

Contents

	<i>Introduction: Why the pinch technique?</i>	<i>page xi</i>
1	The pinch technique at one loop	1
1.1	A brief history	1
1.2	Notation and conventions	3
1.3	The basic one-loop pinch technique	6
1.4	Another way to the pinch technique	17
1.5	Pinch technique vertices	20
1.6	The pinch technique in the light-cone gauge	31
1.7	The absorptive pinch technique construction	34
1.8	Positivity and the pinch technique gluon propagator	42
	References	43
2	Advanced pinch technique: Still one loop	45
2.1	The pinch technique and the operator product expansion: Running mass and condensates	45
2.2	The pinch technique and gauge-boson mass generation	47
2.3	The pinch technique today: Background-field Feynman gauge	62
2.4	What to expect beyond one loop	72
	References	73
3	Pinch technique to all orders	75
3.1	The s - t cancellation to all orders	75
3.2	Quark-gluon vertex and gluon propagator to all orders	79
	References	85

viii	<i>Contents</i>	
4	The pinch technique in the Batalin–Vilkovisky framework	86
4.1	An overview of the Batalin–Vilkovisky formalism	88
4.2	Examples	93
4.3	Pinching in the Batalin–Vilkovisky framework	100
	References	102
5	The gauge technique	104
5.1	The original gauge technique for QED	105
5.2	Massless longitudinal poles	108
5.3	The gauge technique for NAGTs	109
	References	113
6	Schwinger–Dyson equations in the pinch technique framework	114
6.1	Lattice studies of gluon mass generation	115
6.2	The need for a gauge-invariant truncation scheme for the Schwinger–Dyson equations of NAGTs	117
6.3	The pinch technique algorithm for Schwinger–Dyson equations	119
6.4	Pinch technique Green’s functions from Schwinger–Dyson equations	120
6.5	Solutions of the pinch technique Schwinger–Dyson equations and comparison with lattice data	131
6.6	The QCD effective charge	134
	References	141
7	Nonperturbative gluon mass and quantum solitons	144
7.1	Notation	144
7.2	Introduction	144
7.3	The quantum solitons	150
7.4	The center vortex soliton	152
	References	165
8	Nexuses, sphalerons, and fractional topological charge	167
8.1	Introduction to nexuses and junctions	167
8.2	Nexuses in $SU(N)$	170
8.3	The QCD sphaleron	181
8.4	Chiral symmetry breakdown, nexuses, and fractional topological charge	186
	References	188
9	A brief summary of $d = 3$ NAGTs	190
9.1	Introduction	190

<i>Contents</i>		ix
9.2	Perturbative infrared instability	193
9.3	The exact form of the zero-momentum effective action	193
9.4	The dynamical gauge-boson mass	197
9.5	The functional Schrödinger equation	201
9.6	Dynamical gluon mass versus the Chern–Simons mass: Two phases	209
9.7	Compactness and the Chern–Simons number of YMCS solitons	216
	References	223
10	The pinch technique for electroweak theory	226
10.1	General considerations	227
10.2	The case of massless fermions	229
10.3	Nonconserved currents and Ward identities	242
10.4	The all-order construction	246
	References	248
11	Other applications of the pinch technique	250
11.1	Introduction	250
11.2	Non-Abelian effective charges	250
11.3	Physical renormalization schemes versus $\overline{\text{MS}}$	255
11.4	Gauge-independent off-shell form factors	256
11.5	Resummation formalism for resonant transition amplitudes	263
11.6	The pinch technique at finite temperature	270
11.7	Basic principles of thermal field theory	271
11.8	Hints of supersymmetry in the pinch technique Green's functions	276
	References	278
	<i>Appendix: Feynman rules</i>	281
	<i>Index</i>	285