

Contents

Abstract	vii
List of articles	ix
Acknowledgment	xi
Acronyms	xiii
1 Introduction	1
2 Aspects of Quantum Mechanics: Quantum Correlations and Geometric Phase	7
2.1 Quantum correlations	7
2.2 Quantum coherence	12
2.3 Geometric Phase	13
2.3.1 Berry phase	13
2.3.2 Generalization of Berry phase	16
3 Basics of Neutrino Oscillations	19
3.1 Brief history	19
3.1.1 History of neutrino oscillations	20
3.2 Neutrino oscillation phenomena	20
3.2.1 Neutrino oscillations in vacuum	21
3.2.2 Matter effect on neutrino oscillations	22
3.3 Effects of quantum decoherence on neutrino-oscillations	24
3.4 Effects of nonstandard neutrino-matter interactions (NSI) on neutrino oscillations	27
3.5 Experimental facilities	30
3.6 Open questions	31
4 Quantum Correlations in Neutrino Oscillations	33
4.1 Neutrino dynamics with mode entanglement	33
4.2 Measures of Quantum Correlations in neutrino-system	35
5 Effect of Quantum Decoherence on Coherence and Mixedness in Neutrino-system for LSND setup	41
5.1 Effect of decoherence on coherence and mixedness in oscillating neutrino system	42
6 A model independent analysis of New Physics effects on Quantum Coherence	45
6.1 Effect of nonstandard neutrino-matter interaction on coherence in neutrino system	46
7 Geometric Phase in Neutrino Oscillations	51
7.1 Noncyclic geometric phase	51
7.2 Noncyclic geometric phase in neutrino-system	51
7.2.1 Non cyclic geometric phase in vacuum	52

Contents

7.2.2	Non cyclic geometric phase in the presence of earth matter effects	53
7.3	Geometric phase in terms of survival and oscillation probabilities	57
8	Quantum Correlations in Neutrino Oscillations in Curved Spacetime	59
8.1	Gravitational “Zeeman effect”	59
8.2	Quantum correlations in neutrinos	61
8.2.1	Neutrino-antineutrino mixing in single flavour scenario	61
8.2.2	Two-flavour oscillation with neutrino-antineutrino mixing	63
9	Conclusions	67
10	Other works done: Coherence and Mixedness in Mesonic systems	71
10.1	System dynamics	71
10.2	Measures of coherence and mixedness in meson systems	72