2

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.
POST OFFICE BOX 2008, OAK RIDGE, TENNESSEE 37831-6285

ORNL/FTR--3816

DE91 005407

ORNL
FOREIGN TRIP REPORT

ORNL/FTR-3816

DATE: November 8, 1990

SUBJECT: Report of Foreign Travel of J. B. Hayter, Solid State Division

TO: Alvin W. Trivelpiece

FROM: John B. Hayter

PURPOSE: The purpose of this trip was to present two invited papers at the Eleventh Meeting of the International Collaboration on Advanced Neutron Sources (ICANS-XI), and to learn from formal presentations and informal discussions the current state-of-the-art at many worldwide neutron research facilities, in order to ensure that the Advanced Neutron Source design incorporates the best features of modern neutron instrumentation.

SITES

VISITED: National Laboratory for High Energy Physics (KEK), Tsukuba, Japan.

ABSTRACT: The International Collaboration on Advanced Neutron Sources was started about a decade ago with the purpose of sharing information throughout the global neutron community. The collaboration has been extremely successful in optimising the use of resources, and the discussions are open and detailed, with reasons for failure shared as well as reasons for success. Although the meetings have become increasingly oriented towards pulsed neutron sources, many of the neutron instrumentation techniques, such as the development of better monochromators, fast response detectors and various data analysis methods, are highly relevant to the Advanced Neutron Source (ANS). I presented one paper on the ANS, and another on the neutron optical polarizer design work which won a 1989 R&D-100 Award. I also gained some valuable design ideas, in particular for the ANS hot source, in discussions with individual researchers from Canada, Western Europe, and Japan.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

The ICANS-XI meeting was organized into three parallel workshops, with joint Plenary sessions on the first, third, and final days. The workshops were concerned with pulsed source accelerators, spallation target stations, and instrumentation. I attended the instrument workshop, which had sessions on optimization for total performance (a recurring theme throughout the meeting), inelastic scattering, elastic scattering, polarizing devices, detectors, sample environments, and data analysis. The meeting was attended by over 120 scientists, with 37 participants from outside Japan. The program was fairly crowded (70 oral presentations for instrument workshop participants), but there was nevertheless adequate time for discussion. The full proceedings of the meeting (including the discussion recorded during the formal sessions) will be published at the end of this year, and I will restrict comments here to the most general features of interest.

For many years, pulsed neutron sources were searching for their role vis-a-vis reactors, and a wide variety of clever instrumental ideas were tried, with science following the instruments provided, rather than driving their design. The strongest single impression I received at this meeting was that this phase has ended.

There is now a clear consensus on the best instrumental techniques, and on which science can best be done on reactors and which on pulsed sources. As one participant put it, "we can stop arguing about whose is biggest and get on with exploiting the complementary techniques as appropriate." A second impression was that, while at least lip-service is paid to systems design everywhere, the Japanese have made significant gains in performance by putting it into practise. An example of this will be discussed later, but it reinforces our belief that the integrated systems design of the ANS reactor and instruments as one research tool will pay off handsomely.

The instrument workshop papers were mostly detailed and highly technical, but two, in particular, are worth mentioning here. The first, by M. W. Johnson (ISIS), dealt with fiber-optic coupled scintillation detectors. These modular detectors have been in development for many years, but were generally considered to be too gamma-sensitive to be useful. A new design described at the meeting, using ZnS scintillators and aluminized mylar light collectors coupling to the optic fibers, seems to have solved this problem definitively; the announced gamma-discrimination is $10(\text{power})^{8:1}$. The second paper, by R. Lechner (Hahn-Meitner Institute, Berlin), showed how to optimize converging and diverging neutron guides for beam compression and expansion. This has interesting implications for certain ANS instruments, particularly for optimizing the time-of-flight spectrometers, since compressing the beam at a chopping point allows faster chopping for a given maximum chopper speed.

During the meeting, I discussed the ANS at length with P. Egelstaff (U. Guelph). Peter Egelstaff was responsible for the first cold source built (at Harwell), among many other innovations in the field of neutron scattering. He has thought extensively about the problem of producing hot neutrons from a reactor, and pointed out that a source with $1/E$ spectral characteristics would be preferable to a rethermalized Maxwellian. How to produce such a source in practise is not clear, but it lead us to consider materials with an epithermal "window" as possible candidates to replace graphite as the hot source material; if possible, this could substantially simplify the safety case. We are now making calculations to evaluate the feasibility of this idea for the ANS.

On the final afternoon of the meeting, I had the opportunity to visit the KEK Photon Factory and the small KENS Neutron Scattering Facility. KENS is based on a small spallation source, but impressive instrumental performance has been achieved by paying a great deal of attention to complete system design. One feature has been to attempt to count every scattered neutron, by developing relatively inexpensive analyzers made of synthetic mica crystals, and by "papering the walls" of selected instruments with detectors.

In a comparison of the highest resolution inelastic scattering instruments at ISIS (the world's highest flux spallation source at the Rutherford-Appleton Laboratory, England) and at KENS, tunneling spectroscopy measurements on a standard sample (N-oxy picoline) show that the KENS instrument, LAM-80, is effectively 16 times more efficient than the ISIS spectrometer, at the same resolution (1 micro-eV). Conceptual design work is currently in progress on the next generation KENS-II source as part of the Japanese hadron project. The stated goal is to build the world's brightest pulsed cold neutron source.

KENS is essentially staffed by graduate students, and it has the somewhat "unkempt" look of a University laboratory. In contrast, the Photon Factory looks extremely professional. All of the beamlines which we were allowed to see were operational, with several scientists on each. It was interesting to note that, although KEK has a hostel on site, each station was equipped with a large, fold-down sofa bed. One specific item of future interest to ANS spectrometer design is the reuseable "image plate" detector, which was invented at KEK and is now commercialized by Fuji. This detector has the disadvantage that it operates in batch mode, since it requires a separate laser readout unit. However, it now shows good linearity over five decades in intensity, and can handle high countrates, which is a major concern for certain instruments planned for the ANS. It may be possible to couple it with a realtime TV detector for alignment, using the image plate only for final quantitative analysis.

Reports and Papers Received

"A Double Reflection Multilayer Monochromator for Cold Neutron Polarizing and Small Angle Scattering Experiments," T. Ebisawa, S. Tasaki, T. Akiyoshi and N. Achiwa

"Thermodynamic Considerations on a Self-Regulating Characteristic of a Cold Neutron Source with a Closed Thermosiphon," T. Kawai, F. Ogino and M. Utsuro
1990 Annual Report, Laboratory of Neutron Physics, Dubna, USSR

Appendix

ITINERARY

October 19-20, 1990 Travel from Oak Ridge, TN, to Tokyo, Japan, by plane

October 21, 1990 Travel from Tokyo, Japan to Tsukuba, Japan, by bus

October 22-26, 1990 Eleventh Meeting of the International Collaboration on Advanced Neutron Sources (ICANS-XI)

T. Ebisawa
P. Egelstaff
Y. Endoh
S. Itoh
M. W. Johnson
T. Kawai
R. Lechner
N. Watanabe

October 26, 1990 Visit to the KEK Photon Factory and KENS Neutron Scattering Facility, Tsukuba, Japan

N. Watanabe

October 27, 1990 Travel from Tsukuba, Japan to Oak Ridge, TN, by car and plane

END

DATE FILMED

01 / 22 / 91