

Index

(References to glossaries are indicated by italicized numbers.)

- Abers, E., 159
- Abrikosov, A. A., 18
- adiabatic invariant, 219, 372
- aether, 234, 263
- Aharonov, Y., 275
- Aharonov–Bohm effect, 275, 372
- Aks, S. Ø., 322
- Alessandrini, V., 205
- Allen, A. D., 181
- Amati, D., 143, 154, 161, 205
- analogy, 213, 219, 224, 228, 244, 257
- analytic continuation, 55, 372
- analytic functions, 55, 75, 176, 303, 372
- analyticity, 30, 55, 76, 90, 135, 229, 303
 - hermitian, 184, 381
 - maximal, 173, 174, 185, 384
 - physical region, 184, 386
- Anderson, H. L., 79
- angular distribution, 99, 372
 - see also* cross section, scattering
- anomalous magnetic moment, 19, 372
- anomaly cancellation, 206, 372
- anthropic principle, 221, 259, 373
- anticommutator, 213, 373
- Araki, H., 167
- Ascoli, R., 39
- asymptotic behavior, 107, 131, 141, 142, 297, 373
- asymptotic freedom, 25, 373
- asymptotic series, 18, 373
- Atkinson, D., 322
- Aubert, J. J., 202
- Augustin, J-E., 202
- auxiliary hypotheses, xii, 373
- Bachelard, G., 283, 393
- Bacon, F., ix
- Bacon–Descartes ideal, 282
- Balázs, L. A. P., 157, 200, 202, 207, 216, 261
- Ball, J., 216
- Bardakci, K., 196
- Barger, V. D., 155
- Bargmann, V., 50, 60, 61
- Barrow, J. D., 221, 259, 285
- baryon, 197, 373
 - nonexotic, 325
- baryon number (B), 173, 373
- baryonium, 201, 373
- Baumann, K., 321
- Belinfante, J. G., 159
- Bell, J. S., 274
- Bethe, H., 13, 14, 60, 69, 256, 321
- Bev, 373
- bifurcation point, 256, 267, 373
- Blankenbecler, R., 123, 127, 143, 154, 157, 160
- Blatt, J. M., 223
- Bloor, D., xiii, 283, 393
- Bloxham, M. J. W., 186, 324
- Bogoliubov, N. N., 81, 130, 324
- Bohm, D., 231–5, 274, 275, 289, 393
- Bohr, N., 5, 10, 218, 224
- Bonamy, P., 153
- bootstrap, 8, 116, 127–9, 134, 135, 139–41, 168, 176–9, 190, 212, 227, 240, 258, 265, 268, 374
 - applications of, 153–61
 - of internal symmetries, 159
 - of rho meson, 157–9
 - partial, 168, 179, 181
 - and Veneziano model, 195
- Born amplitude, 123, 374
- boson, 374
 - intermediate vector, 23, 25, 246
- bound state, 44, 60, 298, 374
- boundary conditions, 104, 131, 374
 - see also* asymptotic behavior
- branch point, 55, 153, 374
- Breit, G., 36, 38, 51, 52, 226, 306, 309
- Breit–Wigner formula, 30, 36, 52–4, 66, 213, 226, 227, 309–12, 314, 374
- Bremermann, H., 81
- Brenig, W., 35
- Brink, L., 326
- Brinkley, A., 4
- Bros, J., 83
- Brown, L. M., 122, 273

400 *Index*

- Brownian motion, 234
 Brueckner, K., 142
 Buchdahl, G., 272
 Burckhardt, J., 4
 Cao, T. Y., 324, 325
 Capella, A., 164
 Capps, R. H., 81, 159, 206
 Capra, F., 89, 94, 96, 128, 129, 142–5, 164,
 200–3
 Cartwright, N., 1, 289, 393
 Cassidy, D. C., 2, 33, 39
 Castillejo, L., 108
 causal quantum theory, 231–6, 264, 374
 causality, 76, 374
 and analyticity, 226, 302, 303
 and dispersion relations, 57–63, 265
 and first signal, 30, 70, 211, 214, 223
 Heisenberg and, 220
 macroscopic, 176, 184, 384
 microscopic, 68–73, 76, 116, 132, 213,
 229, 230, 265, 385
 and phase shifts, 79
 principle, 226–30, 319
 and quantum mechanics, 232
 Chamberlain, O., 94
 Chan, H.-M., 196, 199
 Chandler, C., 184
 channel, 31, 103, 223, 296, 299, 374
 crossed, 128, 140, 146, 189, 376
 direct, 128, 140, 377
 Charap, J. M., 127
 charge conjugation, 138, 203, 374
 charge exchange reaction, 153, 374
 charge independence, 93, 374
 charge renormalization, 16, 21, 374
 Chew, G. F., 80, 106, 112, 113, 147, 154,
 162, 164, 177, 185, 187, 251, 256, 261,
 281, 393
 analyticity, 90, 180
 bootstrap condition, 8, 127–9, 139–41,
 155–61, 181, 192
 crossing, 103
 Fermi, 90
 form factors, 83
 graduate work, 67
 Heisenberg program, 28, 64, 65, 144,
 266
 impulse approximation, 94–6
 Lagrangian field theory, 96
 La Jolla Conference, 135, 142–5
 Landau, 129
 Low, 90, 97
 Chew, G. F. (*continued*)
 Mandelstam, 139–41, 322
 maximal analyticity, 173
 maximum strength, 148, 173
 methodology, 144, 175, 181, 264, 265
 multiperipheral model, 193
 order, 200
 phase shift, 104, 108
 potential theory, 90
 recollections, 89, 320
 rho meson, 128
 S-matrix program, 118, 129–32, 167–71,
 173–6
 sociological factors, 90, 91
 space-time, 178
 static model, 97–100, 105
 sufficient reason, 135, 144, 174
 (3, 3) resonance, 109
 topological expansion, 199–203
 see also Chew model; Chew–Low
 effective range formula; Chew–Low
 extrapolation; Chew–Low model;
 pole–particle correspondence
 Chew–Frautschi plot, 148–50
 Chew–Low effective range formula, 108,
 129, 375
 Chew–Low extrapolation, 91, 113, 128,
 214, 375
 Chew–Low model, 90, 91, 104–9, 111, 119,
 122, 212, 214
 Chew model, 97–100, 375
 Chou, T. T., 324
 Cini, M., 67, 80, 214, 216, 288
 Cline, D. E., 155
 cluster decomposition, 184, 375
 Cocconi, G., 151
 Coester, F., 318–20
 Collins, P. D. B., 148, 152
 commutation relation, 70, 71
 commutator, 375
 current, 73, 191, 376
 compactification, 206, 375
 complementarity, 284, 375
 completeness, 44, 375
 complex angular momentum, 126, 212,
 375
 compound nucleus model, 223–31
 conservation of probability, 32, 176, 375
 consilience of inductions, 111, 247
 contingency, 250, 255, 259, 269, 283
 contour integral, 126, 375
 convergence of scientific opinion, 243, 247,
 251, 271–81

Index

401

- Cook, L. F., 157
 Coon, D. D., 160
 Copenhagen interpretation, 231, 234, 264, 375
 correspondence principle, 39, 172, 375
 cosmic ray ‘explosions’, 33, 39
 cosmological anthropic principle, 375
see also anthropic principle
 Coster, J., 185
 Coulomb amplitude, 78, 376
 Coulomb field, 59, 376
 coupling constant, 18, 97, 376
 pion–nucleon, 79, 99, 108, 111, 387
 CPT theorem, 182, 376
 creation and annihilation operators, 12, 71, 74, 205, 376
 Cremmer, E., 205
 cross section, 31, 32, 37, 223, 294, 376
 scattering, 60, 98, 147, 294, 389
 crossing, 75, 100–4, 107, 266, 376
 Cushing, J. T., 8, 28, 33, 34, 38, 51, 70, 160, 176, 180, 213, 215, 217–21, 223, 228, 229, 241, 251, 253, 254, 256–8, 261, 264, 265, 270, 273–5, 277–9, 285, 289, 292
 cut, 56, 128, 376
see also Regge cuts
 Cutkosky, R. E., 130, 143, 159, 185
 Cutkosky rules, 130, 185, 376
 cutoff, 106, 141, 159, 376
 Cziffra, P., 104, 105
 Dalitz, R. H., 108
 Darrigol, O., 8
 Davidon, W. C., 79, 80
 de Alfaro, V. S., 191
 de Broglie, L., 231–5
 de Broglie wavelength, 94, 376
 de Haas, W. J., 246
 demarcation problem, 241, 377
 De Tar, C., 89
 determinism, 233, 274
 Dicke, R. H., 259
 Diddens, A. N., 151
 diffraction peak, 148, 152, 377
 shrinkage of, 147, 151, 215, 389
 Dirac, P. A. M., 10, 11, 19, 26, 35, 219, 232, 256, 258, 260, 261, 308
 (Dirac) δ function, 377
 Dirac hole theory, 13, 377
 discovery, xi
 dispersion relations, 57–63, 116, 211, 303, 377
 dispersion relations (*continued*)
 for form factors, 85
 Kramers–Kronig, 57, 70, 72, 87, 213, 305, 306, 383
 model example, 108
 for N/D equations, 141
 nucleon–nucleon, 80
 phenomenology of, 77–80
 pion–nucleon, 79
 proof of, 70–7, 81–3
 and superconvergence, 191
see also Mandelstam representation
 dispersion theory, 8, 30, 377
 divergences, 12–14, 377
 Dolen, R., 157, 191, 192
 Donovan, A., 249
 double dispersion relations, 115, 119, 121, 123–7, 377
see also Mandelstam representation
 double solution, 231
 Drell, S. D., 86, 151
 Dresden, M., 324
 Drude, P., 213, 224
 duality, 26, 189, 191–3, 197, 212, 220, 266, 377
 Duhem–Quine thesis, x, 275, 377
 Dyson, F. J., 15, 18, 47, 48, 56, 82, 108, 130, 167, 256, 394
 Earman, J., 272
 Eden, R. J., 55, 56, 69, 119, 123, 143, 184, 267, 394
 Edwards, S. F., 18, 130
 effective range formula, 95, 108, 295, 377
 Ehrenfest, P., 219
 eightfold way, 143, 377
 Einstein, A., 5, 91, 231, 233, 235, 246, 266
 Eisenbud, L., 53, 54, 61, 226
 Elster, Ch., 280
 empiricism, 1, 242, 243, 378
 constructive, 375
 epistemology, 241
 Epstein, H., 83
 equivalence principle of strong interactions, 145, 378
 Erwin, A. R., 128
 essential singularity, 55, 123, 155, 378
 Euler–Lagrange equations, 22, 378
 exchange degeneracy, 200, 201, 378
 explanation, 251, 258–60

402 *Index*

- factorization, 378
see also scattering (S) matrix, factorization
- Fairlie, D. B., 131
- false zeros, 49, 126
- Faxén, H., 294
- Feenberg, E., 32, 36, 60, 296, 299
- Feldman, D., 73
- Fermi, E., 2, 17, 23, 33, 67, 94, 180
- Fermi theory of β decay, 17, 23, 378
- Fermion, 379
- Ferretti, B., 40
- fertility, 215, 218, 234, 251
- Feshbach, H., 86, 96
- Feynman, R. P., 15, 20, 122, 256, 267, 394
- Feynman diagrams, 19–21, 26, 47, 101, 379
- Fierz, M., 41
- Fine, A., xii, xiii, 250, 251, 254, 255, 275, 394
- fine struture constant, 15, 379
- finite-energy sum rule (FESR), 191, 193, 379
- Finkelstein, J., 89, 203, 216
- Finkler, P., 203
- fixed-source theory, 97, 379
- Foley, H. M., 14
- Foley, K. J., 152
- form factor, 85, 86, 128, 379
- Forman, P., 6, 7, 216, 232, 285
- Forman thesis, 6, 7, 216, 379
- Foucault, M., 257
- foundationist, xi, 240, 242, 282, 379
- Fourier decomposition, 44, 58, 71, 379
- Fox, G. C., 161
- fractal, 284, 379
- Frampton, P. H., 205
- Frank, N. H., 291
- Frank, P., 326
- Franklin, A., 246
- Frautschi, S. C., 89, 141–5, 147, 148, 154, 157, 164, 173
- Frazer, W. R., 91, 128, 129, 143, 165, 207, 216, 270
- Fredholm determinant, 31, 380
- Freund, P. G. O., 162, 192, 198
- Freundlich, Y., 177, 258
- Friedman, M., x
- Fröberg, M., 50, 51
- Froissart, M., 142, 143, 184
- Froissart bound, 142, 148, 380
- Fubini, S., 127, 143, 154, 161, 191, 204, 205
- Fulco, J. R., 128, 129, 216
- fundamental length, 33, 48
- Furlan, G., 191
- G parity, 200, 380
- Gale, G., 221, 241, 259
- Galison, P., xii, 2, 5, 33, 217, 227, 238, 246–8, 252, 272, 277, 285, 394
- gamma function, 194, 380
- Gamow, G., 38
- Gasiorowicz, S., 83, 138
- gauge field theory, 22–6, 222, 245, 380
- gauge invariance, 15, 380
- global, 22, 380
 - local, 23, 383
- Gauron, P., 202
- Gelfand, I. M., 51, 126
- Gell-Mann, M., 24, 81, 144, 167, 170, 174, 191, 213, 251, 256, 265, 268, 280, 281, 394
- bootstrap, 155–6, 158, 274
 - crossing, 75, 76, 90, 101–3
 - on discovery, 267
 - dispersion relations, 65, 68–71, 77, 87, 109, 119, 123, 229
 - Heisenberg program, 28, 64
 - La Jolla Conference, 142, 143
 - Landau, 129, 130
 - mass-shell QFT, 116–18, 145, 316
 - nuclear democracy, 145, 156
 - quarks, 156
 - Regge poles, 145, 148–50, 164
 - Reggeized QFT, 157
 - scattering theory, 35, 95
 - S-matrix program, 115–118, 171
- generative potential, 218, 219
- Gev, 380
- ghost states, 196, 204, 205, 380
- Gierre, R. N., 254
- Gilbert, W., 81
- Glaser, V., 83
- Gliozzi, F., 206
- Gluckstern, R. L., 59, 60, 62, 69, 87, 265
- Glymour, C., 227
- Goddard, P., 205
- Goebel, C. J., 196
- Goldberger, M. L., 83, 86, 91, 96, 167, 174, 185, 251, 256, 265, 394
- causality, 87
 - crossing, 75, 76, 101–3
 - dispersion relations, 65, 68–72, 77, 79, 90, 109, 169–71
- graduate work, 67
- Heisenberg program, 28, 64, 67

Index

403

- impulse approximation, 94, 95
 La Jolla Conference, 142, 143
 Mandelstam representation, 123, 124,
 127
 mass-shell QFT, 145
 microcausality, 70, 71, 213, 229
 multiperipheral model, 161, 162
 pragmatic attitude, 80, 81, 115, 214
 QFT versus SMT, 169, 170
 Regge cuts, 154
 Reggeized QFT, 157
 scattering theory, 35
 Goldstone, J., 24, 205
 Goldstone bosons, 24, 380
 Gordon, D., 204
 Gould, S. J., 288
 grand unified theory (GUT), 25, 26, 380
 Green, M. B., 156, 206, 281
 Green, T. A., 47
 Green's function, 119, 291, 301, 380
 Gribov, V. N., 155, 164
 Gribov singularity, 155, 157, 380
 Gross, D. J., 206
 group, 93, 380
 Grythe, I., 28, 38–40, 42, 49, 64
 Gunson, J., 185
 Haag, R., 35, 167
 Haas, A. E., 218
 Hacking, I., 1, 257, 276, 394
 Hadron, 381
 hamiltonian formalism, 9, 172, 381
 Harari, H., 196
 hard core, xii, 381
 Hardin, L., 277
 harmony of random choices, 275, 381
 Heilbron, J. L., 252
 Heisenberg, W., 1, 5, 6, 56, 185, 213, 256,
 306
 analyticity, 38
 Fermi theory, 23
 fundamental length, 33, 34
 hamiltonian field theory, 33
 matrix mechanics, 10, 11, 26, 219
 nonlinear spinor QFT, 39, 40
 optical theorem, 37
 scattering theory, 35
 S-matrix program, 27, 33–39, 65, 82, 89,
 167; causality, 57; Chew on, 143;
 Gell-Mann on, 143; Heisenberg's
 later views, 41, 42; Kramers on 38,
 42; Møller on, 40, 43, 44; motivation
 for, 2, 26, 33, 34; Pauli on, 40;
 Wentzel on, 47
- Heisenberg, W. (*continued*)
 superconductivity, 40
 unitarity, 35, 36
 Wheeler, 36, 318
 Heisenberg operator, 70, 73, 381
 Heitler, W., 45, 46, 56, 291, 321, 395
 helicity, 191, 381
 Heller, M., 6, 286
 Hempel, C. G., 275, 395
 Hendry, J., 7
 Hepp, K., 83
 Hermann, A., 218
 heuristic, xii, 381
 mathematical, 190, 214, 215, 219, 236,
 258, 260, 261, 264, 265
 Higgs, P. W., 24
 Higgs boson, 25, 222, 381
 Hiley, B. J., 231–4, 289
 historicist, xi, 242
 Hoddeson, L., 273
 Holinde, K., 280
 Holmberg, B., 51
 Holtzman, J., 294
 Hones, M. J., 220, 255
 Horn, D., 157, 191, 192
 Hu, N., 45, 51, 54, 55, 57
 Huang, K., 160
 Huygens, C., 257
 hydrodynamical model, 232, 233
 Hylleraas, E. A., 50, 51
 hypothetico-deductive method, 190, 258,
 382
- Iagolnitzer, D., 182, 184, 185
 Igí, K., 154, 191
 Iizuka, J., 198
 implicate order, 275, 382
 impulse approximation, 94–6, 382
 in and out fields, 73, 382
 indeterminacy, 240
 instrumentalism, x, 382
 interaction, 380
 electromagnetic, 168, 174, 176, 179, 181,
 202, 378
 electroweak, 203, 378
 gravitational, 206, 208
 strong, 244, 390
 internal history, 3–6, 382
 internal symmetry, 159, 382
 invariance group, 22, 382
 isotopic spin (isospin), 78, 93, 173, 382
 Jackson, J. D., 67, 73, 75
 Jacob, M., 205

404 *Index*

- Jammer, M., 231
- Jardine, N., 327
- Jauch, J. M., 321
- Jones, C. E., 202, 203, 216
- Jones, G. L., xv
- Jost, R., 40, 49, 51, 58, 59, 80, 82, 117, 126, 130, 182, 183, 395
- Jost function, 49, 50, 126, 392, 395
- justification, xi
- Kalckar, F., 38, 224
- Källen, G., 18, 73
- Kaloyerou, P. N., 289
- Kaluza, Th., 206
- Kaluza–Klein theory, 206, 382
- Kaplunovsky, V., 284
- Kapur, P. L., 38, 226, 309
- Karplus, R., 59, 70, 77–9, 83, 122
- Kemmer, N., 48, 232
- Keynes, J. M., 239
- Khalatnikov, I. M., 18
- Khuri, N. N., 123, 127
- Klein–Nishina formula, 170, 383
- Klein, O., 206, 308
- Knudsen, O., 317, 318
- Koba, Z., 196, 204
- Kockel, B., 321
- Kohn, W., 51, 126
- Kolb, E. W., 207
- Kortel, F., 39
- Kourany, J. A., 242
- Kramers, H. A., 14, 38, 39, 42, 44, 57, 65, 66, 70, 213, 229, 256, 304–6, 395
- Kramers–Kronig dispersion relation,
see dispersion relations
- Kroll, N., 14, 77, 108
- Kronig, R., 57, 58, 60, 65, 66, 70, 213, 229, 304, 305
- Kruse, U. E., 79
- Kuhn, T. S., xi, xiii, 1, 217, 222, 253, 293, 395
- Kusch, P., 14
- ladder of axiom, ix
- Ladenberg, R., 213
- Lagrangian, 22, 131, 132, 383
field theory, 170, 171; effective, 270
formalism, 383
- LaJolla Conference, 135, 142–5
- Lakatos, I., xi, 7, 217, 222, 240, 242, 248, 254, 281, 395
- Lamb, W. E., 12
- Lamb shift, 13, 14, 19, 383
- Landau, L. D., 18, 129, 130, 143, 167, 168, 171, 174, 221, 395
- Landau rules, 130, 383
- Landau singularities, 221
- Landau surfaces, 184, 383
- Landshoff, P. V., 123, 131, 184, 185
- Lassalle, M., 320
- Laudan, L., 242, 395
antirealism, 264, 278
Leibnizian ideal, 276
method of hypotheses, 257, 258
naturalized philosophy of science, xiii, 249–54
reticulated model, 243, 249, 257, 272, 275, 278, 284, 285
- Laudan, R., 249
- Lax, M., 60, 96
- Le Bellac, M., 205
- Lee, H. C., 199
- Lehmann, H., 81–3, 116, 130, 214, 396
- Lehmann–Symanzik–Zimmermann (LSZ) formalism, 81, 131, 214, 270, 383
- Lehr, W. J., 234
- Leibniz’s principle of sufficient reason, 135, 144, 168, 174, 176, 229, 259
- Leptons, 174, 383
- Levinson, N., 50, 51
- Levitin, B. M., 51, 126
- Lewis, H. W., 95, 96
- lifetime, 310
- Lindenbaum, S. J., 152
- Lippmann, B. A., 35, 90
- Lippman–Schwinger equation, 90, 92, 96, 106
- local field, 132, 171, 383
- logic of induction, 383
- logical positivism, x, 240, 242, 281, 384
- Lorentz invariance, 15, 25, 37, 384
- Losee, J., 241
- Lovelace, C., 164, 196, 205
- Low, F. E., 73, 77, 80, 89, 91, 97, 100, 105, 106, 108, 109, 113, 145, 157, 160–62, 164, 170, 171, 174, 328, 396
- Low equation, 100, 129, 384
- Lu, E. Y. C., 184
- Luttinger, J. M., 58, 117
- Ma, S. T., 44, 49
- MacGregor, M. H., 104, 105
- MacKinnon, E. M., 231, 257, 258, 288
- McGlinn, W. D., 160

Index

405

- McMullin, E., xiv, xv, 1, 218, 228, 229, 274, 289, 327, 396
 Machleidt, R., 280
 Madelung, E., 232
 magnetic moment, 14, 15, 384
 anomalous, 19, 99, 372
 Mandelbrot, B., 379
 Mandelstam, S. L., 89, 90, 115, 174, 261, 396
 bootstrap mechanism, 128, 129, 139, 141, 144
 double-dispersion relation, 109
 duality, 191, 196, 205
 Gribov singularities, 157
 linear Regge trajectories, 151, 194
 mass-shell QFT, 131, 132, 145, 171
 microcausality, 132
 Regge cuts, 154, 155, 164
 Regge poles, 131, 323
 string theory, 281
 see also Mandelstam representation
 Mandelstam representation, 115, 118–23,
 212, 214, 384
 proofs of, 123–6
 Mandl, F., 73
 March, R., 128
 Martin, A. W., 160
 Marx, E., 157
 mass renormalization, 16, 384
 mass shell, 117, 131, 132, 185, 384
 Massey, H. S. W., 291
 matrix mechanics, 11, 34, 384
 Matsuda, S., 154, 191
 Matthews, P., 17
 Maxwell, J. C., 263
 Maxwell's equations, 11, 384
 measurement problem, 168, 175, 185, 202,
 234
 Medawar, P. B., 240, 288
 Medvedev, B. V., 81
 Mehra, J., 232
 Meixner, J., 50
 mesons, 197, 384
 exotic, 201, 378
 none exotic, 325
 Messiah, A., 295, 328
 meta-level, 242, 250, 251, 257, 384
 methodological rules, 213, 220, 221, 238,
 249–62
 Mev, 385
 Meyerson, É., 290, 396
 Millikan, R. A., 247
 Mills, R. L., 22, 23
 Misner, C. W., 277
 Mitter, H., 39
 Miyazawa, H., 79
 models, 203, 213, 220
 Möller, C., 40, 42–4, 49, 50, 67, 396
 momentum transfer, 115, 385
 monopole, 260, 385
 Moravcsik, M. J., 104, 105, 279
 Moshe, M., 138
 Mott, N. F., 291
 Moyer, B. J., 96
 multiperipheral model, 161, 162, 385
 Regge form of, 193, 199
 N/D equations, 140, 158, 385
 N-point amplitude, 196, 204, 385
 Nambu, Y., 80, 81, 90, 109, 119, 190, 205
 Nash, N., xv
 naturalized philosophy of science, xiii, 1,
 241, 255, 271, 294, 385
 nearby singularities, 104, 129, 142, 385
 Ne'eman, Y., 24, 234
 Nelson, E., 234
 Nersessian, N. J., xiii, 230, 396
 neutral current, 247
 Neveu, A., 205, 207
 Newton, R. G., 51
 Ng, S. W., 199
 Nickles, T., xiii, 218, 226, 227, 243, 254,
 396
 Nicolescu, B., 202, 203
 Nielsen, H. B., 196, 204
 Noether's theorem, 22, 25, 385
 non-abelian gauge theory, 261, 385
 nonlinear spinor theory, 39, 40, 385
 nonlocality, 235
 nonseparability, 240
 normal science, xi
 November Revolution, 202, 244, 245
 nuclear democracy, 135, 145, 156, 164,
 168, 180, 385
 nucleon (N), 93, 385
 Nuttall, J., 131
 Oehme, R., 28, 33, 79–81
 Okubo, S., 198
 Okun', L. B., 139
 Oldershaw, R. L., 327
 Olive, D., 182, 184, 186, 205, 206, 268, 281
 Omnes, R., 86
 ontology, 241
 Oppenheimer, J. R., 15, 38, 48

406 *Index*

- optical theorem, 32, 37, 56, 60, 78, 296, 299, 301, 386
- order, 190, 200, 325, 386
- Ouvry, S., 202
- OZI rule, 198, 200, 201, 386
- paradigm, xi
- parity, 203, 386
- Park, J. L., 234
- partial wave, 78, 92, 294, 386
 - amplitude, 126, 127
- particle exchange, 105, 280, 386
- Pascal, B., 257
- Paton, J. E., 196, 199
- Pauli, W., 5, 40, 45, 50, 56, 98, 231, 232, 256
- Peierls, R., 38, 226, 309
- Peng, H. W., 45
- Peres, A., 289
- perturbation theory, 20, 386
- Pham, F., 186
- phase shift, 50, 62, 63, 92, 295, 311, 386
- phase-shift analysis, 78–80, 104, 386
- phenomenology, 104, 386
 - degenerating Regge, 152–5
- Phillips, R. J. N., 164
- philosophical relativism, 241, 248, 386
- photomeson production, 108, 386
- physical region, 146, 386
- Pickering, A., 202, 260, 396
 - analogy, 213
 - dispersion theory, 67
 - pragmatic attitude, 80, 214
 - SMT versus QFT, 165, 207, 269
 - sociological factors, 215, 217, 238, 242–6, 248, 261, 285
 - strong program, xiii
 - symbiosis, 220, 243, 254, 276
- Pignotti, A., 193
- pilot wave, 231
- planar diagram, 197, 386
- Planck, M., 227
- Poénaru, V., 202, 203
- Poisson brackets, 11, 387
- polarization, 153, 387
- pole, 387
 - see also* pole–particle correspondence; Regge poles
- pole factorization, 149, 204, 205, 387
- pole–particle correspondence, 90, 107, 109–13, 129, 130, 387
- Politzer, H. D., 25
- Polivanov, M. K., 81
- Polkinghorne, J., xv, 81, 123, 130, 131, 155, 157, 164, 173, 184–6, 216, 397
- Pomeranchuk, I. Ia., 130, 134, 155, 164
- Pomeranchuk theorems, 136–9, 150, 387
- Pomeron, 148, 199
- Popper, K., xi, 7, 240, 242, 243, 253, 281, 397
- positive definite, 204, 387
- positivism, xi
- potential, 123, 142
- potential theory, 33, 90, 387
- pragmatic attitude, 80, 81, 113, 214, 220, 237
- prescriptive criteria, 242
- principal value integral, 59, 387
- principle of equivalence, 145
- principle of maximal analyticity, 173, 174, 185, 387
- principle of maximum strength, 142, 144, 148, 173, 387
- production threshold, 55, 387
- propagator, 84, 387
- pseudoscalar particle, 388
- Putnam, H., 264, 277
- quantum chromodynamics (QCD), 25, 26, 222, 388
- quantum electrodynamics (QED), 12–19, 388
- quantum field theory (QFT), 8–12, 33, 388
 - axiomatic, 83, 167, 184, 373
 - Reggeized, 157, 325
 - versus SMT, 161, 169–73, 245, 269, 276
 - see also* gauge field theory
- quantum potential, 233
- quantum theory (old), 218, 385
- quarks, 25, 156, 190, 388
- radiation damping, 45, 213, 304, 388
- radiative corrections, 14, 388
- Raine, D. J., 6, 286
- rational reconstruction, 240
- rationalist, xi, 388
- rationality, 219, 237, 240, 260, 271, 272, 274, 281
- Ravens’ paradox, 275, 388
- Rayleigh, Lord, 219
- Rayleigh scattering, 77, 306, 388
- Rebbi, C., 205
- Rechenberg, H., 28, 36, 64, 232
- recycling of analogies, 244, 255
- Redhead, M. L. G., xv, 118, 148
- reduction technique, 73–5

Index

407

- Regge, T., 90, 116, 126, 129, 142, 143, 397
 Regge cuts, 153, 155, 200, 201, 388
 Regge phenomenology, 248
 degenerating, 152–5, 164, 165, 248
 Regge poles, 126, 127, 131, 135, 141, 142,
 145, 146, 151, 212, 214, 323, 388
 Regge trajectory, 388
 Reggeon calculus, 164, 324
 renormalizatin, 12–19, 99, 221, 268, 388
 research program, xii, 218, 249, 388
 degenerating, 154, 248, 376
 see also Regge phenomenology
 resonance, 29, 30, 55, 63, 98, 99, 224, 305,
 308–15, 389
 δ_{33} , 94, 99, 109, 141, 376
 rho (ρ), 128, 129, 389
 Rutherford, R. C., 12
 reticulated model x, 243, 249, 273, 274,
 277, 287
 Revolutionary science, xi
 rho (ρ) meson, 128, 129, 389
 Richard, J. M., 202
 Riemann–Lebesgue lemma, 62, 389
 Rigden, J. S., 5
 Ringland, G. A., 164
 Rivier, D., 47
 Rohrlich, F., 59, 60, 62, 69, 87, 265, 277,
 321
 Rolnik, W. B., 322
 Rorty, R., 327, 328
 Rosenthal-Schneider, I., 91
 Rosenzweig, C., 199–202
 Rosner, J. L., 196, 198
 Rossetti, G., 191
 Roy, S. M., 160
 Ruderman, M. A., 77, 79, 108
 Ruegg, H., 196
 Ruelle, D., 83
- S-matrix theory (SMT), 29, 390
 see also sattering (*S*) matrix program
 Sakita, B., 196
 Salam, A., 17, 23–5, 81
 Salam–Weinberg model, 25, 26, 203, 260,
 389
 Salmon, W. C., 242
 Salzman, F., 106, 216
 Salzman, G., 106
 Scadron, M., 160
 scalar particle, 159, 389
 scattering, 19
 amplitude, 32, 57, 291, 389
 Compton, 20, 170, 375
 scattering (*continued*)
 Coulomb, 78, 376
 Delbrück, 59, 60, 62, 376
 diffractive, 199
 elastic, 31, 378
 hard, 244, 381
 length, 94, 295, 389
 Møller, 20, 21, 385
 soft, 244, 390
 scattering (*S*) matrix, 17, 31, 74, 295
 defined, 31, 47, 177, 317, 318
 factorization of, 149, 185, 196, 204
 false zeros of, 49, 50, 318, 319
 ordered, 201
 planar, 201
 poles of, 43, 44, 61
 poles versus zeros, 55
 program, 212, 229, 258, 265;
 autonomous, 8, 129–32, 145, 168,
 172, 186, 215, 220, 373; axiomatic,
 169, 182–5, 188; causal, 82, 270, 374;
 conceptual framework of, 173–6;
 dual topologial (DTU), 201, 202;
 Heisenberg's, 28, 34, 39, 42, 57, 64,
 65, 67, 69, 89, 105, 115, 117, 118, 143,
 144, 167, 168, 210, 220, 266;
 topological (TSMT), 190, 200–3, 207;
 versus QFT, 161, 169–73, 245, 269,
 276
 Wheeler, 31
 zeros of, 38, 49
 see also pole–particle correspondence
 Schaat, M. M., 199
 Scherk, J., 205, 206
 Schmid, C., 157, 191, 191–3
 Schrödinger, E., 5, 10, 11, 219, 231, 308
 Schrödinger equation, 11, 22, 31, 35, 42,
 124, 223, 226, 233, 234, 292, 299, 307,
 309
 Schrödinger theory, 389
 Schützer, W., 60, 61, 63, 68–70, 226
 Schwarz, J. H., 156, 191, 195, 202, 205,
 206, 215, 216, 281, 325
 Schwarzschild, B. M., 206, 207
 Schweber, S. S., 3, 8, 9, 214, 248, 256, 270,
 285, 288, 397
 Schwimmer, A., 324
 Schwinger, J., 15, 18, 35, 47, 90, 256, 397
 scientific realism, xiii, 230, 264, 389
 Sreaton, G. R., 123, 130
 Seckel, D., 207
 self-energy correction, 13, 14, 389
 separability, 229, 389

408 *Index*

- Serber, R., 38
 shadow matter, 207, 389
 Shapere, D., xiii, 227, 241, 242, 250, 251,
 254, 255, 275, 284, 397
 Shimony, A., 228
 Shirkov, D. V., 324
 Siegel, H., 241
 Siegert, A. J. F., 38, 52, 226, 309, 310
 signature, 195, 325, 389
 simple model of science, x, 254
 Singh, V., 157
 singularity, *see cut; essential singularity;*
 pole
 Slater, J. C., 213, 232, 291
 Slotnick, M., 58, 117
 Snider, D. R., 162
 sociologial, 390
 factors, 217, 238, 243–9, 284
 solitons, 261, 390
 Solvay Congress, 14, 41, 131, 161, 169,
 231, 232, 235
 Sommerfeld, A., 220
 Sommerfield, C. M., 122
 spacelike separation, 69, 229, 390
 space-time continuum, 168, 175, 178, 240,
 265
 spectral functions, 124, 125
 spin-statistics theorem, 37, 182, 183, 390
 spontaneous symmetry breaking, 24, 25,
 206, 390
 Squires, E. J., 148, 152
 Stack, J., 216
 Stanghellini, A., 143, 154, 161
 Stapp, H. P., 104, 105, 178, 182–6, 200,
 284
 static model (fixed-source theory), 97, 390
 Steinberger, J. L., 95, 96
 Steinmann, O., 83
 Stern, A. W., 175
 Stirling, A. V., 153
 stochastic mechanics, 234
 Stöckler, M., 8
 Stoops, R., 41
 strangeness, 159, 173, 390
 Streater, R. F., 320
 string theories, 26, 190, 203–7, 213, 266
 strong program, 283, 390
 Stückelberg, E. C. G., 45–7, 397
 SU(2) symmetry, 93, 390
 SU(3) symmetry, 24, 25, 159, 196, 390
 substitution law, 101, 321, 390
 subtraction procedure, 391
 see also renormalization
 subtractions, 14, 15, 127, 131, 391
 Sukhatme, U., 164
 sum rule, 77, 189, 391
 superconvergence relations, 154, 191, 391
 superdeterminism, 289, 391
 superselection rule, 183, 391
 superstrings, 26, 190, 207, 208, 220, 221,
 266, 391
 supersymmetry, 206, 326, 391
 Sursock, J., 216
 Symanzik, K., 81, 82, 116, 126, 214
 tachyon, 195, 205, 391
 Takeda, G., 81
 Tan, C.-L., 89, 164
 Tarjanne, P., 159
 Tarski, J., 123
 Taylor, J. C., 123
 Taylor, J. G., 81
 Taylor, J. R., 184
 Taylor, T. B., 96
 Teller, P., 221, 228
 ter Haar, D., 49
 Ter-Martirosyan, K. A., 164
 theory construction and selection, 223,
 230, 231, 237, 246, 255, 270
 Thirring, W. E., 67, 70, 77, 87, 213, 229,
 265
 Thomas-Kuhn sum rule, 77
 Thomson scattering, 77, 306, 391
 't Hooft, G., 25
 Thorn, C. B., 205
 (3, 3) resonance, *see* resonance, δ_{33}
 time reversal, 391
 Tiomno, J., 60, 61, 63, 68–70, 226
 Tipler, F. J., 221, 259, 285
 Titchmarsh, E. C., 328
 TOE, 191
 Toll, J. S., 59, 62, 68–70
 Tomonaga, S., 15, 256
 topological expansion, 190, 196–200
 topology, 391
 Toulmin, S., 327
 Touschek, B., 50
 Toynbee, A., 250
 Tran Thanh Van, J., 164
 Treiman, S. B., 86, 123, 127
 triadic model, *see* reticulated model
 Tsou, S. T., 199
 Turner, M. S., 207
 Udgaonkar, B. M., 148, 150
 unified field theory, 391

Index

409

- unitarity, 23, 35–37, 58, 59, 87, 107, 176, 177, 392
 elastic, 92, 140, 378
 unphysical region, 185, 186, 392
 unphysical region, 117, 392
 Uschersohn, J., 202
- vacuum, 263
 polarization, 14, 392
- van der Waerden, B. L., 213
- van Fraassen, B. C., 1, 254, 397
- van Hove, L., 153
- van Kampen, N. G., 50, 60–3, 69, 70, 76
- vann Woodward, C., 269
- Varnak, S. J., xv
- vector particle, 159, 392
- Veneziano, G., 157, 189, 199, 201, 204, 205, 251
- Veneziano model, 189, 193–6, 203, 212, 214
- vertex function, 84, 117, 392
- vertex modification, 21, 392
- Vigier, J-P., 232, 233
- Vinh Mau, R., 165, 202, 280
- Virasoro, M. A., 196, 205
- virtual process, 14
- von Neumann, J., 126, 232
- W boson, *see* boson, intermediate vector
- Walker, W. D., 128
- Waller, I., 308
- Waltz, R., 198
- Watkins, J. W. N., xi, xiv, 282, 398
- Watson, K. M., 94
- wave mechanics, 11, 392
- weak interaction, 168, 174, 185, 202, 392
- Weinberg, S., 24, 160, 161, 164, 165, 207, 229, 270, 398
- folk theorems, 207, 270
- Weinstein, M., 284
- Weisskopf, V. F., 45, 52, 223, 224, 226, 256, 306, 308
- Wentzel, G., 28, 45, 47, 48, 67, 89, 145, 398
- Wess, J., 326
- West, E., 128
- Wheeler, J. A., 27, 30, 31, 36, 59, 62, 65, 68, 69, 259, 398
- Whewell, W., ix, 4, 398
- Wichmann, E. H., 122
- Wick, G. C., 36, 95, 96, 104–6, 183
- Wightman, A. S., 83, 167, 183, 320
- Wigner, E. P., 38, 68, 126
 causality, 60
 compound nucleus model, 223, 228
 phase-shift bound, 62, 63, 313
 radiation damping, 45, 224, 306
 resonance formula, 51–4, 61, 66, 226, 227, 309
 superselection rule, 183
- Wildermuth, K., 50
- Wilson, P. A., 221, 259, 260
- Wong, D. Y., 143
- Wouthuysen, S. A., 38
- Wright, J., 160
- Yang, C. N., 22, 23, 73, 95, 261
- Yang–Mills theory, 23–5, 185, 222, 392
- Yukawa, H., 2, 256, 280
- Yukawa potential, 97, 105, 127, 392
- Zachariasen, F., 84, 86, 148, 150, 151, 154, 157, 159, 160, 164, 178
- Zahar, E., 215, 248
- Zemach, C., 157, 159, 178
- zeros, *see* scattering (*S*) matrix
- Zimmermann, W., 81, 82, 116, 214
- Zumino, B., 326
- Zurek, W. H., 289
- Zweig, G., 198, 215, 280