## **Contents**

Abstract								
Li	List of articles xxiv Acronyms xxv							
A								
1	Intro	oduction	1					
2	Intro	oduction to various tools	9					
	2.1	Dynamics of closed systems	9					
	2.2	Dynamics of open systems	10					
	2.3	Quantum measurement theory	10					
	2.4	Dynamical maps	11					
		2.4.1 Quantum channel						
	2.5	Markovian and Non-Markovian processes						
		2.5.1 Theory of Markovian open quantum systems						
		2.5.2 Theory of non-Markovian open quantum systems						
	2.6	Quantum correlations						
		2.6.1 Temporal quantum correlations						
		2.6.2 Spatial quantum correlations						
	2.7	Nonclassical properties of light						
		2.7.1 Criteria for nonclassicality of light	20					
3	Temporal quantum correlations in subatomic systems 25							
•	3.1	Dynamics of the relevant subatomic systems						
	3.2	Detailed study of various temporal quantum correlations						
4	Aspects of non-Markovian Open Quantum Systems 41							
-	4.1	Introduction						
	4.2	Facets of quantum information under non-Markovian evolution						
		4.2.1 Quantum Fisher infomation flow and non-Markovianity						
		4.2.2 Results and discussion						
	4.3	Violation of Leggett-Garg type inequalities in a driven two level atom interacting						
		with a squeezed thermal reservoir	49					
		4.3.1 Model: A driven two level system	50					
		4.3.2 Leggett-Garg type inequality for the two level driven system						
		4.3.3 Results and discussion	55					
	4.4	Study of coherence based measure in (non) Markovian channels	57					
		4.4.1 A coherence based measure of quantumness of channels						
		4.4.2 Specific channels						
		4.4.3 Results and discussion						
	4.5	A proposed measure of quantumness of channels	63					
		4.5.1 Measure of quantumness of channels	65					
	4.6	Application to quantum channels	66					

7	Conclusion and future directions					
	6.5	Conclusi	ion	. 124		
			Quantum violation of LGIs			
			Various formulations of LGIs			
			he algebraic maximum			
			Consequences of the maximal coherent behavior: Violation of LGIs upto			
		6.4.2 I	Degree of coherence in terms of $l_1$ norm	. 120		
		6.4.1	$\mathcal{PT}$ symmetric time evolution $\dots$	. 119		
	6.4		l coherent behavior about exceptional points in a $\mathcal{PT}$ symmetric qubit .			
			Results and discussion			
			Effect of different quantum noise channels on nonclassicality			
			Model			
			Nonclassicality for a single input state at beam-splitter			
	0.5	tem with open system effects				
	6.3		between nonclassicality and $\mathcal{PT}$ symmetry in an effective two level sys-	. 101		
			Some properties of the output fields			
			Model and Solution			
	0.2	-	n Zeno effect and nonclassicality in a $\mathcal{PT}$ symmetric system of coupled	. 97		
	6.1 6.2	•	metry in nutshell	. 95		
6		-	(PT) symmetric Open Quantum Systems	95		
_	D	<b>T</b> :	(DT)	0.5		
	5.4	Conclusi	ion	. 90		
	5.3	Results a	and Discussion	. 83		
	5.2	Cavity co	ontaining two ensembles of two-level atoms	. 79		
	5.1		tion	. 77		
5	Non	classica	lity in a cavity quantum optical system	77		
	4.10	Conclusi	ion	. 75		
			Leggett-Garg inequality			
			A simple model			
	4.9		Garg inequality under non-Markovian noise			
	4.8	Results a	and discussion			
	4.7	Experim	ental relevance of the measure	. 67		