

Index

- ε -expansion 62
- ϕ^3 theory 36
 - one-loop calculations 38
- Λ parameter of QCD 188

- Adler–Bardeen theorem 338
- Altarelli–Parisi equation 370
- anomalies 331
 - Adler–Bardeen theorem 338
 - not in non-singlet axial current 346
 - one-loop calculation 342
 - triangle 349
- anomalously broken symmetries 18, 331
- asymptotic freedom 187

- bare parameters
 - definition 10
 - renormalization group calculation 209
 - dimensional regularization 217
- basic graph 90
- basic Lagrangian 89
 - definition 11
- BPH 53
 - see also* renormalization prescriptions
- BPHZ 53, 133
 - see also* renormalization prescriptions
- broken symmetries 18
 - anomalous 18
 - dynamically 19
 - explicitly 18
 - spontaneously 18
 - not at $d = 2$ 26
 - perturbation theory 26, 247
 - renormalization 247, 314
- BRS, *see* gauge theories

- canonical momentum field 5
- causality 6
- charge conjugation symmetry, for gauge theories 35
- chiral symmetry 17, 333
 - and anomalies 338
- commutation relations
 - canonical equal-time 5
 - from Green's functions 6
- composite operators 138
 - definition 146
 - equations of motion 155, 158
 - mixing under renormalization 149
 - properties 152
 - renormalization, example 142
 - tensor operators 150
 - twist 363
 - Ward identities 160
 - see also* operator product expansion
- continuum limit 8
 - see also* renormalization
- coordinate space, renormalization in 59, 277
- cosmological term, and renormalization 118
- counterterm Lagrangian 11, 89
- cut-off
 - dimensional regularization 13, 53, 62
 - for infra-red 56
 - lattice 8
 - Pauli–Villars 12
 - see also* individual entries

- decoupling theorem 222
 - examples 226
 - exceptions 223
 - manifest decoupling 230
 - proof 233
 - renormalization group 240
- deep inelastic scattering 354
 - Altarelli–Parisi equation 370
 - calculation of Wilson coefficients 364
 - operator product expansion 361
 - partons and operator product expansion 369
 - W_4 and W_5 357, 371
- degree of divergence 45
- differentiation with respect to parameters in Lagrangian 163
- dimensional regularization 13, 53, 62
 - axioms 64
 - definition 67
 - convergence 68
 - Dirac matrices in 83, 334
 - list of integrals 81
 - properties 73

- reduced to ordinary integration 67
 - uniqueness 65
- dimensional transmutation 203
- Dirac matrices
 - γ_5 at $d \neq 4$ 86, 334
 - definition in d dimensions 83
- dynamically broken symmetries 19
- equations of motion
 - Green's function 6,13
 - momentum space 15
 - operator 5
- Euclidean space-time 8.
- evanescent operators 346
- explicit symmetry breaking 18
- factorization theorems 1, 187
- Faddeev–Popov ghost, *see* gauge theories
- Feynman rules
 - for gauge theories 34
 - see also* perturbation theory
- fixed points 190
- forest formula 109
 - 3-loop example 106
- functional integral
 - for bosons 6
 - for fermions 27
 - Monte-Carlo calculation 13
- gauge dependence of counterterms 309, 327
- gauge invariant operators 316
- gauge theories 28
 - BRS invariance 32
 - charge conjugation symmetry 35
 - Faddeev–Popov ghost 30
 - Feynman rules 34
 - gauge invariance v. gauge independence 31
 - gauge-fixing 30
 - operator product expansion 321
 - proof of renormalizability 298
 - quantization 29
 - renormalization 293
 - renormalization group 319
 - Slavnov–Taylor identities 32
- Gell-Mann–Low formula 22
- General Relativity
 - as example of gauge theory 17
 - cosmological term and renormalization 118
- generating functional
 - for Green's functions 7
- global symmetries
 - renormalization 244
 - spontaneously broken, invariance of counterterms 247
 - unbroken, invariance of counterterms 245
- Goldstone bosons, *see* Nambu–Goldstone bosons
- Goldstone model 247
- Grassmann algebra 27
- Green's functions
 - definition 6
 - equations of motion 13
 - functional integral 7
 - generating functional 7
 - momentum space 15
- Hamiltonian, field theory 5
- infra-red behavior, and renormalization group 187, 191
- Landau ghost 196
- large mass expansion 222
- large momentum behavior of Green's functions 185
- lattice 8
- leading logarithms 193
 - non-renormalization group 196
- list of integrals 81
- low-energy behavior 191
- mass-shell renormalization prescription 48
- massive photon, renormalization 324
- minimal subtraction 56, 135
 - see also* renormalization prescriptions
- Monte-Carlo 13
- Nambu–Goldstone bosons 21, 252
- Noether's theorem 18
- non-renormalizability 49
 - in real physics 122
- non-renormalization of currents 162
- normal products, *see* composite operators
- operator product expansion 257
 - and parton model 369
 - and renormalization group 274
 - deep inelastic scattering 361
 - examples 139, 258
 - gauge theories 321
 - in coordinate- and momentum-space 257
 - proof 266
 - to define composite operators 258
- overlapping divergence 99
- oversubtraction 130
 - on 1PR graphs 131
- partition function, functional integral as 8
- parton model 355, 358, 369
- Pauli–Villars cut-off 12

- perturbation theory 21
 - as saddle point expansion 26
 - Feynman rules for gauge theories 34
 - maximum accuracy with asymptotic freedom 189
 - not convergent 24, 189
- perturbative QCD 1
- Poincaré symmetry 17
- propagator 22
 - short-distance behavior 278
 - thermal 280
- QCD
 - Λ parameter 188
 - asymptotic freedom 188
 - Feynman rules 34
 - perturbative 1
 - see also* gauge theories
- QED
 - gauge dependence of counterterms 327
 - in external field 291
 - renormalization 293, 322
 - renormalization group 329
 - Ward identities 326
 - see also* gauge theories
- quantum chromodynamics, *see* QCD
- quantum electrodynamics, *see* QED
- quantum field theory
 - analog of statistical mechanics 8
 - axioms 6
 - review 4
 - standard properties 6
 - standard theories 36
 - see also*,
 - ϕ^3 theory; QCD; QED
- quantum mechanics
 - as field theory at $d = 1$ 6
- R_ξ -gauge 314
- reconstruction theorem 6
- regulator, *see* cut-off
- renormalizability 49, 116
- renormalization 9, 88
 - and continuum limit 9
 - axial current 340
 - coordinate space 59, 277
 - examples 281
 - examples 38
 - for massless theories 59
 - forest formula 109
 - gauge dependence of counterterms 309, 327
 - gauge invariant operators 316
 - gauge theories 293
 - with symmetry breaking 308, 314
 - in external field 291
 - locality of counterterms 97, 125
 - non-zero temperature 286
 - oversubtraction 130
 - prescriptions 52
 - QED 293, 322
 - with photon mass 323
 - renormalization group 50, 168
 - Λ parameter 188
 - asymptotic freedom 187
 - change of renormalization prescription 200
 - coefficients 180
 - composite operators 219
 - computation of bare parameters 209
 - dimensional regularization 217
 - cut-off procedure, dependence on 206
 - decoupling theorem 240
 - dimensional transmutation 203
 - equation 183
 - examples 50, 172
 - fixed points 190
 - gauge theories 319
 - infra-red behavior 187, 191
 - Landau ghost 196
 - large momentum behavior 185
 - leading logarithms 193
 - minimal subtraction 56, 181
 - several couplings 197
 - solution of RG equation 184
 - renormalization prescriptions 52
 - BPH 53
 - BPHZ 53, 133
 - mass-shell 48
 - minimal subtraction 135
 - at one loop 56
 - spontaneously broken symmetries 253
 - renormalized field 10
 - renormalized mass, and physical mass 51
- Slavnov–Taylor identities 32
- spontaneously broken symmetries 18
 - absence of IR divergences 252
 - choice of renormalization prescription 253
 - renormalization 247
 - renormalization of current 251
- super-renormalizability, definition 118
- supersymmetries 17, 339
- symmetries 15, 244
 - BRS, *see* gauge theories
 - charge conjugation, *see* gauge theories
 - gauge 28
 - Ward identities 19, 160
 - see also* broken symmetries; global symmetries
- thermodynamic limit of functional integral 8
- triangle anomaly 349

- twist 363
- ultra-violet regulators 12
 - see also* cut-off; dimensional regularization
- unitary gauge 324, 330
- Ward identities 16, 19, 160
 - axial current 339, 349
 - QED 326
 - renormalization 246–256
- Weinberg's theorem 125
- Wick rotation 8, 39
- Wightman axioms 6
- Wilson expansion, *see* operator product expansion
- Yang–Mills theory, *see* gauge theories

