

Contents

Acknowledgements	xii
1. Introduction	1
1.1 Description	1
1.2 Summary	2
1.3 Literature on related fields	5
2. Brownian motion and Itô calculus	6
2.1 Brownian motion and QSD	6
2.2 Probabilities	11
2.3 Itô calculus	12
2.4 Using Itô calculus	14
2.5 Drift and the interval τ	15
2.6 Correlation and ensemble covariance	17
2.7 Complex diffusion	19
2.8 Time scales and Markov processes	20
2.9 Many fluctuations	21
3. Open quantum systems	24
3.1 States of quantum systems	24
3.2 Ensembles of quantum systems	27
3.3 Entanglement	31
3.4 Open systems	35
3.5 Measurement and preparation	36
3.6 The boundary problem	40
3.7 Quantum expectation and quantum variance	41
4. Quantum state diffusion	44
4.1 Master equations	44
4.2 QSD equations from master equations	47
4.3 Examples	51
4.4 Projectors	61
4.5 Linear unravelling	62
4.6 Other fluctuations	63
4.7 QSD, jumps and Newtonian dynamics	64
4.8 The circuit analogy	65

x	<i>Contents</i>	
5.	Localization	67
5.1	Measurement and classical motion	67
5.2	Quantum variance and covariance, ensemble localization	70
5.3	Quantum measurement	72
5.4	Dissipation	74
5.5	Channels and statistical properties	76
5.6	Localization theorems	77
5.7	Proof of dispersion entropy theorem	81
5.8	Discussion	82
6.	Numerical methods and examples	85
6.1	Methods	85
6.2	Localization and the moving basis	88
6.3	Dissipative quantum chaos	89
6.4	Second-harmonic generation	93
6.5	Continuous Stern–Gerlach	94
6.6	Noise in quantum computers	95
6.7	How to write a QSD program	97
7.	Quantum foundations	103
7.1	Introduction	103
7.2	Matter waves are real	105
7.3	Niels Bohr and Charles Darwin	106
7.4	Quantum theory and physical reality	107
7.5	Preparation of quantum states	109
7.6	Too many alternative theories	112
7.7	Gisin condition	115
8.	Primary state diffusion – PSD	119
8.1	First approach – Schrödinger from diffusion	119
8.2	Decoherence	123
8.3	Feynman’s lectures on gravitation	124
8.4	Second approach – spacetime PSD	125
8.5	Geometry of the fluctuations	129
8.6	Matter interferometers	129
8.7	Conclusions	132

9. Classical dynamics of quantum localization	134
9.1 Introduction	134
9.2 Classical systems and quantum densities	136
9.3 Quantum expectations and other properties of densities	139
9.4 Probability distributions and means	141
9.5 Elementary density diffusion	142
9.6 Generalization	144
9.7 Density entropy decreases	147
9.8 Localization for wide open systems	149
9.9 Localization of a particle in a medium	150
9.10 Discussion	154
10. Semiclassical theory and linear dynamics	155
10.1 Classical equations for open systems	155
10.2 Semiclassical theory of ensembles	156
10.3 Semiclassical theory of pure states	160
10.4 Localization regime	161
10.5 Linear phase space transformations and squeezed states	162
10.6 Linear dynamics and the linear approximation	166
10.7 Summary and discussion	169
References	170
Index	179