

Contents

1	Introduction	1
1.1	β Decay and the Neutrino	1
1.2	Neutrinos in the Standard Model	3
1.3	Neutrino Oscillation	5
1.4	Sources of Neutrinos	7
1.4.1	Natural Sources	8
1.4.2	Terrestrial Neutrino Sources	12
1.5	Knowns and Unknowns in Neutrino Physics	22
1.5.1	Questions within standard 3ν oscillation framework	24
1.5.2	Beyond standard 3ν neutrino oscillation	27
1.6	Scope of the Thesis	30
	Bibliography	30
2	Neutrino Oscillation Phenomenology at Terrestrial Neutrino Experiments	43
2.1	PMNS matrix parametrization	43
2.1.1	Majorana phase in neutrino oscillation	47
2.2	Three Neutrino Flavour Oscillation in Vacuum	49

2.3	Three Neutrino Flavour Oscillation in Matter	58
2.3.1	Neutrino Oscillation Probability in Matter	62
2.4	Oscillation Parameter Degeneracy	71
2.5	Summary	74
	Bibliography	74
3	Experiment Specifications and Event Spectra	79
3.1	Specifications of the Terrestrial Neutrino Oscillation Experiments .	80
3.1.1	T2K-II	80
3.1.2	NO ν A-II	83
3.1.3	JUNO	86
3.2	Simulation Technique	88
3.2.1	GLOBES package	89
3.2.2	Neutrino Flux for T2K-II and NO ν A-II	91
3.3	Event Spectra	97
3.3.1	T2K-II and NO ν A	97
3.3.2	JUNO	104
3.4	Discussion	105
	Bibliography	105
4	Leptonic CP Violation and Mass-Hierarchy in T2K-II, NOνA-II and JUNO	110
4.1	Introduction	110
4.1.1	Importance of JUNO	113
4.2	Method of χ^2 analysis	114

4.3	Mass Hierarchy	116
4.4	CP Violation	120
4.5	Effect of varying exposure of T2K-II on mass hierarchy and CP Violation	123
4.6	Discussion	124
	Bibliography	125
5	Octant Degeneracy and Precision Measurements of Oscillation Parameters in T2K-II, NOνA-II and JUNO	127
5.1	Introduction	127
5.2	Allowed regions of θ_{13} mixing angle and δ_{CP}	129
5.3	Allowed regions of θ_{23} mixing angle and Δm_{31}^2	130
5.4	Resolving the octant of the θ_{23} mixing angle:	131
5.5	Discussion	132
	Bibliography	133
6	Conclusion and Future Scopes	134
	Publications based on the Thesis Works	137