View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by CERN Document Server

References Part I

R.M.F. Houtappel, H. Van Dam and E.P. Wigner, Rev. Mod. Phys. **37**, 595 (1965)

D.H. Sattinger, Spontaneous Symmetry Breaking: mathematical methods, applications and problems in the physical sciences, in *Applications of Non-Linear Analysis*, H. Amann et al. eds., Pitman 1981

G. B. Whitham, *Linear and Non-Linear Waves*, J. Wiley, New York 1974

R. Rajaraman, Phys. Rep. **21 C**, 227 (1975)

S. Coleman, *Aspects of Symmetry*, Cambridge Univ. Press 1985

M. Reed, *Abstract non-linear wave equation*, Springer, Heidelberg 1976

C. Parenti, F. Strocchi and G. Velo, Phys. Lett. **59B**, 157 (1975)

C. Parenti, F. Strocchi and G. Velo, Ann. Scuola Norm. Sup. (Pisa), III, 443 (1976)

F. Strocchi, Lectures at the Workshop on *Recent Advances in the Theory of Evolution Equations*, ICTP Trieste 1979, published in *Topics in Functional Analysis 1980-81*, Scuola Normale Superiore, Pisa 1982

F. Strocchi, Stability properties of the solutions of non-linear field equations. Hilbert space sectors and electric charge, in *Nonlinear Hyperbolic Equations in Applied Sciences*, Rend. Sem. Mat. Univ. Pol. Torino, Fasc. spec. 1988

W. Strauss, *Nonlinear Wave Equations*, Am. Math. Soc. 1989

C. Parenti, F. Strocchi and G. Velo, Comm. Math. Phys. **53**, 65 (1977)

C. Parenti, F. Strocchi and G. Velo, Phys. Lett. **62B**, 83 (1976)

E. Noether, Nachr. d. Kgl. Ges. d. Wiss. Göttingen (1918), p. 235

H. Goldstein, *Classical Mechanics*, 2nd. ed., Addison-Wesley 1980

E. L. Hill, Rev. Mod. Phys. **23**, 253 (1951)

K. Jörgens, Mat. Zeit. **77**, 291 (1961)

I. Segal, Ann. Math. **78**, 339 (1963)

V. Arnold, *Ordinary Differential Equations*, Springer 1992

G. Sansone and R. Conti, *Non-linear Differential Equations*, Pergamon Press 1964

W. Strauss, Anais Acad. Brasil. Ciencias **42**, 645 (1970)

R.F. Streater and A.S. Wightman, *PCT, Spin and Statistics and All That*, Benjamin-Cumming Pubbl. C. 1980

D. Ruelle, *Statistical Mechanics*, Benjamin 1969

R. Haag, *Local Quantum Physics*, Springer-Verlag 1996

C. Parenti, F. Strocchi and G. Velo, Structure Properties of Solutions of Classical Non-linear Relativistic Field Equations, in *Invariant Wave Equations*, G. Velo and A.S. Wightman eds., Springer-Verlag 1978

L.R. Volevic and B.P. Paneyakh, Russian Math. Surveys **20**, 1 (1965)

S. Coleman, Phys. Rev. D **15**, 2929 (1977)

R. Haag and D. Kastler, J. Math. Phys. **5**, 848 (1964)

J. Goldstone, Nuovo Cim. **19**, 154 (1961)

J. Goldstone, A. Salam and S. Weinberg, Phys. Rev. **127**, 965 (1962)

Y. Nambu and G. Jona-Lasinio, Phys. Rev. **122**, 345 (1961); Phys. Rev. **124**, 246 (1961)

F. Strocchi, *Elements of Quantum Mechanics of Infinite Systems*, World Scientific 1985

P.W. Higgs, Phys. Lett. **12**, 132 (1964)

T.W. Kibble, Broken Symmetries, in *Proc. Oxford Int. Conf. Elementary Particles*, Oxford 1965

G.S. Guralnik, C.R. Hagen and T.W. Kibble, Broken Symmetries and the Goldstone Theorem, in *Advances in Particle Physics* Vol. 2, R.L. Cool and R.E. Marshak eds., Interscience, New York 1968

G. Morchio and F. Strocchi, Infrared problem, Higgs phenomenon and long range interactions, in *Fundamental Problems of Gauge Field Theory*, G. Velo and A.S. Wightman eds., Plenum 1986

F. Strocchi, Mass/energy gap associated to symmetry breaking. A generalized Goldstone theorem for long range interactions, in *Fundamental Aspects of Quantum Theory*, V. Gorini and A. Frigerio eds., Plenum 1986

J. Goldstone and R. Jackiw, Phys. Rev. **D11**, 1486 (1975)

R. Rajaraman, *Solitons and Instantons*, North-Holland 1982

R.F. Dashen, B. Hasslacher and A. Neveu, Phys. Rev. **D10**, 4130 (1974)

J. Goldstone and R. Jackiw, Phys. Rev. **D11**, 1486 (1975)

C. Rebbi and G. Soliani, *Solitons and Particles*, World Scientific 1984

A. Barone, F. Esposito and C.J. Magee, Theory and Applications of the Sine-Gordon Equation, Riv. Nuovo Cim. **1**, 227 (1971)

A.C. Scott, F.Y. Chiu, and D.W. Mclaughlin, Proceedings I.E.E.E. **61**, 1443 (1973)

S. Coleman, Phys. Rev. **D11**, 2088 (1975)

J. Fröhlich, The Quantum Theory of Non-linear Invariant Wave Equations, in *Invariant Wave Equations*, G. Velo and A.S. Wightman eds., Springer-Verlag 1977

J. Goldstone, Nuovo Cimento **19**, 154 (1961)

J. Goldstone, A. Salam and S. Weinberg, Phys. Rev. **127**, 965 (1962)

J. Swieca, Goldstone's theorem and related topics, in *Cargèse Lectures in Physics*, Vol. 4, D. Kastler ed., Gordon and Breach 1970

F. Strocchi, Phys. Lett. **A267**, 40 (2000)

H. Pecher. Math. Zeit. **185**, 261 (1984); **198**, 277 (1988)

References Part II

F. Strocchi, *Elements of Quantum Mechanics of Infinite Systems*, World Scientific 1985

W. Heisenberg, *The Physical Principles of the Quantum Theory*, Dover Publications 1930

P.A.M. Dirac, *The Principles of Quantum Mechanics*, Oxford University Press 1986

M. Reed and B. Simon, *Methods of Modern Mathematical Physics*, Vol. I, Academic Press 1972

J. Slawny, Comm. Math. Phys. **24**, 151 (1972)

J. Manuceau, M. Sirugue, D. Testard and A. Verbeure, Comm. Math. Phys. **32**, 231 (1973)

R. Haag, *Local Quantum Physics*, Springer 1996

F. Strocchi, *An Introduction to the Mathematical Structure of Quantum Mechanics*, (Scuola Normale Superiore, Pisa 1996, World Scientific 2005 [SNS 1996]

O. Bratteli and D.W. Robinson, *Operator Algebras and Quantum Statistical Mechanics*, Vol. 1, 2, Springer 1987, 1996

M.A. Naimark, *Normed Rings*, Noordhoff 1964

G.F. Dell'Antonio, S. Doplicher, J. Math. Phys. **8**, 663 (1967)

J.M. Chaiken, Comm. Math. Phys. **8**, 164 (1967); Ann. Phys. **42**, 23 (1968)

H.J. Borchers, R. Haag and B. Schroer, Nuovo Cim. **29**, 148 (1963)

A.S. Wightman and S. Schweber, Phys. Rev. **98**, 812 (1955)

S.S. Schweber, *Introduction to Relativistic Quantum Field Theory*, Harper and Row 1961

H. Araki and E.J. Woods, J. Math. Phys. **4**, 637 (1963)

H. Araki and W. Wyss, Helv. Phys. Acta **37**, 139 (1964)

R. Jost, *The General Theory of Quantized Fields*, Am. Math. Soc. 1965

R. Haag, *On quantum field theories*, Dan. Mat. Fys. Medd. **29**, No. 12 (1955)

R.F. Streater and A.S. Wightman, *PCT, Spin and Statistics and All That*, Benjamin-Cummings 1980

M. Reed and B. Simon, *Methods of Modern Mathematical Physics*, Vol. II (Fourier Analysis, Self-Adjointness), Academic Press 1975

A.S. Wightman, Introduction to some aspects of the relativistic dynamics of quantized fields, in *Cargèse Lectures in Theoretical Physics*, M. Levy ed., Gordon and Breach 1967

A.S. Wightman, Constructive Field Theory. Introduction to the Problems, in *Fundamental Interactions in Physics and Astrophysics*, G. Iverson et al. eds., Plenum 1972

Constructive Quantum Field Theory, G. Velo and A.S. Wightman eds., Springer 1973

J. Glimm and A. Jaffe, *Quantum Physics*, Springer 1981

R.J. Glauber, Phys. Rev. Lett. **10**, 84 (1963); Phys. Rev. **131**, 2766 (1963)

V. Chung, Phys. Rev. **140B**, 1110 (1965)

J. Fröhlich, G. Morchio and F. Strocchi, Ann. Phys. **119**, 241 (1979)

G. Morchio and F. Strocchi, Nucl. Phys. **B211**, 471 (1984)

G. Morchio and F. Strocchi, Infrared problem, Higgs phenomenon and long range interactions, in *Fundamental Problems of Gauge Field Theory*, G. Velo and A.S. Wightman eds., Plenum 1986

T.W. Kibble, Phys. Rev. **173**, 1527; **174**, 1882; **175**, 1624 (1968)

R. Haag, Subject, Object and Measurement, in *The Physicist's Conception of Nature*, J. Mehra ed., Reidel 1973

A.S. Wightman, Some comments on the quantum theory of measurement, in *Probabilistic Methods in Mathematical Physics*, F. Guerra et al. eds., World Scientific 1992

D.A. Dubin and G.L. Sewell, Jour, Math. Phys. **11**, 2290 (1970)

G.L. Sewell, Comm. Math. Phys. **33**, 43 (1973)

G. Morchio and F. Strocchi, Comm. Math. Phys. **99**, 153 (1985)

G. Morchio and F. Strocchi, J. Math. Phys. **28**, 622 (1987)

D. Kastler, Topics in the algebraic approach to field theory, in *Cargèse Lectures in Theoretical Physics*, F. Lurçat ed., Gordon and Breach 1967

R. Haag, Phys. Rev. **112**, 669 (1958)

D. Ruelle, Helv Phys. Acta **35**, 147 (1962)

H. Araki, Prog. Theor. Phys. **32**, 884 (1964)

D.W. Robinson, Comm. Math. Phys. **7**, 337 (1968)

M. Guenin, Comm. Math. Phys. **1**, 127 (1966)

I.E. Segal, Proc. Natl. Acad. Sci. USA, **57**,1178 (1967)

D.A. Dubin, *Solvable models in algebraic statistical mechanics*, Oxford Univ. Press 1974

N.M. Hugenholtz, Quantum mechanics of infinitely large systems, in *Fundamental Problems in Statistical Mechanics II*, E.G.D. Cohen ed., North-Holland, Amsterdam 1968

R.P. Feynman, *Introduction to Statistical Mechanics*, Benjamin 1972

R.F. Streater, Comm. Math. Phys. **6**, 233 (1967)

E.P. Wigner, *Group Theory and its Applications to the Quantum Mechanics of Atomic Spectra*, Academic Press 1959

V. Bargmann, J. Math. Phys. **5**, 862 (1964)

V. Bargmann, Ann. Math. **59**, 1 (1954)

D.J. Simms, *Lie Groups and Quantum Mechanics*, Lect. Notes Math. 52, Springer 1968

D.J. Simms, Rep. Math. Phys. **2**, 283 (1971)

F. Strocchi, *Selected Topics on the General Properties of Quantum Field Theory*, World Scientific 1993

J. Goldstone, Nuovo Cim. **10**, 154 (1961)

S. Coleman and E. Weinberg, Phys. Rev. **D7**, 1888 (1973)

B.W. Lee, Nucl. Phys. **B9**, 649 (1969)

K. Symanzik, Renormalization of Theories with Broken Symmetry, in *Cargèse Lectures in Physics 1970*, D. Bessis ed., Gordon and Breach 1972

C. Becchi, A. Rouet and R. Stora, Renormalizable Theories with Symmetry Breaking, in *Field Theory, Quantization and Statistical Physics*, E. Tirapegui ed., D. Reidel 1981

J. Collins, *Renormalization*, Cambridge Univ. Press 1984

L.S. Brown, *Quantum Field Theory*, Cambridge Univ. Press 1994

D. Ruelle, *Statistical Mechanics*, Benjamin 1969

G.L. Sewell, *Quantum Theory of Collective Phenomena*, Oxford Univ. Press 1986

B. Simon, *The Statistical Mechanics of Lattice Gases*, Vol. I, Princeton Univ. Press 1993

N.N. Bogoliubov, *Lectures on Quantum Statistics*, Vol. 2, Gordon and Breach, 1970

S.G. Brush, Rev. Mod. Phys. **39**, 883 (1967)

K. Huang, *Statistical Mechanics*, Wiley 1987

G. Gallavotti, *Statistical Mechanics: A Short Treatise*, Springer 1999

B.M. McCoy and T.T. Wu, *The Two Dimensional Ising Model*, Harvard Univ. Press 1973

T.D. Schulz, D.C. Mattis and E.H. Lieb, Rev. Mod. Phys. **36**, 856 (1964)

E. Lieb, Two-dimensional Ice and Ferroelectric Models, in *Boulder Lectures in Theoretical Physics*, Vol. XI D, K.T. Mahantappa and W.E. Brittin eds., Gordon and Breach 1969

J.B. Kogut, Rev. Mod. Phys. **51**, 659 (1979)

H.E. Stanley, *Introduction to Phase Transitions and Critical Phenomena*, Oxford Univ. Press 1974

C.J. Thompson, *Mathematical Statistical Mechanics*, Princeton Univ. Press 1972

H.M. Hugenholtz, States and Representations in Statistical Mechanics, in *Mathematics of Contemporary Physics*, R.F. Streater ed., Academic Press 1972

D. Ruelle, Helv. Phys. Acta **36**, 789 (1963)

J. Lebowitz and E. Lieb, Adv. Math. **9**, 316 (1972), Appendix by B. Simon

R. Haag, N.M. Hugenholtz and M. Winnink, Comm. Math. Phys. **5**, 215 (1967)

R. Kubo, J. Phys. Soc. Jap. **12**, 570 (1957)

P.C. Martin and J. Schwinger, Phys. Rev. **115** 1342 (1959)

J. Dixmier, *Von Neumann algebras*, North-Holland 1981

A. Leonard, Phys. Rev. **175**, 176 (1968)

J. Cannon, Comm. Math. Phys. **29**, 89 (1973)

J. Bros and D. Buchholz, Z. Phys. C-Particles and Fields **55**, 509 (1992); Nucl. Phys. **B429**, 291 (1994)

J. Goldstone, A. Salam and S. Weinberg, Phys. Rev. **127**, 965 (1962)

D. Kastler, D.W. Robinson and J.A. Swieca, Comm. Math. Phys. **2**, 108 (1966)

D. Kastler, Broken Symmetries and the Goldstone Theorem in Axiomatic Field Theory, in *Proceedings of the 1967 International Conference on Particles and Fields*, C.R. Hagen et al. eds., Interscience 1967

J.A. Swieca, Goldstone theorem and related topics, in *Cargése Lectures in Physics*, Vol. 4, D. Kastler ed., Gordon and Breach 1970

R.F. Streater, Spontaneously broken symmetries, in *Many degrees of freedom in Field Theory*, L. Streit ed., Plenum Press 1978

R.V. Lange, Phys. Rev. Lett. **14**, 3 (1965); Phys. Rev. **146**, 301 (1966)

J.A. Swieca, Comm. Math. Phys. **4** , 1 (1967)

J.D. Bjorken and S.D. Drell, *Relativistic Quantum Fields*, McGraw-Hill Book Company 1965

G. Morchio and F. Strocchi, Ann. Phys. **170**, 310 (1986)

W. Magnus, Commun. Pure Appl. Math. **7**, 649 (1954)

R.M. Wilcox, J. Math. Phys. **8**, 962 (1967)

A. Klein and B.W Lee, Phys. Rev. Lett. **12**, 266 (1964)

T.W.B. Kibble, Broken Symmetries, in *Proceedings of the Oxford International Conference on Elementary Particles*, Oxford 1965

G.S. Guralnik, C.R. Hagen and T.W.B. Kibble, Broken Symmetries and the Goldstone Theorem, in *Advances in Particle Physics*, Vol. 2., R.L. Cool, R.E. Marshak eds., Interscience 1968

R. Haag, D. Kastler and E.B. Trych-Pohlmeyer, Comm. Math. Phys. **38**,137 (1974)

L. Landau, J. Fernando Perez and W.F. Wreszinski, J. Stat. Phys. **26**, 755 (1981)

Ph. Martin, Nuovo Cim. **68**, 302 (1982)

M. Fannes, J.V. Pule' and A. Verbeure, Lett. Math. Phys. **6**, 385 (1982)

Ch. Gruber and P.A. Martin, Goldstone theorem in Statistical mechanics, in *Mathematical Problems in Theoretical Physics*, (Berlin Conference 1981), R. Schrader et al. eds., Springer 1982

W.F. Wreszinski, Fortschr. Phys. **35**, 379 (1987)

R. Requardt, J. Phys. A: Math. Gen. **13**, 1769 (1980)

G. Morchio and F. Strocchi, Ann. Phys. **185**, 241 (1988); Errata **191**, 400 (1989)

F. Strocchi and A.S. Wightman, J. Math. Phys. **15**, 2198 (1974)

G. Morchio and F. Strocchi, Ann. Inst. H. Poincaré, **A 33**, 251 (1980)

F. Strocchi, Comm. Math. Phys. **56**, 57 (1977)

A.S. Wightman, Ann. Inst. H. Poincaré, I, 403 (1964)

K. Hepp, Helv. Phys. Acta **36**, 355 (1963)

H. Ezawa and J.A. Swieca, Comm. Math. Phys. **5**, 330 (1967)

P.W. Higgs, Phys. Lett. **12**, 133 (1964) J. Bros, H. Epstein and V. Glaser, Comm. Math. Phys. **6**, 77 (1967)

R. Jost and H. Lehmann, Nuovo Cim. **5**, 1598 (1957)

F. Dyson, Phys. Rev. **110**, 1460 (1958)

H. Araki, K. Hepp and D. Ruelle, Helv. Acta Phys. **35**, 164 (1962)

A.S. Wightman, Analytic functions of several complex variables, in *Dispersion Relations and Elementary Particles*, (Les Houches Lectures), C. de Witt and R. Omnes eds., Wiley 1961

H. Araki, *Mathematical Theory of Quantum Fields*, Oxford University Press 1999

P.W. Higgs, Phys. Rev. Lett. **13**, 508 (1964); Phys. Rev. **145**, 1156 (1966); Spontaneous Symmetry breaking, in *Phenomenology of particle physics at high energy: Proc. 14th Scottish Univ. Summer School in Physics 1973*, R.L. Crawford and R. Jennings eds., Academic Press 1974, p. 529

G.S. Guralnik, C.R. Hagen and T.W. Kibble, Phys. Rev. Lett. **13**, 585 (1964)

T.W.B. Kibble, Phys. Rev. **155**, 1554 (1966)

F. Englert and R. Brout, Phys. Rev. Lett. **13**, 321 (1964).

S. Coleman, *Aspects of symmetry. Selected Erice lectures*, Cambridge Univ. Press 1985

S. Elitzur, Phys. Rev. **D 12**, 3978 (1975); G.F. De Angelis, D. De Falco and F. Guerra, Phys. Rev. **D 17**, 1624 (1978)

S. Weinberg, *The Quantum theory of Fields*, Vol. II, Sect. 21.1

R. Ferrari, L.E. Picasso and F. Strocchi, Comm. Math. Phys. **35**, 25 (1974)

J.A. Swieca, Nuovo Cim. **52A**, 242 (1967)

K. Symanzik, *Lectures on Lagrangean Quantum Field Theory*, Desy report T-71/1

G. Morchio and F. Strocchi, Removal of the infrared cutoff, seizing of the vacuum and symmetry breaking in many body and in gauge theories, invited talk at the *IX Int. Conf. on Mathematical Physics*, Swansea 1988, B. Simon et al. eds., Adam Hilger Publ. 1989

F. Strocchi, Long range dynamics and spontaneous symmetry breaking in many body systems, lectures at the Maratea Workshop on *Fractals, Quasicrystals, Knots and Algebraic Quantum Mechanics*, A. Amann et al. eds., Kluwer Academic Publ. 1988

S.S. Schweber, *An Introduction to Relativistic Quantum Field Theory*, Harper and Row 1961

G. Morchio and F. Strocchi, J. Phys. A: Math. Theor. **40**, 3173 (2007)

P.A.M. Dirac, Canad. J. Phys. **33**, 650 (1955)

O. Steinmann, *Perturbative Quantum Electrodynamics and Axiomatic Field Theory*, Springer 2000

D. Buchholz, S. Doplicher, G. Morchio. J.E. Roberts and F. Strocchi, Ann. Phys. **290**, 53 (2001).

G. Morchio and F. Strocchi, J. Math,. Phys. **44**, 5569 (2003)

W.A. Bardeen, Nucl. Phys. **B 75**, 246 (1974)

G. Morchio, D. Pierotti and F. Strocchi, Ann. Phys. **188**, 217 (1988)

R.J. Crewther, in *Field Theoretical methods in Particle Physics*, W. Rühl ed., Reidel (1980), p. 529.

Index

algebra of canonical variables, 68
algebra of observables, 69
algebraic symmetry, 71, 119
anti-kink, 41
anti-soliton, 43
asymptotic abelianess, 91
asymptotic localization, 91

bicommutant, 96
Bloch-Nordsieck model, 86
Bose gas, 151
  dynamical delocalization, 108
  free, 106
Bose-Einstein condensation
  symmetry breaking, 124, 155
Bose-Eistein condensation, 106

Cauchy problem, 14
  global, 55
  global existence and uniqueness, 20
  small times, 53
charge integrability, 166
classical field equations, 13
classical source model, 84
cluster property, 99
continuous internal symmetry, 35
  generator, 36
Coulomb systems, 164

delocalization, non-relativistic, 91
disjoint physical world, 74
disjoint realizations, 8, 21
double well model, 8
dynamical delocalization, 168
dynamical delocalization and interaction range, 169

energy bounded below, 31
energy-momentum renormalized density, 31

Fermi gas, 151
first order formalism, 18
Fock representation, 73
folium, 73

Galilei symmetry breaking, 164
gauge symmetry breaking, 109
Gibbs states, 139
GNS
  representation, 70
  theorem, 70
Goldstone bosons, 161
Goldstone theorem, 161, 162
  classical fields, 45
  general proof for local fields, 186
  GSW proof, 185
  local relativistic fields, 181
  mathematical discussion, 174
  non-symmetric Hamiltonians, 189
  non-zero temperature, 177
ground state
  non symmetric, 9
  uniqueness, 96, 103

Heisenberg algebra, 67
Heisenberg ferromagnet
  symmetry breaking, 123
Higgs mechanism, 164, 186
  non perturbative, Coulomb gauge, 199
  non perturbative, local gauges, 196
  perturbative approach, 193
Higgs mechanism and EDDG theorem, 195
Hilbert space sector, 23

HSS, 23

initial data, locally regular, 18
Ising model, 131
  Bogoliubov strategy, 136
  cyclic boundary conditions, 133
  free boundary conditions, 132
  Goldstone strategy, 136
  mean field approximation, 136
  periodic boundary conditions, 133
  Ruelle strategy, 135
  symmetry breaking boundary conditions, 135

kink, 40
KMS condition, 139
KMS state, 141
  extremal, 149
  primary, 147

Landau phonons, 161
Lipschitz condition, local, 19
local algebra, 90
local observables, 89
local structure, 21, 89
locality, 90
lower bound condition, 20

mean ergodic limit, 100

Noether charge, 35
Noether current, 35
Noether theorem, 16
Noether theorem and symmetry breaking, 33
non-Fock representation, 81
non-linear elliptic problem, 58

observables, 68

phase, 74
  pure, 147
phases, 8, 21
physically realizable operations, 89

quasi-local algebra, 90

sector, 22
  physical, 31, 58
Sine-Gordon equation, 42
soliton, 43
spectral condition, 95
spin systems, 105
  short range interaction, 110
spontaneous symmetry breaking, 9
stability group of a sector, 35
stability under space translations, 29, 95
stability under time evolution, 24, 91
state
  mixed, 69
  pure, 69
Swieca condition, 168
symmetries of classical systems, 7
symmetry, 7
  internal, 14
  local generation, 165
symmetry breaking
  axial in QCD, 204
  examples, 39, 42
  non perturbative Ruelle strategy, 129
symmetry breaking criterium
  Bogoliubov non-perturbative strategy, 130
  Goldstone, 127
symmetry breaking in gauge theories, 193
symmetry breaking in quantum systems, 115, 118
symmetry breaking in superconductivity, 161
symmetry breaking order parameter, 120

thermal states, 139
thermofield theory, 159
transfer matrix, 133
translationally invariant state,uniqueness, 97

U(1) problem in QCD, 204
unitary implementation of symmetries, 36

vacuum, 28, 32
vacuum sectors, 31
von-Neumann bicommutant theorem, 97

wave equation, free propagator, 51
Weyl algebra, 67
Wigner symmetries, 115
Wigner theorem, 115