Experimental Activities in China

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The following nuclear data measurement laboratories are included in china Nuclear Data Network: China Institute of Atomic Energy(CIAE), Peking University, Sichuan University, Lanzhou University and etc. The summarized activities are covered during recent years.

1 China Institute of Atomic Energy

● Measurements of Neutron Emission Spectra of n+^{7}Be and n+^{6,7}Li

The neutron emission double-differential cross sections(DDXs) of ^{9}Be and ^{6,7}Li were measured at incident neutron energies of 8.17 and 10.27 MeV on HI-13 Tandem Accelerator in CIAE. At 10.27 MeV, the influence of breakup source neutrons from D(d,np) reactions was eliminated by using the combination of abnormal and normal fast neutron TOF spectrometers. The measured TOF spectra were analyzed by detailed Monte-Carlo simulation and the DDXs were determined by comparing the measured TOF spectra to simulated ones. The cross sections were normalized to n-p(normal geometry measurement) or n-C(abnormal geometry measurement) scattering measurement.

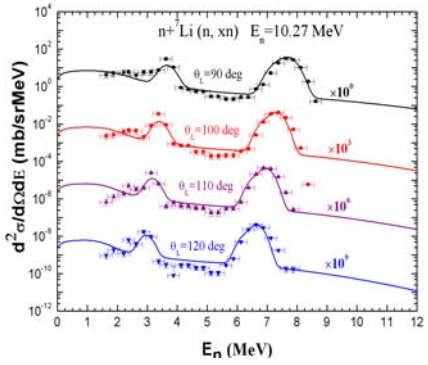

Fig.1 Measured DDXs result of ^{7}Li at 10.27 MeV

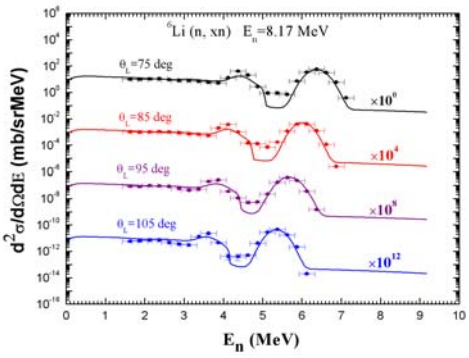

Fig. 2 Measured DDXs for ^{6}Li at 8.17 MeV

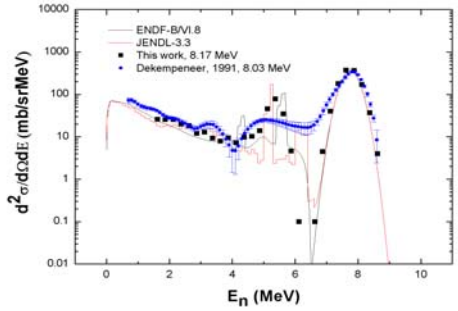

Fig. 3 DDXs result of ^{9}Be at 40 degree for 8.17 MeV

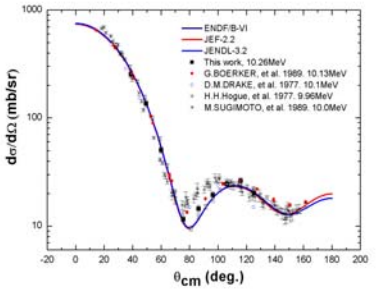

Fig. 4 Elastic scattering cross sections for ^{9}Be at 10.27 MeV

● Measurement of gamma-ray production cross sections

Gamma-ray production cross-sections from inelastic neutron scattering have been measured for ^{12}C、^{14}N、^{16}O、^{27}Al 、^{56}Fe、^{40}Ca、^{28}Si and ^{238}U. The measurements were carried out with the use of time-of-flight method and of the HPGe-BaF2 anti-Compton spectrometer .

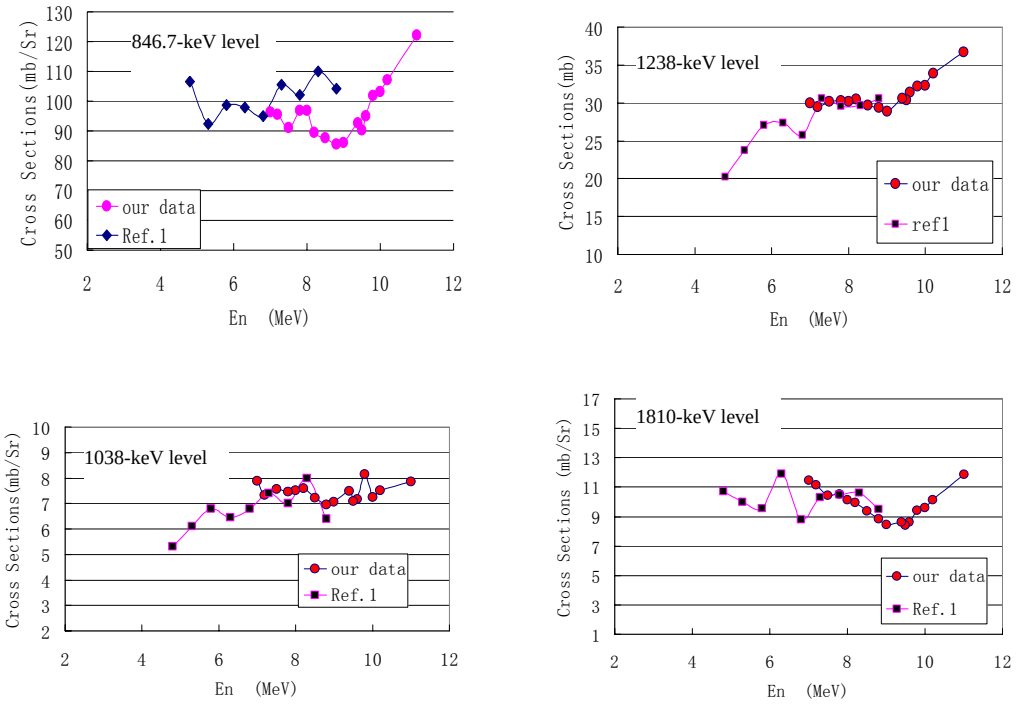

Fig. 5 Gamma-ray production cross-sections of ^{56}Fe

● Measurement of the thermal Neutron Cross Section of the Reaction of ^{135}CS

The thermal neutron cross section of ^{135}CS was measured by neutron activation analysis in this work. We obtained the fission number occurring in the U target through measuring the radioactivity of fission monitor ^{137}CS, and calculated the number of ^{135}CS atoms in the fission products by the fission yield of ^{135}CS and ^{137}Cs. ^{197}Au was selected to serve as neutron flux monitor when ^{135}CS was activated. The zirconium phosphate inorganic exchanger was used to separate carrier-free cesium from fission products, anion exchange resin was used to decontaminate U. The value we obtained is (2.55±0.10)b.

● The experiment method study of decay data and measurement

The half-lives, relative γ ray emission probabilities of 36 γ ray and absolute γ ray emission probability for 191.9keV γ ray of ^{101}Mo were measured. The radioactive source of ^{101}Mo were obtained from the $^{100}Mo(n,\gamma)^{101}Mo$ reaction. A total of 27 sources were prepared. Single γ ray spectra were recorded by HPGe detector.

Half-lives were extracted from the decay curves of 191.9keV γ ray. Results from the decay over 11 half-lives of 12 separate sources were subjected to analysis by the method of least squares. The results gave a weighted average of 14.84±0.02 minutes where the error quoted is the probable error of the mean.

About 36 γ rays transitions to the ground state and the first two excited states of ^{101}Tc, which used to deduce the absolute γ ray emission probabilities by scheme balance method were determined. To improve the statistics, 15 sources were used. The results are listed in Table1.

Table 1 Relative γ ray emission probabilities of ^{101}Mo

Energy/keV	relative γ ray emission	probabilities		Energy/keV	relative γ ray emission	probabilities
	Present work	NDS[1]			Present work	NDS[1]
191.92	100	100		1018.58	3.38 22	4.0 2
378.99	1.72 2	1.69 8		1304.00	14.7 3	14.9 4
491.5	0.32 2	0.37 3		1583.1	0.43 3	0.45 4
499.65	7.63 38	7.66 24		1589.67	1.57 7	1.49 6
505.05	64.4 7	2.0 2		1594.8	0.12 3	0.12 3
505.92		63.8 14		1599.26	9.52 28	9.6 4
523.83	1.08 4	0.87 6		1605.3	0.29 8	0.23 3
533.57	2.34 10	2.18 10		1615.0	0.21 4	0.31 3
590.10	104.8 49	105.5 46		1662.49	3.80 7	3.84 7
606.8	0.11 10	0.4 1		1759.72	5.12 15	5.52 24
660.64	1.14 4	1.23 6		1882.26	0.67 7	0.47 3
695.56	37.2 6	36.6 8		1888.3	0.13 5	0.24 4
701.80	1.86 6	1.96 11		1946.54	0.30 4	0.44 3
732.98	1.67 13	1.47 8		2032.10	37.6 7	36.2 10
871.08	9.25 14	9.4 4		2038.40	11.6 3	1.14 15
877.39	18.8 4	17.7 10		2041.24		11.8 4
887.0	0.70 7	1.03 7		2047.31	0.29 8	0.49 4
1012.47	77.0 42	71.5 37		2114.34	2.95 18	3.16 14

To check the decay scheme and the relative γ ray emission probabilities of ^{101}Mo, the affiliation method was adopted to determine the absolute γ ray emission probability for 191.9keV γ ray. The results is Pγ (191.9keV)=17.20±0.18. This value is different from the NDS value 18.21±0.21, which deduced by scheme balance method.

The decay data evaluation covers the following nuclides: ^{7}Be, ^{101}Mo,^{175}Hf, ^{225}Ra, ^{231}Th, ^{233}Pa and ^{233}U. All evaluations including decay scheme were completed.

● Spectroscopic Studies of Highly Ionized Ions

The measurements were performed at the HI-13 tandem accelerator at the China Institute of Atomic Energy (CIAE). The appropriate beam energy was calculated by a semi-empirical formula of Nikolaev and Dimitriev. The ions were extracted from the ion source and accelerated to a high energy. In the beam-foil target chamber, the beam was collimated with a 3.5mm aperture, then passed through a 25μg/cm^2 carbon foil and were finally collected in a Faraday cup 20cm from the spectrometer entrance slit. Typical ion currents were 100-200 nA. The energy loss in the foil was taken into account when calculating the final beam velocities. Photons emitted by the foil-excited ions were dispersed by a 2.2 meter grazing incidence GIM-957 XUV-VUV monochromator equipped with a 600 lines /mm grating. The photons were registered by a Channeltron detector or a CCD detector, operating in the photon-counting mode. The spectrometer viewed the beam at an angle of 90^o. The spectrometer entrance slit is positioned very close to the ion beam (5 mm from

the center of a 2.5 mm diameter beam.) to give a short time window, which is a practical necessity for measuring very short lifetimes. The line width [full width at half-maximum (FWHM)] in these spectra is 0.06nm when spectrometer slit widths is 30 μm. Doppler broadening of the lines due to the finite but small entrance aperture was negligible in this spectral region. Moving the excited foil step by step, we gained the radioactive decay spectra.

In present work some excited configurations have been analyzed and some level lifetimes of Ni XVII Cu, Br, S, Ge ,etc, have been measured. We have got many new lines, lifetime and energy level values, Ge XXIII one lines, Mg-like Ge eleven lines, Mg-like Ni seven lines, Cu Ⅹ Ⅷ nine linnes, Cu Ⅹ Ⅶ four lines, Br XXIV nineteen lines, Mg-like Br 23 energy levels, Be-Like sulfur one lifetime value, Si two lifetime values.

2 Peking University

- **Differential and angle-Integrated cross-section measurement for the ^{6}Li(n,t)^{4}He reaction**

Differential cross sections and angle integrated cross sections for the ^{6}Li(n,t)^{4}He reaction at E_n=1.05,1.54 and 2.25 MeV were measured by using the gridded ionization chamber method. Mono-energetic neutrons were produced through the T(p,n)^{3}He reaction. The experiment was performed at the 4.5MV Van de Graaff of Peking University. Neutron flux was determined by the ^{238}U(n,f) reaction. Present results were compared with the existing data.

- **Differential and Angle-Integrated Cross Section Measurement for the ^{64}Zn(n,α)^{61}Ni Reaction**

Differential and angle-integrated cross sections of the ^{64}Zn(n,α)^{61}Ni reaction were measured at neutron energy 5.03 and 5.95 MeV by using a gridded ionization chamber. The experiment was performed at the 4.5 MV Van de Graaff accelerator of the Institute of Heavy Ion Physics, Peking University. The neutrons were produced through the D(d,n)^{3}He reaction with a deuterium gas target. Absolute neutron flux was determined by the ^{238}U(n,f) reaction and a calibrated BF_3 long counter. Present results are compared with existing data.

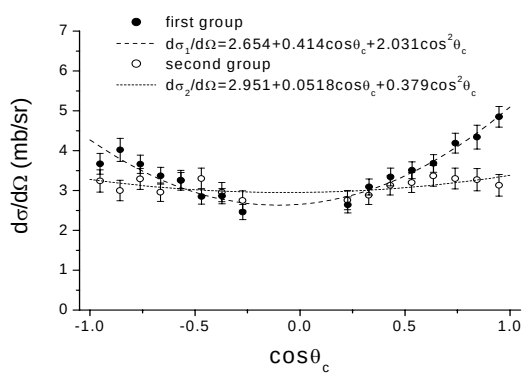

Fig. 6 The differential cross sections of ^{64}Zn(n,α)^{61}Ni reaction in the c.m. system at E_n =5.03 MeV

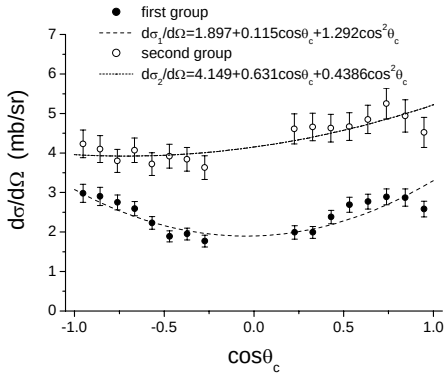

Fig. 7 The differential cross sections of ^{64}Zn(n,α)^{61}Ni reaction in the c.m. system at E_n = 5.95 MeV

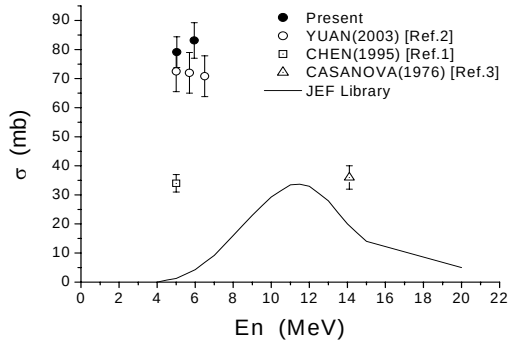

Fig. 8 cross sections of the $^{64}Zn(n,\alpha)^{61}Ni$ reaction

3 Lanzhou University：

- **Measurement of The Half-life of ^{79}Se**

The number of ^{79}Se atoms was measured with Multi-collector inductively coupled plasma mass spectrometry, the radioactivity of ^{79}Se was measured with Liquid Scintillation spectrometry. Based the number of ^{79}Se atoms and the radioactivity of ^{79}Se, The calculated Half-life of ^{79}Se was（ $4.61\pm0.29)\times10^{5}$a

- **Cross sections Measurement**

The following cross sections was measured at neutron energy from 13.5 to 14.6MeV at Lanzhou University by using the activation method :
$^{150}Nd(n,2n)^{149}Nd$, $^{148}Nd(n,2n)^{147}Nd$, $^{142}Nd(n,2n)^{141}Nd$, $^{160}Gd(n,2n)^{159}Gd$, $^{141}Pr(np)^{141}Ce$, $^{139}La(np)^{139}Ba$, $^{158}Gd(np)^{158}Eu$, $^{146}Nd(np)^{146}Pr$.

4 Sichuan University:

The cross sections for the $^{115}In(n,\gamma)^{116}In$, $^{116}mIn(n,\gamma)^{117}In$ and $^{71}Ga(n,\gamma)^{72}Ga$ reaction were measured in neutron energy range from 30 to 1500 keV in the past years.