List of Figures

Figure No.	Caption	Page No.
FIG 1.1	Laboratory System	7
FIG 1.2	Center of Mass System	7
FIG 2.1	Nuclear reaction mechanisms	20
FIG 2.2	Outgoing particle spectra; the role of compound nucleus (C), pre-equilibrium (P) and direct reaction (D) mechanism with respect to incident particle energy	21
FIG 2.3	Decay of compound nucleus	21
FIG 2.4	Pre-equilibrium mechanism as explained in the exciton model	23
FIG 3.1	Backshift of Resonance Peak Energy in Nd isotopes which is result from the term $e^{\left(-\left(\frac{(Ei-Sj\cdot Rp)}{2}\right)^2\right)}$	43
FIG. 3.2	Backshift of Resonance Peak Energy in Pt isotopes which is result from the term $e^{\left(-\left(\frac{(Ei-Sj\cdot Rp)}{2}\right)^2\right)}$	44
F IG 3.3	R _p parameter fitted for different elements using eq. 3.10	46
FIG 3.4	Intercept C for eq. 3.10 for different elements fitted with eq. 3.11	47
FIG 3.5	S_f parameter for different (N-Z)/N fitted with eq. 3.14	48
FIG 3.6	Comparison of Evaluated data using TALYS-1.6, EMPIRE- 3.2.2, and Empirical Formula with Experimental data from EXFOR comparison for ^{144-146,148,150} Nd, and ¹⁴⁸ Sm	50
FIG 3.7	Comparison of Evaluated data using TALYS-1.6, EMPIRE- 3.2.2, and Empirical Formula with Experimental data from EXFOR comparison for ^{150,152,154} Sm, ¹⁸⁶ W, ¹⁸⁶ Os, and ¹⁸⁸ Os	51
FIG 3.8	Comparison of Evaluated data using TALYS-1.6, EMPIRE- 3.2.2, and Empirical Formula with Experimental data from EXFOR comparison for ^{189,190,192} Os, ^{191,193} Ir, and ¹⁹⁴ Pt	52
FIG 3.9	Comparison of Evaluated data using TALYS-1.6, EMPIRE- 3.2.2, and Empirical Formula with Experimental data from EXFOR comparison for ^{195,196,198} Pt, ¹⁹⁷ Au, ²⁰⁶ Pb and, ²⁰⁷ Pb	53

FIG 3.10	Comparison of Evaluated data using TALYS-1.6, EMPIRE- 3.2.2, and Empirical Formula with Experimental data from EXFOR comparison for ²⁰⁸ Pb, ²³³⁻²³⁶ U, and ²³⁸ U	54
FIG 3.11	Effect of deformed nuclei in (n, Υ) nuclear reaction, data comparisons for TALYS – 1.6, EMPIRE – 3.2.2 and Present Empirical formula	55
FIG. 3.12	Comparison of Evaluated data for 180 W, 183 W, 202 Pb, 203 Pb, 204 Pb, and 205 Pb using TALYS -1.6 , EMPIRE $-3.2.2$	57
FIG 3.13	Comparison of Evaluated data for 231 Pa, 232 U, 237 U, and 239 Pu using TALYS – 1.6, EMPIRE – 3.2.2, and Empirical Formula	58
FIG 4.1(a)	14 UD TIFR-BARC Pelletron facility	65
FIG 4.1(b)	Experimental arrangement showing neutron production using Li (p, n) reaction	66
FIG 4.1(c)	Gamma spectroscopy system for activity measurement	66
FIG 4.2(a)	Typical γ -ray spectra for W targets obtained by using HPGe detector	68
FIG 4.2(b)	Typical γ -ray spectra for Gd targets obtained by using HPGe detector	68
FIG 4.3(a)	⁷ Li (p, n) ⁷ Be neutron spectra for the 7.0, 11.0, 15.0 and 18.8 MeV proton energies	74
FIG 4.3(b)	Visualization of peak averaged neutron energy for 15 MeV neutron peak	74
FIG 4.3(c)	Neutron flux correction for the threshold energy reactions, shown for ¹⁵⁴ Gd (n, 2n) ¹⁵³ Gd reaction with threshold energy of 8.953 MeV labeled by 'A' and maximum neutron energy labeled by 'B'	75
FIG 4.4	Typical monitor reaction gamma ray spectra using HPGe detector	75
FIG 4.5	Present measured cross section for ${}^{186}W(n, \gamma){}^{187}W$ and ${}^{182}W(n, p){}^{182}Ta$, ${}^{154}Gd(n, 2n){}^{153}Gd$ and ${}^{160}Gd(n, 2n){}^{159}Gd$ reactions compared with EXFOR and predicted cross section data using different theoretical nuclear models of TALYS – 1.8 and EMPIRE – 3.2.2; The LEVDE-2 model of EMPIRE – 3.2.2 predicts very low values (below 100 mb) of cross sections comparing to other models hence it cannot be seen in plot of ${}^{154}Gd(n, 2n){}^{153}Gd$	79

FIG 5.1 (a)	MCNP modeling of the irradiation experimental setup	87
FIG 5.1(b)	Gamma counting setup at IPR, Gandhinagar	87
FIG 5.2	Gamma spectrum measured using HPGe detector	88
FIG 5.3	²⁵² Cf Source neutron spectra – average neutron spectra in W sample, and the effective neutrons for the selected reactions, which are above the threshold energy of the reactions	93
FIG 5.4	Relative intensity showing the self-shielding effect increases as the thickness of the sample increases	94
FIG 5.5	MCNP Model of the detector to calculate efficiency for irradiated volume sample placed on end cap of the detector	94
FIG 5.6(a)	Comparison of measured and MCNP calculated detector efficiency at various gamma energies	95
FIG 5.6(b)	Comparison of Experimental to MCNP calculated detector efficiency ratio at various gamma energies	95
FIG 5.7	Comparison of present measured spectrum averaged cross section with experimental and EMPIRE-3.2.2 evaluated cross section for $^{183}W(n, p)^{183}Ta$; the present data and data point of J. Rivier et al., [32] are spectrum averaged cross sections, other experimental data are for mono energy neutrons	97
FIG 5.8	Comparison of measured cross section with experimental and EMPIRE-3.2.2 evaluated cross section for $^{184}\mathrm{W}(n,p)^{184}\mathrm{W}$	98
FIG 6.1	The structural materials used in ITER	105
FIG 6.2	Typical measured gamma spectra from irradiated mixed powder of $(As_2O_3, + Al)$ using HPGe detector	109
FIG 6.3	Self absorption and self scattering effect for Ni and Zn sample	111
FIG 6.4	Comparison of measured ⁷⁵ As (n, p) ⁷⁵ Ge Cross section with EMPIRE-3.2.2, TALYS-1.6, EXFOR data	112
FIG 6.5	Comparison of measured ⁶⁶ Zn(n, p) ⁶⁶ Cu Cross section with EMPIRE-3.2.2, TALYS-1.6, EXFOR data	112

FIG 6.6	Comparison of measured ⁶⁴ Zn(n, p) ⁶⁴ Cu Cross section with EMPIRE-3.2.2, TALYS-1.6, EXFOR data	113
FIG 6.7	Comparison of measured ⁵⁵ Mn(n, p) ⁵⁵ Cr Cross section with EMPIRE-3.2.2, TALYS-1.6, EXFOR data	113
FIG 6.8	Comparison of measured ${}^{51}V(n, p){}^{51}Ti$ Cross section with EMPIRE-3.2.2, TALYS-1.6,EXFOR data	114
FIG 6.9	Comparison of measured ⁵⁸ Ni(n, p) ⁵⁸ Co Cross section with EMPIRE-3.2.2, TALYS-1.6, EXFOR data	114