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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Progress Report on Nuclear Data Activities in Chile in 1982

by

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University of Chile
Santiago, Chile

Work performed under IAEA Technical Co-operation Interregional Project
INT/1/018 on Nuclear Data Techniques and Instrumentation

March 1983

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Abstract

During 1982 main efforts were focussed on the solutions to some technical problems in the accelerator. The stability of the main magnet of the 56 cm isochronous cyclotron was improved to better than $1:10^3$. A cold cathode ion source was successfully operated, and now an external deuteron beam of about 1 µA can be obtained. This represents an improvement of one order of magnitude in beam intensity and it is adequate for monoenergetic neutron production with very thin Ti-T targets. In these improvements the participation of Mr. F. Furlanetto, an I.A.E.A. expert, was decisive.

The beam pipe was extended by 9 meters to the neutron cave. An experiment to measure total non-elastic cross sections in the energy range from 17 to 20 MeV is being assembled. There are theoretical and practical interests in these measurements: WRENDA 79/80 & 81/82. Prof. J.A. Jungerman, an I.A.E.A. expert, advised us in the experiment planning. The University of California lent us a large neutron detector in order to start the experiment.

Tests of the associated electronics are being done. An Am-Be neutron source has been used to try n-γ pulse shape discrimination. An n-γ spectrum is shown in figure 2.

In addition, tests on a 150 KV, 14 MeV, neutron generator, belonging to the Chilean Nuclear Energy Commission have been done. Problems with its ion source are being studied.

Introduction

This report updates the information outlined in a previous report handled at I.C.T.P., February 1982.

During 1982 main effort was oriented to solve some technical problems in the cyclotron accelerator. Also the planning of experiments with fast neutrons was a matter of concern. With the collaboration of I.A.E.A. experts both aspects were clarified. By the end of the year, two senior nuclear physicists joined the staff of the Physics Department, they will partially participate in the fast neutron experiments too.

1.- Experimental facilities.-

The accelerator, a 56 cm isochronous variable energy cyclotron, presented a high instability of its main magnetic field. This problem was solved with the collaboration of Mr. J.A. Furlanetto, who visited the Laboratory as an I.A.E.A. expert, in July 1982. Now, the stability is about $1:10^3$.

Further stabilization of the trim coils is needed and should be implemented in the future.

At present we can obtain about 1 μA of external deuteron beam. This represents an improvement of ten times from a year ago. Further beam development is needed, but so far is adequate to start experimentation.

A cold cathode ion source has been succesfully used. An special power supply was constructed in order to allow the ion source to be switched from the Penning mode to the plasma mode.

In order to improve the beam's extraction efficiency different pullers have been tried in the dees. The most promising one was developed during Prof. J. Jungerman's visit, an expert from I.A.E.A. too. This puller reduces the distance between the plates of the dee closer to the ion source's exit window.

The beam pipe was extended by about 9 meters to the center of the neutron cave as shown in figure 1.

At the end of the beam pipe a tritium target chamber was located. An adjustable beam collimator was built together with a remote control unit. A beam pick off tube was inserted in between the collimator and target.

A new MCA Canberra 40 has been purchased. Work is being done to dump information directly into a Heath LSI/11 microcomputer.

A new rough pumping system has been ordered and will replace an unreliable system twenty five years old. High vapour pressure oil was purchased for the diffusion pumps. Hopefully a vaccum better than 10^{-5} torr will be obtained.

Twenty thick tritium targets were provided by I.A.E.A., under the Project TC/INT/1/018.

The use of a 14 MeV neutron-generator, belonging to the Chilean Nuclear Energy Commission is an interesting possibility. This 150 KV machine could develop as an important tool for fast neutron research. Following Mr. Furlanetto's suggestions, problems in its ion source are being attacked.

2.- The experiment.-

The first experiment to be developed deals with the measurement of total non-elastic cross section for several elements such as C, Fe, etc. in the energy range from 17 to 20 MeV.

This experiment was suggested by Prof. J. Jungerman. There are very few measurements of this kind and even less at this energy range. Measurements done at 40 MeV and 60 MeV could be complemented with others at lower energies. There are both theoretical and practical interests in these measurements, as mentioned in WRENDA 79/80, 81/82.

The measurement of σ_{ne} as has been planned following the method developed at U. California, Davis and published in the papers by J. Zanelli et al. Phys. Rev. C. 23, #3, (1981), 1015 and F.P. Brady et al. Nucl. Inst. and Meth. 178, (1980) 427.

The computer Code SCAT 2 for Optical Model (CEA-N-2227, INDC (FR)49/L) is being tested in the University's IBM 370 computer. This program will provide basic calculations in order to get an estimate of the neutron detector angular range and further data analysis.

The experiment configuration is shown in figure 2. The neutron detector, a liquid scintillator NE 224 coupled to a RCA 4522 photomultiplier, was brought by Professor Jungerman and has been lent to our Laboratory by Prof. F.P. Brady from the University of California. It is hoped that a similar detector could be obtained for our group during 1983.

The photomultiplier base was wired at our electronic shop.

Work is being done in the neutron beam monitor. Old and extensively used photomultipliers RCA 8575 have been coupled to 0.8 mm thickness NE-102 foils. Unfortunately the ph.m. behavior is erratic and they should be replaced.

Associated electronic circuitry is shown in figure 3. An Am-Be Neutron source has been used to test n-γ pulse shape discrimination with the Ne-224 detector. The darker blocks have been used, and the n-γ peaks are shown in figure 4.

3.- Future work.-

We think that these initial steps towards the implementation of a reliable fast neutron facility, could bring a new and attractive activity to this laboratory. Still, work needs to be done in order to improve beam quality. This will imply better use of the new ion source, improvement in the design of beam pullers, study of internal beam orbits, better extraction efficiency, etc. Concerning the experiment we need to improve the data acquisition system by replacing old, or, borrowed electronic units and detectors by new ones. Besides, a definite location for the tritium target needs to be determined according to background measurements and TOF possibilities.

Tests on the neutron-generator will be performed.

Most of these above mentioned tasks could be done during 1983 depending on the amount of resources the Laboratory would obtain.

Partial support from I.A.E.A., collaboration from the University of California, and equipment acquisition from the Scientific Development Department from the University of Chile are acknowledged.

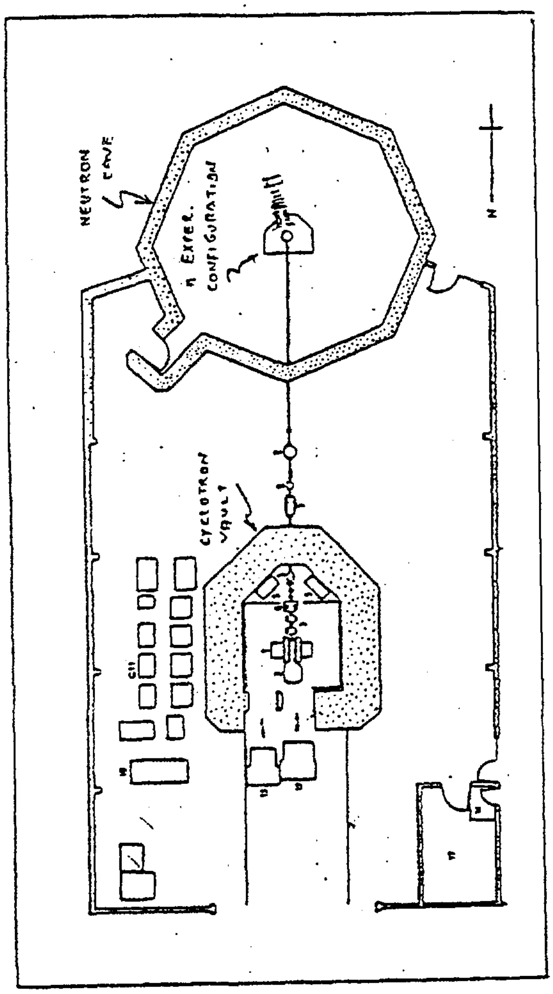

FIGURE 1

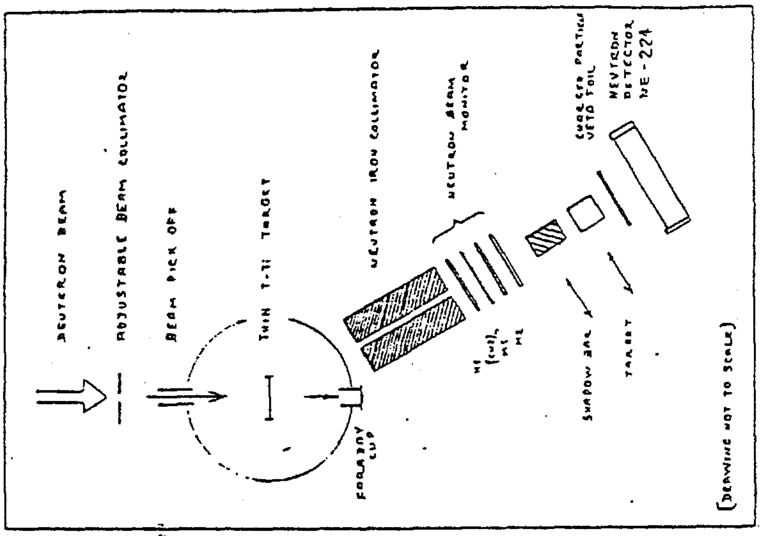

FIGURE 2

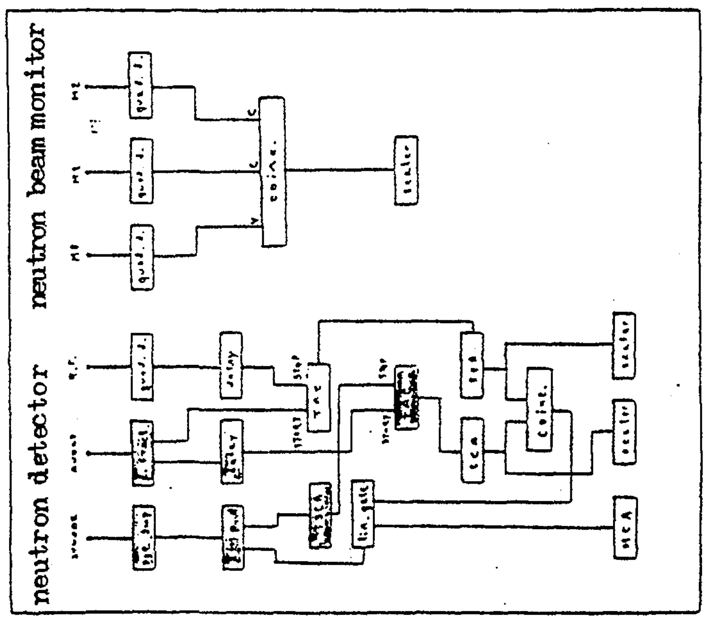

FIGURE 3

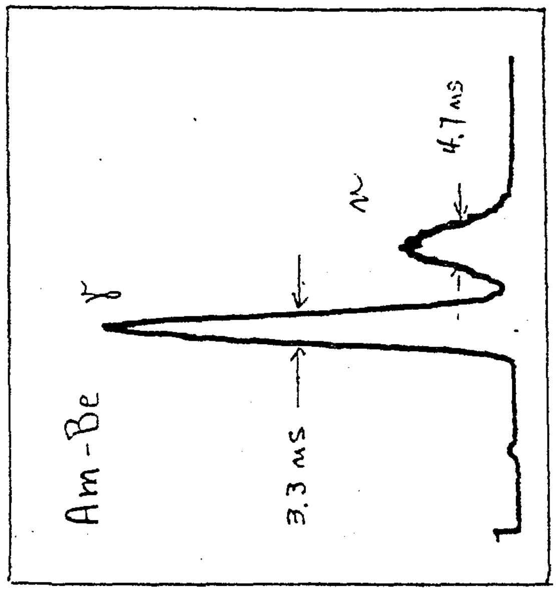

FIGURE 4