

Contents

Black Holes, Black Rings, and their Microstates	1
Iosif Bena and Nicholas P. Warner	
1 Introduction	1
2 Three-Charge Microscopic Configurations	6
3 Black Rings and Supertubes	16
4 Geometric Interlude: Four-Dimensional Black Holes and Five-Dimensional Foam	26
5 Solutions on a Gibbons-Hawking Base	31
6 Bubbled Geometries	45
7 Microstates for Black Holes and Black Rings	57
8 Mergers and Deep Microstates	63
9 Implications for Black-Hole Physics	78
References	87
Black Hole Entropy and Quantum Information	93
M. J. Duff and S. Ferrara	
1 Black Holes and Qubits	93
2 The $N=2$ STU Model	95
3 Cayley's Hyperdeterminant	98
4 Black Hole Entropy	100
5 The $N = 8$ Generalization	101
6 Decomposition of $E_{7(7)}$	102
7 Tripartite Entanglement of 7 Qubits	103
8 Cartan's $E_{7(7)}$ Invariant	105
9 The Black Hole Analogy	108
10 Subsectors	111
11 Conclusions	112
References	113

Extremal Black Hole and Flux Vacua Attractors	115
S. Bellucci, S. Ferrara, R. Kallosh and A. Marrani	
1 Introduction	116
2 Special Kähler Geometry	123
3 Extremal Black Hole Attractor Equations in $\mathcal{N} = 2, d = 4$ (ungauged) Supergravity	129
4 Flux Vacua Attractor Equations in $\mathcal{N} = 1, d = 4$ Supergravity from Type IIB on $\frac{CY_3 \times T^2}{\mathbb{Z}_2}$	160
5 Some Recent Developments on Extremal Black Hole Attractors ..	176
References	186
Lectures on Black Holes and the AdS₃/CFT₂ Correspondence	193
P. Kraus	
1 Introduction	193
2 Gravity in Asymptotically AdS ₃ Spacetimes	197
3 Charged Black Holes and Chern-Simons Terms	210
4 String Theory Constructions	215
5 Partition Functions and Elliptic Genera	225
6 Computation of Partition Functions in Gravity: Warmup Examples	231
7 Computation of Partition Functions in Supergravity	235
8 Computation of BPS Spectra	240
9 Conclusion	243
References	244
The Attractor Mechanism in Five Dimensions	249
F. Larsen	
1 Introduction	249
2 The Basics of the Attractor Mechanism	250
3 Black Ring Attractors	262
4 Extremization Principles	275
References	280
Lectures on Black Holes, Topological Strings, and Quantum Attractors (2.0)	283
B. Pioline	
1 Introduction	283
2 Extremal Black Holes in String Theory	285
3 Special Geometry and Black Hole Attractors	293
4 Topological String Primer	311
5 Higher Derivative Corrections and Topological Strings	323
6 Precision Counting of Small Black Holes	329
7 Quantum Attractors and Automorphic Partition Functions	336
8 Conclusion	365
References	366