of transuranic isotopes.

The Monte Carlo radiation transport code MCNPX developed at LANL is an important tool in the design of transmuter technology. It must be validated, however, for the neutron energy that will be employed. Experiments are being conducted at LANSCE to test the ability of MCNPX to accurately predict neutron production and leakage rates from lead/bismuth targets. Students at UNLV are being educated in the use of MCNPX to analyze the results of these tests and to use the software to in the development of future experimental studies.

2. Review of Tasks

The development of new systems for the transmutation of nuclear waste will depend upon computational tools that can provide an accurate assessment of the system performance. MCNPX, a Monte Carlo neutron transport code, will be used by UNLV students to support AAA experimental work at LANSCE. The tasks listed in the proposal are outline in the table below. The work conducted in the first quarter is highlighted in this report.

	Year 1											
Task	9/01	10/01	11/01	12/01	1/02	2/02	3/02	4/02	\5/02	6/02	7/02	8/02
Neutron Leakage Experiments												
MCNPX Training												
LANL/LANSCE Visits and Work												
Postanalysis of neutron data												
Sodium Activation Experiments												
MCNPX Training												
MCNPX (and other codes) modeling												
LANL/LANSCE Visit												
Analysis of Data												
Actinide Fission Measurements												
Neutron Multiplicity Measurements												
MCNPX Simulations												
LANSCE Site Visit												

The second quarter report covers work completed to this point.

Tasks

- Acquire MCNPX for use on student workstations and provide for the adequate training of the student researchers.

- Work with Drs. Beller, Klann, Pitcher, and Wender along with other researchers at LANL and ANL to model the integral experiment at LANSCE.

- Conduct MCNPX simulations of the preliminary design of an integral experiment to estimate the neutron leakage from lead/bismuth targets of varying radii. Provide similar computational support for proton activation experiments in sodium coolant.

3. Progress in the Second Quarter

- Student Training

The students working on the project are indicated below. Mr. Viggato recently started working at Bechtel, SAIC in Las Vegas and is not continuing the AAA work. We recently hired Ashraf Kaboud, an MS student in mechanical engineering. Mr. Kaboud is a U.S. citizen and will begin work in May.

* Jason Viggato - doctoral student in mechanical engineering.
* Daniel Lowe – sophomore in mechanical engineering.
* Suresh Sadenini – masters student in mechanical engineering. Mr. Sadenini is on a teaching assistantship this semester and is not receiving financial support from this project. He is working on his M.S. project in neutron spallation.

MCNPX

J. Viggato, D. Lowe, S. Sadenini, and W. Culbreth completed an introductory MCNPX course taught by Dr. Laurie Waters and her staff from LANL. The course was conducted at UNLV in January 2002.

The students each have a 1.8 GHz computer with 512 MB of RAM for their MCNPX work. We also acquired Techplot 9.0, an interactive graphics program compatible with MCNPX. We also obtained ProEngineer, a computer-aided design program, for creating accurate images of the Blue Room at LANSCE and the experimental setup.

Visits

- UNLV

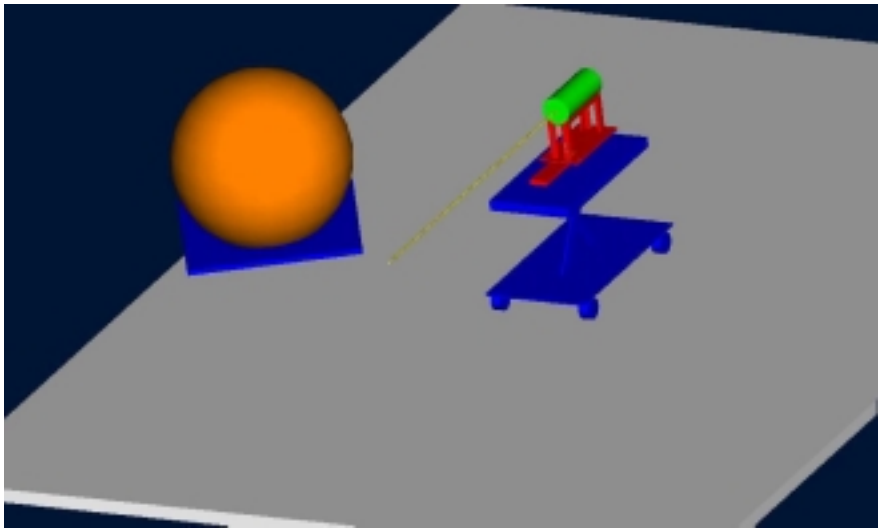

Figure 1 Schematic of the Blue Room Experiment at LANSCE, December 2002

Dr. Klann visited with the project members at UNLV in February and in April to discuss the research project. Mr. Lowe is being scheduled to work at LANL on additional Pb/Bi target experiments during this summer.

- IAC

Mr. Sadenini is schedule to work at IAC during the summer to help with an experiment to generate neutrons in a lead target with an electron accelerator. He will also provide MCNPX simulations, and to analyze data. Mr. Sadenini will be supported by the IAC during the summer. This work at IAC nicely complements the work that we are doing on the LANSCE experiments.

- Postanalysis of Neutron Data

Experiments were conducted by Dr. Klann and his team at LANL/LANSCE in December to study the leakage of neutrons from a lead/bismuth target exposed to an 800 MeV neutron beam. The experiments were conducted on a 20 cm diameter, 50 cm long solid target. Neutron fluence was measured from time-of-flight detectors located in the room and from activation foils. Dr. Klann asked us to prepare a number of MCNPX simulations to compare with the results of the experiment. A second experiment is scheduled in July, 2002 on a larger target.

Mr. Lowe has prepared ProEngineer files to document the geometry of the experiment. An example drawing is shown in figure 1.

The students have been working on a number of MCNPX simulations of the neutron leakage. An example of the number of neutrons per square centimeter passing through the surface of the target is shown in figure 2. The top of the target is located at zero degrees and a steel table underneath the target causes a high neutron flux through the lower surface of the target.

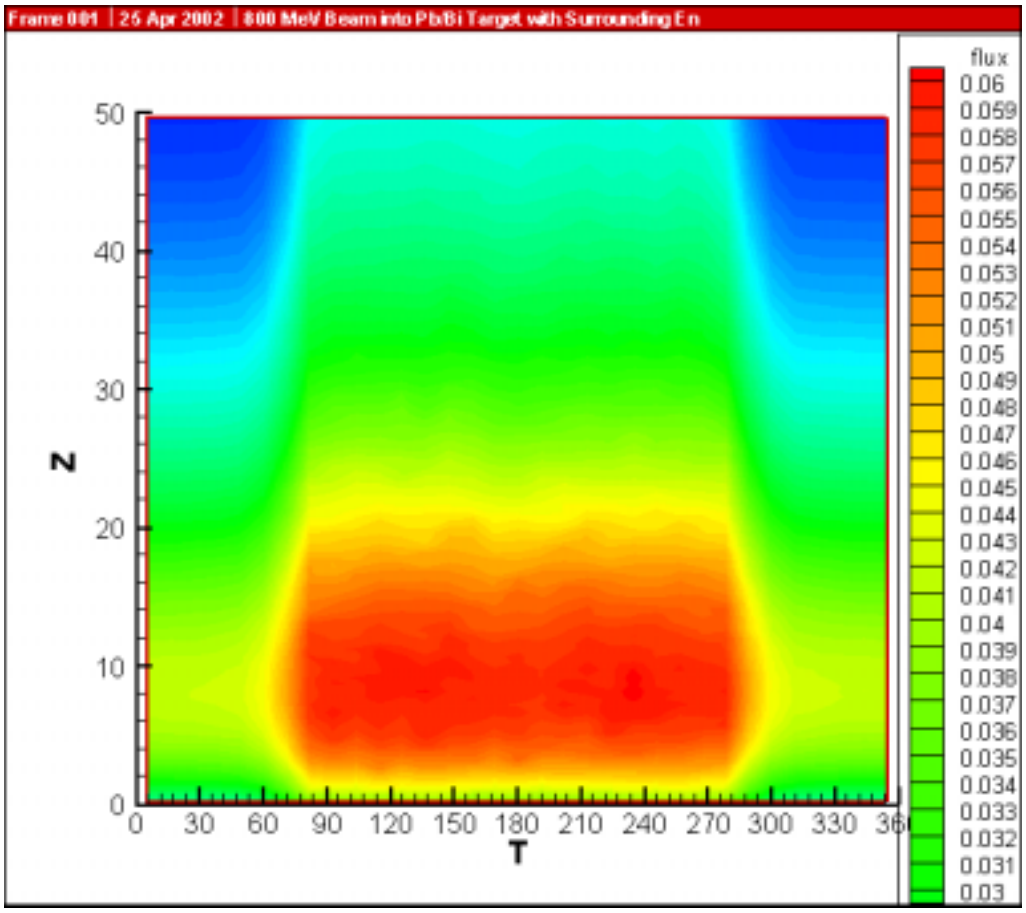

Figure 2 Neutrons per Square Centimeter per Incident 800 MeV Proton in on Lead/Bismuth Target

4. Work Scheduled for Third Quarter

During the third quarter, the students will continue to work on MCNPX simulations of the Blue Room experiments from December. We will also integrate Mr. Kaboud into the work. We still have some unresolved problems with MCNPX 4.2.j that we will seek resolution to in the third quarter.

Mr. Lowe is working with Dr. Klann for his summer work at LANL. We have also been asked to study the possibility of conducting tests in a manner similar to the international nuclear criticality benchmark project with well documented experiments and simulations.