CONTENTS

Preface ................................................................. xii
Bertfried Fauser, Jürgen Tolksdorf and Eberhard Zeidler

Constructive Use of Holographic Projections ......................... 1
Bert Schroer
  1. Historical background and present motivations for holography 1
  2. Lightfront holography, holography on null-surfaces and the origin of the area law 4
  3. From holography to correspondence: the AdS/CFT correspondence and a controversy 14
  4. Concluding remarks 22
  Acknowledgements 23
  References 23

Topos Theory and ‘Neo-Realist’ Quantum Theory ................... 25
Andreas Döring
  1. Introduction 25
  1.1. What is a topos? 26
  1.2. Topos theory and physics 29
  2. A formal language for physics 31
  3. The context category $V(R)$ and the topos of presheaves $Set^{V(R)^{op}}$ 33
  4. Representing $L(S)$ in the presheaf topos $Set^{V(R)^{op}}$ 35
  5. Truth objects and truth-values 38
    5.1. Generalised elements as generalised states 38
    5.2. The construction of truth objects 39
    5.3. Truth objects and Birkhoff-von Neumann quantum logic 41
    5.4. The assignment of truth-values to propositions 42
  6. Conclusion and outlook 45
  Acknowledgements 46
  References 46

A Survey on Mathematical Feynman Path Integrals:
Construction, Asymptotics, Applications ......................... 49
Sergio Albeverio and Sonia Mazzucchi
  1. Introduction 49
  2. The mathematical realization of Feynman path integrals 52
  3. Applications 56
    3.1. Quantum mechanics 56
    3.2. Quantum fields 60
  Acknowledgements 62
**References**

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>173</td>
</tr>
</tbody>
</table>


*Ferdinand Brennecke and Michael Dütsch*

1. Introduction 177
2. The off-shell Master Ward Identity in classical field theory 179
3. Causal perturbation theory 182
4. Proper vertices 184
5. The Quantum Action Principle 186
5.1. Formulation of the Master Ward Identity in terms of proper vertices 186
5.2. The anomalous Master Ward Identity - Quantum Action Principle 188
6. Algebraic renormalization 194
Acknowledgement 195
References 195

**Plane Wave Geometry and Quantum Physics** ......................... 197

*Matthias Blau*

1. Introduction 197
2. A brief introduction to the geometry of plane wave metrics 198
2.1. Plane waves in Rosen and Brinkmann coordinates: heuristics 198
2.2. Curvature of plane waves 200
2.3. Geodesics, lightcone gauge and harmonic oscillators 200
2.4. From Rosen to Brinkmann coordinates (and back) 202
2.5. The Heisenberg isometry algebra of a generic plane wave 203
2.6. Geodesics, isometries, and conserved charges 205
2.7. Synopsis 207
3. The Lewis–Riesenfeld theory of the time-dependent quantum oscillator 207
3.1. Description of the problem 207
3.2. Outline of the Lewis–Riesenfeld procedure 208
3.3. Deducing the procedure from the plane wave geometry 210
4. A curious equivalence between two classes of Yang-Mills actions 211
4.1. Description of the problem 211
4.2. A classical mechanics toy model 212
4.3. The explanation: from plane wave metrics to Yang-Mills actions 214
References 215

**Canonical Quantum Gravity and Effective Theory** .................. 217

*Martin Bojowald*

1. Loop quantum gravity 217
2. Effective equations 220
2.1. Quantum back-reaction 221
2.2. General procedure 222
3. A solvable model for cosmology 225
3.1. Interactions 229
6.4. Universal and generalized $\mathfrak{g}$-connections 379
6.4.1. Examples 380
7.1. Weak cokernels of $L_\infty$-morphisms 382
7.1.1. Examples 386
7.2. Lifts of $\mathfrak{g}$-descent objects through string-like extensions 388
7.2.1. Examples 389
7.3. Lifts of $\mathfrak{g}$-connections through string-like extensions 391
7.3.1. Examples 396
8. $L_\infty$-algebra parallel transport 399
8.1. $L_\infty$-parallel transport 399
8.1.1. Examples 401
8.2. Transgression of $L_\infty$-transport 402
8.2.1. Examples 404
8.3. Configuration spaces of $L_\infty$-transport 404
8.3.1. Examples 405
9. Physical applications: string-, fivebrane- and $p$-brane structures 414
Appendix A. Explicit formulas for 2-morphisms of $L_\infty$-algebras 417
Acknowledgements 420
References 420

Index ................................................................. 427
Quantum Field Theory
Competitive Models
Fauser, B.; Tolksdorf, J.; Zeidler, E. (Eds.)
2009, XIX, 436 p., Hardcover
ISBN: 978-3-7643-8735-8
A product of Birkhäuser Basel