Experimental Activities in Japan

Tokio FUKAHORI[1], Akira HASEGAWA[1] and Mamoru BABA[2]
[1]*Nuclear Data Center, Japan Atomic Energy Research Institute*
E-mail: fukahori@ndc.tokai.jaeri.go.jp
[2]*Cyclotron and Radioisotope Center, Tohoku University*

The experimental activities in Japan are summarized in the following tables with laboratory-wise. The summarized activities are covered during the period of last one year. Notations in tables are defined as

DA: Angular Distribution,
DDX: Double-differential Cross Section,
DE: Energy Spectrum,
FPY: Fission Product Mass Yield,
RI: Resonance Integral, and
SIG: Cross Section.

Japan Atomic Energy Research Institute (JAERI)

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
Li-6(n,xt) Be-9(n,xt)	Product. Rate	14 MeV	DT neutron generator (FNS)	liquid scintillation counter	4
Co-56, Zn-65, Cr-51, V-48, Re-184, Bi-206 production for Fe, Cu, V, Ti, W, Pb targets	eff. SIG	14 MeV	DT neutron generator (FNS)	activation method	5
Pu-239(d,pf)	FPY	13.5 MeV	Tandem accelerator	dE-E counter for proton, silicon PIN diode for FP	24, 38

Japan Nuclear Cycle Development Institute (JNC)

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
Ho-166m(n,g)Ho-167	SIG, RI	thermal	Kyoto University Reactor (KUR)	two-step irradiation technique	1*,6
Ag-109(n,g)Ag-110m	SIG, RI	thermal	Rikkyo University Reactor	activation method	3*,7
Se-80(n,g) Zr-94,96(n,g) Sn-124(n,g)	SIG, RI	thermal	Rikkyo University Reactor	activation method	8
Np-237(n,g)Np-238	SIG, RI	thermal	Kyoto University Reactor (KUR)	activation method	9,48
Tc-99(n,g)	SIG	thermal	Omega West Reactor at LANL,	prompt gamma-ray spectroscopic method	45

Kyoto University Research Reactor Institute (KURRI)

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
Np-237(n,g)	SIG	0.15 eV - 1 keV	Linac	TOF, Pb slowing-down spectrometer (KULS)	10
Rh(n,g)	SIG	0.003 eV - 80 keV	Linac	TOF, Pb slowing-down spectrometer (KULS)	11
I-129(n,g) Cs-133(n,g) Pr-141(n,g)	SIG	0.003 eV - 140 keV	Linac	TOF, Pb slowing-down spectrometer (KULS)	12, 25, 35
I-127(n,g) Cs-133(n,g)	SIG	< several tens of keV	Linac	TOF, prompt gamma-ray spectroscopy with whole energy absorption BGO detector	46
Th-233(n,g)	eff. SIG	thermal-epithermal	KUR	gamma-ray spectroscopy with chemical separation	49

Kyushu University

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
C-12, Al-27, Ni-58, Zr-90, Au-197, Bi-209(p,z)	DDX	42, 68 MeV	JAERI/TIARA		13*
Be-9(p,xp)	DDX	392 MeV	AVF cyclotron at RCNP	stacked scintillators detector (dE-E counter)	14, 30
Fe(p,xn) Pb(p,xn)	DDX	0.8, 1.5 GeV	12 GeV PS at KEK	TOF, most-forward angle	29, 41
Fe(n,xn)	DDX	20-700 MeV white	LANL/LANSCE	TOF, NaI with CH_2 radiator	34
Pb-208(p,xp) Bi-209(p,xp)	DDX	392 MeV	AVF cyclotron at RCNP	stacked scintillators detector (dE-E counter)	40
C-12(a,z)	DDX	400 MeV	Ring cyclotron at RCNP	stacked scintillators detector (dE-E counter)	44

Nagoya University

Reaction	Quantity	Incident Energy	Facility	Apparatus/ Method	Ref.
Mg-26, Si-29,30, Cr-53,54, Zn-67, Sr-87, Mo-98,100, Ru-102, Pd-105,106,108, Te-123, Dy-163, Hf-179, Os-189 (n,np+d)	Act. SIG	13.4-14.9 MeV	DT neutron generator at Osaka University (OKTAVIAN)	activation method	15
Nd-146,148, Sm-152, Gd-155,158, Dy-164, Er-170, Yb-174,176 (n,np+d)	Act. SIG	13.4-14.9 MeV	DT neutron generator (JAERI/FNS)	activation method	16
Y-89, Zr-90, Ba-137, Au-197(n,n')	Act. SIG	2-3 MeV	DT neutron generator (JAERI/FNS)	activation method	27

Osaka University

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
Mn-55(n,2n)	DA	14 MeV	pencil beam with DT neutron generator (JAERI/FNS)	activation method	17, 28

Tohoku University

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
C, Si, Fe, Zr, Pb(n,ela)	DA	55,65,75 MeV,	JAERI/TIARA	TOF	19*
U-233,238(n,f) Th-232(n,f)	prompt neutron spectrum	0.6, 1.9, 4.1 MeV	Dynamitron accelerator	TOF	19, 20
N(n,xp),(n,xd),(n,xt),(n,xa) O(n,xp),(n,xd),(n,xt),(n,xa)	DDX	75 MeV	JAERI/TIARA	counter telescope	21
C, Si, Fe, Zr, Pb(n,non)	SIG	40-80 MeV	JAERI/TIARA	transmission method with closed-geometry	22*

Tohoku University, Cyclotron and Radioisotope Center (CYRIC)

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
Li(d,n)	DDX	20-40 MeV	AVF cyclotron	TOF	18
Li(d,x)Be-7	SIG	20-40 MeV	AVF cyclotron	activation method	18
C, Al, Ta, W, Pb (p,xn)	TTY	50, 70 MeV	AVF cyclotron	TOF	31, 33
Li(d,xn) Be(d,xn)	TTY	25, 40 MeV	AVF cyclotron	TOF	32, 42
Li(d,x)Be-7 Be(d,x)Be-7	SIG	25, 40 MeV	AVF cyclotron	activation method	32, 43
Ta-181(p,x)	Act. SIG	30-70 MeV	AVF cyclotron	activation method	39

Tokyo Institute of Technology (TIT)

Reaction	Quantity	Incident Energy	Facility	Apparatus/Method	Ref.
Tc-99(n,g)	SIG, g-DE	8-90, 190, 330, 540 keV	Pelletron accelerator	TOF, anti-Compton NaI(Tl)	2*
Dy-161,162(n,g)	SIG	10-90 keV	Pelletron accelerator	TOF, anti-Compton NaI(Tl)	23
Bi-209(n,g)Po-210 Bi-209(n,g)Bi-209m	Act. SIG	30, 534 keV	Pelletron accelerator	TOF, HPGe for gamma-ray, Si surface barrier detector for alpha	26, 47
Er-170(n,g)	SIG	200 keV	Pelletron accelerator	TOF, anti-Compton NaI(Tl)	36
O-18(n,g)	SIG	10-90 keV	Pelletron accelerator	TOF, anti-Compton NaI(Tl)	37

References

* : Work is finished. The others are in progress.

1. T. Katoh, et al., *J. Nucl. Sci. Technol.* **39[7]**, 705 (2002).
2. T. Matsumoto, et al., *J. Nucl. Sci. Technol.* **40[2]**, 61 (2003).
3. S. Nakamura, et al., *J. Nucl. Sci. Technol.* **40[3]**, 119 (2003).
4. K. Ochiai, et al., "Measurement of Tritium Production Rate for Enriched Lithium-6/Beryllium Assembly with D-T Neutron Source", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.15 (2003).
5. J. Hori, et al., "Radioactivity Production around the Surface of a Cooling Water Pipe in a D-T Fusion Reactor by Sequential Charged Particle Reactions", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.16 (2003).
6. T. Katoh, et al., "Measurement of Thermal Neutron Capture Cross Section and Resonance Integral of ^{166m}Ho(n,g)^{167}Ho Reaction Using a Two-Step Irradiation Technique", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.24 (2003).
7. S. Nakamura, et al., "Measurement of Thermal Neutron Capture Cross Section and Resonance Integral of ^{109}Ag(n,g)^{110m}Ag Reaction", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.25 (2003).
8. S. Nakamura, et al., "Thermal Neutron Capture Cross Section and Resonance Integral of ^{80}Se, ^{94,96}Zr and ^{124}Sn", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.26 (2003).
9. T. Katoh, et al., "Measurement of Thermal Neutron Capture Cross Section and Resonance Integral of the ^{237}Np(n,g)^{238}Np Reaction", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.27 (2003).
10. K. Kobayashi, et al., "Measurement of Neutron Capture Cross Section of ^{237}Np by Linac Time-of-Flight Method and with Linac-Driven Lead Slowing-Down Spectrometer", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.31 (2003).
11. S. Lee, et al., "Neutron Capture Cross Section Measurement of Rhodium in the Energy Region from 0.003 eV to 80 keV by Linac Time-of-Flight Method", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.32 (2003).
12. K. Kobayashi, et al., "Neutron Capture Cross Section Measurement of ^{129}I, ^{133}Cs and ^{141}Pr with Linac Time-of-Flight Method", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.33 (2003).
13. M. Harada, et al., "Light Charged-Particle Production in Proton-Induced Reactions on ^{12}C, ^{27}Al, ^{58}Ni, ^{90}Zr, ^{197}Au and ^{209}Bi at 42 and 68 MeV", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.38 (2003).
14. T. Kin, et al., "The Measurement of Proton Production Cross Section Induced by Intermediate Energy Protons", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.42 (2003).
15. H. Sakane, et al., "Measurement of Activation Cross Section of (n,np+d) Reactions Producing Short-Lived Nuclei in the Energy Range between 13.4 and 14.9 MeV Using an Intense Neutron Source OKTAVIAN", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.47 (2003).
16. H. Sakane, et al., "Measurement of Activation Cross Section of (n,np+d) Reactions Producing Short-Lived Nuclei in the Energy Range between 13.4 and 14.9 MeV", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.49 (2003).
17. M. Mitsuda, et al., "Measurement of (n,2n) Reaction Cross Section Using a 14 MeV Pencil Beam Source", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.65 (2003).
18. M. Baba, et al., "Experimental Studies on the Neutron Emission Spectrum and Induced Radioactivity of the ^{7}Li(d,n) Reaction in the 20-40 MeV Region", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.73 (2003).

19. M. Baba, et al., "Experiments on Neutron Scattering and Fission Neutron Spectra", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.74 (2003).
20. T. Miura, et al., "Measurement of Fast Neutron-Induced Prompt Neutron Fission Spectra of ^{233}U, ^{238}U and ^{232}Th", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.74 (2003).
21. T. Sanami, et al., "Double Differential Hydrogen and Helium Production Cross Section of Oxygen and Nitrogen for 75 MeV Neutrons", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.75 (2003).
22. M. Ibaraki, et al., "Measurement of Neutron Non-Elastic Cross Sections of C, Si, Fe, Zr and Pb in 40-80 MeV Region", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.76 (2003).
23. G. Kim, et al., "Capture Cross Section Measurements of ^{161}Dy and ^{162}Dy in the Energy Region between 10 keV and 90 keV", Progress Report, (Ed.) J. Katakura, *INDC(JPN)-190/U*, p.79 (2003).
24. K. Nishio, et al., "Fragment Mass Distribution of the ^{239}Pu(d,pf) Reaction at the Super-deformed beta-vibrational Resonance", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.40 (2003), to be published.
25. S. Lee, et al., "Neutron Capture Cross Section Measurement of Pr in the Energy Region from 0.003 eV to 140 keV by Linac Time-of-Flight Method", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.127 (2003), to be published.
26. K. Saito, et al., "Measurement of Cross Sections of the ^{210}Po Production Reaction by keV-Neutron Capture of ^{209}Bi", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.133 (2003), to be published.
27. T. Shimizu, et al., "Measurements of Activation Cross Sections Producing Short-lived Nuclei in the Energy Range of 2-3 MeV with Pulsed Neutron Beam", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.138 (2003), to be published.
28. M. Mitsuda, et al., "Measurement of (n,2n) Reaction Cross Section Using a 14MeV Pencil Beam Source", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.144 (2003), to be published.
29. D. Satoh, et al., "Neutron Production by 0.8 and 1.5 GeV Protons on Fe and Pb Targets at the Most-Forward Region", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.150 (2003), to be published.
30. T. Kin, et al., "The Measurement of Energy Spectra for ^{9}Be(p,p'x) Reaction at 392 MeV", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.156 (2003), to be published.
31. N. Kawata, et al., "Measurements of Differential Thick Target Yield for C, Al, Ta, W, Pb(p,xn) Reactions at 50 and 70 MeV", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.160 (2003), to be published.
32. M. Hagiwara, et al., "Measurements of Neutron Emission Spectra and ^{7}Be Production in Li(d,n) and Be(d,n) Reactions for 25 and 40 MeV Deuterons", Proc. of 2002 Symposium on Nuclear Data, Nov. 21-22, 2002, JAERI, Tokai, Japan, *JAERI-Conf*, p.166 (2003), to be published.
33. N. Kawata, et al., "Measurement of Thick Target Neutron Yields - C, Al and W(p,xn) Reactions Induced by 70 MeV Protons -", C43, orally presented at 2002 Fall Meeting of AESJ at Iwaki Meisei University, unpublished.
34. N. Shigyo et al., "Measurement of Continuous Energy Neutron Incident Neutron Production Double-Differential Cross Section", C44, orally presented at 2002 Fall Meeting of AESJ at Iwaki Meisei University, unpublished.
35. S. Lee, et al., "Measurement of Neutron Capture Cross Section of I-129 between 0.005 eV and 44 keV", C50, orally presented at 2002 Fall Meeting of AESJ at Iwaki Meisei University, unpublished.

36. K. Ohgama, et al., "Measurement of Neutron Capture Cross Section of Er-170 at 200 keV", C51, orally presented at 2002 Fall Meeting of AESJ at Iwaki Meisei University, unpublished.
37. T. Ohsaki, et al., "Re-measurement of the keV-Neutron Capture Reaction Cross Sections of ^{18}O", C52, orally presented at 2002 Fall Meeting of AESJ at Iwaki Meisei University, unpublished.
38. K. Nishio, et al., "Mass Distribution of ^{240}Pu Following Beta-Vibrational Resonance", C56, orally presented at 2002 Fall Meeting of AESJ at Iwaki Meisei University, unpublished.
39. M.S. Uddin, et al., "Investigations on the Excitation Functions of Ta+p Nuclear Reactions between 30 and 70 MeV Range", C27, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
40. K. Ikeda, et al., "Measurement of Proton Production Cross Section of ^{208}Pb and ^{209}Bi", C28, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
41. D. Satoh, et al., "Measurement of Neutron Production Double-Differential Cross Sections for 0.8 and 1.5 GeV Proton Incidence in the Most-Forward Directions", C29, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
42. M. Hagiwara, et al., "Measurements of Neutron Energy-Angular Distribution from Thick Target Li(d,xn) Reaction", C30, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
43. N. Hirabatashi, et al., "Measurements of Li(d,x)^{7}Be Reaction Rate and Cross Section", C31, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
44. T. Kin, et al., "Measurement of the Spectra of Light Particle Production Cross Section Induced by 400 MeV Alpha", C32, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
45. K. Furutaka, et al., "Determination of the ^{99}Tc(thermal n,g)^{100}Tc Reaction Cross Section by Prompt Gamma-ray Spectroscopic Method", C37, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
46. S. Lee, et al., "Neutron Capture Cross Section Measurement of ^{127}I and ^{133}Cs below Several Tens of keV", C38, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
47. K. Saito, et al., "Cross Section Measurement for the ^{210}Po and ^{210m}Bi Production Reactions by keV-Neutron Capture of ^{209}Bi", C39, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
48. S. Nakamura, et al., "The Thermal Neutron Capture Cross Section Measurement of ^{237}Np(n,g)^{238}Np Reaction", C41, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.
49. H. Chatani, "Measurement of the Effective Cross Section of the Th-233(n,g)Th-234 Reaction Using the KUR Core", C43, orally presented at 2003 Annual Meeting of AESJ at Arkas Sasebo, unpublished.