International Atomic Energy Agency

INDC(BAN)-002/G

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Report on Nuclear Data Activities in Bangladesh

Atomic Energy Centre, Dhaka

February 1983

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

Reproduced by the IAEA in Austria
March 1983
83-1874

INDC(BAN)-002/G

Report on Nuclear Data Activities in Bangladesh

Atomic Energy Centre, Dhaka

February 1983

Atomic Energy Centre,
Dhaka.

1. Measurement of cross-sections for neutron induced reactions at 14 MeV.

(N.I.Molla, M.Mizanul Islam, M.Mizanur Rahman and Sofia Khatun)

a) On-going programme:-

In view of the discrepancies among the previously reported cross-section data and the recent data needs for Fusion Reactor Technology(FRT) relevant materials, a multiyear programme of neutron nuclear data measurements for various reactions at 14 MeV neutrons have been undertaken. The measurements were done via activation technique around the 3 MeV Van de Graaff accelerator of the Atomic Energy Centre, Dhaka. Presently, measurements are being carried out on the cross-sections for the common reactions like(n,p), (n,2n) and (n,α) at 14 MeV in the mass region $46 \leq A \leq 100$. The attention was focussed to give a fresh look at the systematics of (n,2n) reaction in this mass region. Several FRT relevant materials of high purity and of known-weight chosen as targets which, previously sealed in thin polythene bags and sandwithched between two layers of flux monitor materials (Al or As_2O3), were irradiated with 14.8 MeV neutrons. The radioactivity of the reaction products was determined by high-precision γ-ray spectroscopy using a co-axial Ge(Li) detector. Cross-sections were obtained by applying the usual corrections like those for decay, γ-transition intensities (f_d), internal conversion coeffi-cients (α), counting efficiency, geometry, absorption, etc.

The investigated reactions, decay data of the product nuclei and the measured cross-sections together with the maximum errors are given in table 1. Each value is based on three or more independent measurements. The error quoted includes statistical and systematic errors.

b) Future plans

Since the neutron flux is rather low around the VDG accelerator, the measurements are being done only for the most common reactions in a limited mass region. However, recently a Neutron Generator has been received through the IAEA under the regular Technical Co-operation programme for 1981. The Generator was badly damaged during transportation from France which is now awaiting repair and test. A rabbit transport system for short irradiations has also been provided by the IAEA under the Interregional Project No.TA/INT/1/018 on Nuclear Data Techniques and Instrumentation. As a participant to the Interregional Project, one of the group members (M.M.I.) also visited the Neutron Generator and low energy nuclear physics laboratories of the CBMN, Geel, Belgium, KFK, Karlsruhe, Federal Republic of Germany, and Technical University, Dresden, German Democratic Republic, under the programme of Scientific Visits of the IAEA's Technical Cooperation programme.

The laboratory facilities for Neutron Nuclear Data measurements are now in a developing stage. The research programme is aiming at the measurements of cross-sections

Table-1

Reaction	Decay $T_{\frac{1}{2}}$	Data of product nucleide E_γ (KeV)	f_d		Cross-section (mb)
$^{46}Ti(n,2n)^{45}Ti$	3.08h	511	1.68	0	53±6.6
$^{52}Cr(n,2n)^{51}Cr$	27.7d	320	0.102	0.003	377±45
$^{58}Ni(n,2n)^{57}Ni$	36.h	1378	0.77	0	30±6.5
$^{59}Co(n,2n)^{58}Co$	70.78d	811	0.9943	0.0003	342±42
$^{64}Zn(n,2n)^{63}Zn$	38.4m	670	0.08	0.0005	175±30
		962	0.06	0.0002	
$^{69}Ga(n,2n)^{68}Ga$	68,3m	1077	0.035	0	803±153
$^{70}Ge(n,2n)^{69}Ge$	39.0h	574	0.13	0	608±92
		1107	0.28	0	
$^{74}Se(n,2n)^{73}Se$	7.1h	361	1.0	0.011	677±76
$^{76}Se(n,2n)^{75}Se$	120d	136	0.6	0.024	1040±115
$^{86}Sr(n,2n)^{85}Sr$	64.9d	514	0.99	0.007	861±96
$^{88}Sr(n,2n)^{87m}Sr$	2.81h	388	0.80	0.28	275±39
$^{93}Nb(n,2n)^{92m}Nb$	10.15d	934	0.11	0.0008	1633±179
$^{48}Ti(n,p)^{48}Sc$	43.67h	983	1.0	0.0001	38±7.7
		1038	0.98	0.0001	
		1312	1.0	0.0001	
$^{80}Se(n,\alpha)^{77}Ge$	11.3h	211	0.32	0	13±3.2
		264	0.59	0	
		416	0.27	0	

and excitation functions for (n,γ), (n,xn), (n, charged particles) and (n,n' charged particles) reations in the energy range upto 20 MeV, with an emphasis on 14 MeV neutrons pertinent to fusion reactor technology. Fission neutron spectrum averaged cross-sections for (n,p), (n,n'p), (n,α) and (n,2n) reactions will be done using the research reactor being installed at the AERE, Savar. Theoretical calculations using the code HELGA will be performed by the 4341 IBM computer being installed at the AERE, Savar.

A 3 MeV Van de Graaff accelerator, a 14 MeV Neutron Generator and a 3 MW TRIGA Mark II Research Reactor are the expected central facilities for neutron sources.

2. Level schemes and gamma ray angular distribution measurements in ^{28}Si, ^{46}Ti, and ^{53}Mn.

(M.I. Molla, M.Mizanur Rahman and Sofia Khatun)

The spins of the resonances at E_p=1588, 1799, 2044 and 2198 keV from ^{27}Al(P,γ)^{28}Si reaction have been determined through angular distribution measurements of gamma rays. The spins assigned to the corresponding resonant states are: 13116 keV(J=3), 13320 keV (J=2), 13556keV (J=4) and 13705 keV (J=2,3). The decay schemes of the resonances at E_p=1588 and 2044 keV are proposed.

The level scheme of ^{46}Ti have been proposed at E_p=1026, 1047 and 1377 keV resonances. The gamma decay and energy of 29 levels are observed. The spin J=3 for the 11355 keV resonating state (E_p=1026 keV) and the spins J=1,2,3 for the 11698 keV resonating state (E_p=1377 keV) have been assisgned.

The angular distribution measurements of gamma rays have been performed for the determination of spins of the resonances at E_p=1388, 1395, 1608 and 1901 keV from the ^{52}Cr (p,γ) ^{53}Mn reaction. The energies of the correspinding resonant states and spins as obtained are as follows:

7923 keV (J=5/$_2$), 7930 keV (J=5/$_2$), 8139 keV (J=$\frac{1}{2}$, 3/$_2$) and 8426 keV (J=7/$_2$).

The decay scheme of the E_p=1901 keV resonance has been constructed.

DEPARTMENT OF PHYSICS
UNIVERSITY OF RAJSHAHI

1. A Study of Neutron-induced Reaction ^{12}C (n,n')3α at E_n = 17.4 MeV.

(L.A. Banu, A.S. Mondal, A.K. Basak, M.M. Kasim, M.M. Haque and A. Husain.)

The mechanism of $^{12}C(n,n')$ 3α reactions at 17.4 MeV has been studied in nuclear emulsion exposed at AEC, Dhaka. The Kinematically complete measurements on 277 events reveal: (i) 43% of the events proved through the 9.64, 10.84, 11.83 and 12.71 MeV states in ^{12}C, (ii) 31% of the events are attributed to the $^{12}C(n,\alpha)$ ^{9}Be $(2\alpha,n')$ process via the 2.43 and 4.74 MeV states in ^{9}Be, (ii) 17.3% and 8.3% of the events follow the three-body and four-body break-up process respectively.

2. A Study on Nuclear Evaporation in Nuclear Emulsion exposed to 3.0 GeV/c Mesons

(M.H. Ahsan, A.S Mondal, A.K. Basak, M.M. Kasim and A Husain.)

A search for disintegrations of the Ag and Br nuclei in nuclear K-5 emulsions produced the following results:

The emission probabilities of neutrons, protons, deuterons, tritons and alpha-particles are 0.426 $\pm$ 0.018, 0.327 $\pm$ 0.015, 0.107 $\pm$ 0.007, 0.052 $\pm$ 0.005 and 0.088 $\pm$ 0.007, respectively. (ii) The mean nuclear temperatures of the protons, deuterons, tritons and alpha emission are 3.5, 4.5 and 3.5 MeV respectively.

3. Spectroscopy of ^{64}Cu using the $(^{3}He,p)$ reaction at 18 MeV.

(M.M. Rahman, A.S.Mondal, A.K.Basak and A. Husain.)

Momentum analyzed proton groups from the reaction were recorded in nuclear emulsion plates in the magnetic spectrograph of AERE, Harwell, England. The analysis of the data gives indication of some new levels over those obtained by single-nucleon transfer. The data is being processed for assignment of spin-parity for the new levels.