

Contents

1	Disordered Topological Insulators: A Brief Introduction	1
1.1	Homogeneous Materials	1
1.2	Homogeneous Disordered Crystals	5
1.3	Classification of Homogenous Disordered Crystals	6
	References	7
2	Electron Dynamics: Concrete Physical Models	11
2.1	Notations and Conventions	11
2.2	Physical Models	12
2.3	Disorder Regimes	17
2.4	Topological Invariants	19
	References	23
3	Non-commutative Brillouin Torus	25
3.1	Disorder Configurations and Associated Dynamical Systems	25
3.2	Algebra of Covariant Physical Observables	27
3.3	Fourier Calculus	30
3.4	Differential Calculus	31
3.5	Smooth Sub-algebra	34
3.6	Sobolev Spaces	36
3.7	Magnetic Derivations	41
3.8	Physics Formulas	44
	References	47
4	Auxiliary C^*-Algebras	49
4.1	Periodic Disorder Configurations	49
4.2	Periodic Approximating Algebra	51
4.3	Finite-Volume Disorder Configurations	53
4.4	Finite-Volume Approximating Algebra	54
4.5	Approximate Differential Calculus	57

4.6 Bloch Algebras	59
References	61
5 Canonical Finite-Volume Algorithms	63
5.1 General Picture.	63
5.2 Explicit Computer Implementation.	67
References	69
6 Error Bounds for Smooth Correlations.	71
6.1 Assumptions.	71
6.2 First Round of Approximations	73
6.3 Second Round of Approximations	74
6.4 Overall Error Bounds.	77
References	77
7 Applications: Transport Coefficients at Finite Temperature	79
7.1 The Non-commutative Kubo Formula	79
7.2 The Integer Quantum Hall Effect.	80
7.3 Chern Insulators.	93
References	96
8 Error Bounds for Non-smooth Correlations	99
8.1 The Aizenman–Molchanov Bound.	99
8.2 Assumptions.	102
8.3 Derivation of Error Bounds	103
References	107
9 Applications II: Topological Invariants.	109
9.1 Class AIII in $d = 1$	109
9.2 Class A in $d = 2$	113
9.3 Class AIII in $d = 3$	116
References	118

A Computational Non-commutative Geometry Program
for Disordered Topological Insulators

Prodan, E.

2017, X, 118 p. 19 illus. in color., Softcover

ISBN: 978-3-319-55022-0