CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-40145-6 — Quantized Detector Networks
George Jaroszkiewicz
Table of Contents
More Information

Contents

Preface *page* xv
Acronyms xviii

1 Introduction **1**
1.1 Motivation 1
1.2 Physics, Not Metaphysics 3
1.3 A Brief History of Quantum Interpretation 6
1.4 Plan of This Book 9
1.5 Guidelines for Reading This Book 10
1.6 Terminology and Conventions 11

2 Questions and Answers **13**
2.1 What Is Physics? 13
2.2 Physics and Time 14
2.3 Reduction versus Emergence 16
2.4 Peaceful Coexistence 17
2.5 Questions and Answer Sets 18
2.6 Answer Set Collapse 19
2.7 Incompatible Questions and Category Errors 21
2.8 Propositions 22
2.9 Negation, Context, Validation 23
2.10 Proof of Negation 24
2.11 A Heretical View of Reality 25
2.12 Generalized Propositions and Their Classification 25

3 Classical Bits **28**
3.1 Binary Questions 28
3.2 Question Cardinality 28
3.3 Classical Binary Questions 29
3.4 Classical Bits 29
3.5 Signal Bits 30
3.6 Nodes 31
3.7 Dual Bits 32
3.8 The Interpretation of Bits and Their Duals 32

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-40145-6 — Quantized Detector Networks
George Jaroszkiewicz
Table of Contents
More Information

3.9 Matrix Representation 33
3.10 Classical Bit Operators 33
3.11 Labstates 34
3.12 Time and the Stages Concept 35
3.13 Stage Diagrams 38
3.14 Measurements and Observations 38
3.15 Transtemporal Identity 39
3.16 Typical Experiments 40
3.17 Rank-One Stochastic Evolution 42
3.18 Stochastic Bits 43
3.19 Left-Stochastic Matrices 44
3.20 Stochastic Jumps 44
3.21 Stochastic Questions 45

4 Quantum Bits 46
4.1 Quantum Bits 46
4.2 Preferred Bases 46
4.3 Qubit Properties 47
4.4 Qubit Operators 48
4.5 Signal Bit Operators 50
4.6 The Standard Born Interpretation 50
4.7 The Born Interpretation in QDN 53
4.8 Classical and Quantum Ensembles 53
4.9 Basis Transformations 54
4.10 The Preferred Basis Problem 55
4.11 Rank-One Qubit Evolution 57
4.12 Mixed Qubit States 58
4.13 Density Operators 58

5 Classical and Quantum Registers 60
5.1 Introduction 60
5.2 Labels versus Ordering 60
5.3 The Signal Basis Representation 61
5.4 Maximal Questions 62
5.5 Signality 63
5.6 The Economy of Success 64
5.7 Quantum Registers 65
5.8 The Computational Basis Representation 66
5.9 Register Operators 67
5.10 Classical Register Operators 68
5.11 The Signal Algebra 69
5.12 Signal Excitations 70
5.13 Signality Classes 71

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-40145-6 — Quantized Detector Networks
George Jaroszkiewicz
Table of Contents
More Information

5.14 Binary Decomposition 72
5.15 Computational Basis Representation for Signal Operators 73

6 Classical Register Mechanics 75
6.1 Introduction 75
6.2 Classical Registers 76
6.3 Architecture 76
6.4 Permutation Flows 79
6.5 Signality-Conserving Flows 81
6.6 Evolution and Measurement 82
6.7 Random Initial States 83

7 Quantum Register Dynamics 84
7.1 Introduction 84
7.2 Persistence 84
7.3 Quantized Detector Networks 85
7.4 Persistence and Ensembles 88
7.5 Observers and Time 89
7.6 The Born Probability Rule 90
7.7 Principles of QDN Dynamics 92
7.8 Born Maps and Semi-unitarity 93
7.9 Application to Dynamics 94
7.10 The Signal Theorem 97
7.11 Null Evolution 100
7.12 Path Summations 102

8 Partial Observations 105
8.1 Introduction 105
8.2 Observables 105
8.3 Maximal Questions 107
8.4 Partial Questions 109
8.5 Partial Question Eigenvalues 110
8.6 Identity Classes 111
8.7 Needles in Haystacks 112

9 Mixed States and POVMs 114
9.1 Introduction 114
9.2 Sets and Measures 115
9.3 Hilbert Spaces 116
9.4 Operators and Observables 116
9.5 Trace 117
9.6 Projection-Valued Measure 117
9.7 Mixed States 118

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-40145-6 — Quantized Detector Networks
George Jaroszkiewicz
Table of Contents
More Information

9.8 Partial Trace 119
9.9 Purification 120
9.10 Purity and Entropy 121
9.11 POVMs 122
9.12 Naimark's Theorem 123
9.13 QDN and POVM Theory 124

10 Double-Slit Experiments 131
10.1 Introduction 131
10.2 Run Protocol 132
10.3 Baseball in the Dark 133
10.4 Observed Phenomena 134
10.5 A Wave-Mechanics Description 136
10.6 The QDN Account of the Double-Slit Experiment 138
10.7 Contextual Subspaces 141
10.8 The Sillitto–Wykes Variant 142
10.9 The Monitored Double-Slit Experiment 143

11 Modules 148
11.1 Modules 148
11.2 The Vacuum 149
11.3 The Wollaston Prism 150
11.4 The Newtonian Prism 152
11.5 Nonpolarizing Beam Splitters 157
11.6 Mirrors 160
11.7 Phase Changers 160
11.8 Polarization Rotators 160
11.9 Null Modules 161

12 Computerization and Computer Algebra 162
12.1 Introduction 162
12.2 Program MAIN 163
12.3 The Wollaston Interferometer 165
12.4 Going to the Large Scale 169
12.5 Prospects 171

13 Interferometers 172
13.1 Introduction 172
13.2 The Mach–Zehnder Interferometer 172
13.3 Brandt's Network 174
13.4 The Two-Photon Interferometer 176

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-40145-6 — Quantized Detector Networks
George Jaroszkiewicz
Table of Contents
More Information

14 Quantum Eraser Experiments **179**
14.1 Introduction 179
14.2 Delayed-Choice Quantum Eraser 181
14.3 Which-Path Measure 185
14.4 Wheeler's Double-Slit Delayed Choice Experiment 186
14.5 The Delayed Choice Interferometer 189
14.6 The Double-Slit Quantum Eraser 190
14.7 Concluding Remarks 197

15 Particle Decays **198**
15.1 Introduction 198
15.2 One Species Decays 200
15.3 The Quantum Zeno Effect 205
15.4 Matrix Analysis 207
15.5 The Ammonium System 209
15.6 Kaon-type Decays 212

16 Nonlocality **217**
16.1 Introduction 217
16.2 Active and Passive Transformations 221
16.3 Local Operations 225
16.4 Primary and Secondary Observers 226
16.5 Subregister Bases 228
16.6 Local and Remote Evolution 229
16.7 The No-Communication Theorem 229

17 Bell Inequalities **232**
17.1 Introduction 232
17.2 The Stern–Gerlach Experiment 235
17.3 Circumventing the Simultaneity Problem 241
17.4 The Standard Quantum Calculation 244
17.5 The QDN Calculation 247

18 Change and Persistence **250**
18.1 Introduction 250
18.2 Comparisons 255
18.3 Signal Correlation Measure of Change 259

19 Temporal Correlations **263**
19.1 Introduction 263
19.2 Classical Bit Temporal Correlations 264

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-40145-6 — Quantized Detector Networks
George Jaroszkiewicz
Table of Contents
More Information

19.3 The Classical Leggett–Garg Inequality 265
19.4 Qubit Temporal Correlations 266
19.5 QDN Spin Correlation 267
19.6 The Leggett–Garg Correlation 268
19.7 Understanding the Leggett–Garg Prediction 268

20 The Franson Experiment 271
20.1 Introduction 271
20.2 The Franson Experiment 271
20.3 FRANSON-1: $\Delta T \ll \tau_2$ 273
20.4 FRANSON-2: $\tau_1 \ll \Delta T$ 274
20.5 FRANSON-3: $\tau_2 \ll \Delta T \ll \tau_1$ 277
20.6 Conclusions 278

21 Self-intervening Networks 279
21.1 Introduction 279
21.2 Experiment SI-1: Basic Self-intervention 284
21.3 Experiment SI-2: Double Self-intervention 285
21.4 Experiment SI-3: Interfering Single Self-intervention 286
21.5 Schrödinger's Cat 287

22 Separability and Entanglement 291
22.1 Introduction 291
22.2 Quantum Registers 291
22.3 Splits 293
22.4 Partitions 294
22.5 Quantum Zipping 298

23 Causal Sets 299
23.1 Introduction 299
23.2 Causal Sets 302
23.3 QDN and Causal Sets 303
23.4 Quantum Causal Set Rules 304
23.5 Case Study 1: The Double-Slit Experiment 305
23.6 Case Study 2: The Monitored Double-Slit Experiment 306
23.7 Case Study 3: Module Causal Set Structure 307

24 Oscillators 309
24.1 Introduction 309
24.2 The Classical Oscillator Register 310
24.3 Quantization 314
24.4 Bosonic Operators 315
24.5 Quantum Register Oscillator Operators 317

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-1-009-40145-6 — Quantized Detector Networks
George Jaroszkiewicz
Table of Contents
More Information

24.6 Comparison with Quantum Field Theory 319
24.7 Fermionic Oscillators 320

25 Dynamical Theory of Observation 322
25.1 Introduction 322
25.2 Power Bits 323
25.3 Power Bit Operators 325
25.4 Matrix Representation 325
25.5 Special Operators 326
25.6 The Laboratory 328
25.7 The Universal Register 329
25.8 Contextual Vacua 330
25.9 Experiments 332
25.10 Quantization 335
25.11 The Elitzur–Vaidman Bomb-Tester Experiment 335
25.12 The Hardy Paradox Experiment 339
25.13 Implications and Comments 342

26 Conclusions 343

Appendix 345
A.1 QDN Notation 345
A.2 Lab Time and Frame Fields 346
A.3 Lab Time and Stages 346
A.4 Ensembles 348
A.5 Vector Spaces 350

References 357
Index 365

© in this web service Cambridge University Press & Assessment www.cambridge.org