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Report on Participation of the Instituto de Engenharia

Nuclear (IEN), Rio de Janeiro, Brazil

in the IAEA Interregional Project TC/INT/1/018

by

L.T. Auler

May 1983

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1. Introduction.

The physics Department of the Nuclear Engineering Institute (IEN) operates a CV-28 cyclotron since 1975. Among other uses, this accelerator is well suited to produce monoenergetic neutrons in a broad range, roughly, from 1 to over 20 MeV. In order to fully exploit this capability of the accelerator, even though the group is small, support from the IAEA, through the Interregional Project, was sought and obtained.

A report on past work to build a facility for fast neutron data measurements with our CV-28 is presented in what follows.

2. Fast neutron facility.

A dedicated beam line starting from the switching magnet inside the cyclotron cave has been planned. This beam extension will be equipped with a vacuum system and a beam diagnostic system. Quadrupole doublet lenses, based on another beam transport system already installed⁽¹⁾ are under construction. A layout of the installation is shown in figure 1.

Starting of installation of this beam extension is expected for late this year when all parts will be available.

Besides the equipment necessary for the beam extension line, during the last few months some electronics equipment were received for the neutron program. Some new, fastphotomultiplier tubes from Hamamatsu, similar to 8850 RCA, has increased the assortment of this type of equipment. A new 3500M Le Croy multichannel analyser was also received this year. This MCA has built in a microcomputer with 32 k of RAM and is floppy disk operated. Together with its CAMAC capabilities, it makes a great addition to the laboratory.

A number of Nuclear Enterprises NE 213 liquid scintillator is being purchased to be used as neutron detector by the pulse shape discrimination technique.

3. Technical Assistance from IP.

The interregional Project is contributing decisively for this program by offering fellowships for training people in laboratories abroad and through expert mission that will be sent to Rio for advising in several points relating to the neutron production installation.

The following material totalling US\$ 10,000.00, has been already received during the past year.

- 10 T-Ti targets, 20 Ci each.
- deuterium gas, 200 liters, 99,9%
- ³He gas, 20 liters, 99,9%

One of the lab's younger physicists is being trained at the Physikalisch Technisch Bundesanstalt in Braunschweig, Federal Republic of Germany, through an 8 months fellowship from IAEA. His work is a quantitative comparison (figures of merit) of different pulse shape analysers coupled to various NE 213 scintillation detectors. Preliminary reports of this work were already sent by Mr. J.C. Suita, recipient of the fellowship, to the pertinent body withing the Agency.

The expert mission at IEN, which is hopefully expected to occur this year, will be conducted by Dr. H. Klein, from PTB, a well reputed scientist in the field. Topics of extensive discussion will be:

- neutron detectors
- eletronics
- instuments and computer codes for detector calibration
- neutron sources
- investigation of neutron sources and detectors.

To have the most out of this mission, it should be timed so that Mr. Suita sould use the last weeks at the PTB, after the expert visit, to prepare the further developments in Rio.

4. Other developments.

Besides the experience obtained via the IP, people at IEN are in parallel, preparing themselves for doing neutron work, by following the latest developments in the current literature and at international conferences like the one held last year in Antwerp. At this conference a poster was presented with the title "A facility for fast neutron data measurements in Brasil"⁽²⁾ where tests of the cyclotron were presented to show the feasibility of using the machine as a monoenergetic neutron source in a broad energy range.

Work has also started with a view on data analysis. Two programs, useful for neutron spectrum unfolding are already available in the Honeywell-Bull CII computer of CNEN: FORIST and LOUHI 78. The first is a well known computer code for neutron spectrum unfolding by iterative smoothing of pulse height distributions measured with NE-213 spectrometers⁽³⁾. The second is a general purpose unfolding program⁽⁴⁾ that has been used to obtain neutron spectra from threshold detectors⁽⁵⁾. Work will start on a line similar to this last reference, in order to get acquainted with the kind of neutron spectra can be had at the accelerator, as is.

5. Conclusions.

The program which has started at IEN to use the CV-28 cyclotron to produce fast neutrons, has been decisively supported by the Interregional Project, which is gratefully acknowledged and hopefully will continue.

Even in the presence of economic problems of the nation as a whole, the delay in the program is small.

With the experience we carry from other fields plus the training being acquired through the IP, there are great hopes that in the near future there will be a very active group in fast neutron research in Rio.

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