

# INDEX

- 120°-phase, 221, 226, 265
- 1D, 11, 25, 51, 53, 54, 116, 118–121, 132, 133, 148, 151, 264
- 2D, 51–53, 136, 148, 157, 201, 203, 239, 242, 249, 264, 287, 296, 297, 318
- 3D, 51–53, 148, 157, 201, 252, 253, 261, 263, 297
- ABX<sub>3</sub>, 36, 226, 265
- advanced Green function, 59–61, 70
- AF1, 206, 207
- AF, 218, 230, 232
- AF<sub>1</sub>, 214, 218, 220, 226, 230, 232
- AF<sub>2</sub>, 230, 232
- angular displacement, 301, 304–306, 307
- angular momentum, 12, 32, 37
- anisotropy, 34, 45, 47, 49, 149, 203, 288
- antibonding state, 4
- antiferromagnet, 167, 188, 197, 198, 200, 201, 203, 205, 207, 310
- antiferromagnetic, 37, 204, 207, 230, 300, 305, 310, 337
- apex angle, 31, 33, 188, 195, 196, 249, 252, 253
- Berezinskii–Kosterlitz–Thouless (BKT), 296, 329
- Bessel functions, 49, 74, 75, 299
- bilayer, 246, 252
- bilinear Hamiltonian, 42, 44, 159, 160, 163, 177, 190, 194, 196, 227
- body centered cubic (BCC), 45, 46, 50, 197–201, 257–260
- Bogoliubov transformation, 159, 161, 193, 233, 236
- Bohr magneton, 6, 265, 277
- bonding state, 4
- boson Green function, 59, 91
- boson Hamiltonian, 40, 42, 60, 131, 161, 195
- bound state, 18, 26, 29, 31, 36, 131–158
- Bravais lattice, 44, 169, 188, 227, 236, 266
- Brillouin zone (BZ), 33, 46, 57, 59, 137, 143, 145, 149, 155, 157
- broken symmetry, 45, 207
- BX<sub>2</sub>, 36, 201, 226
- Catalan’s constant, 85
- checkerboard, 297, 307–312, 314, 316–318, 320, 321, 338
- classical spin waves, 31, 249, 261
- close-packed, 203
- cluster, 6, 7, 9, 11, 37
- commensurate, 221, 226, 324, 325, 327
- complementary error function, 268
- cone structure, 195
- connected diagrams, 93, 94, 96, 97, 100, 106, 168, 302
- constant of motion, 12, 13, 314
- correlation function, 56, 59–61, 68, 74, 296, 329
- Coulomb integral, 3, 4
- critical temperature, 264, 334, 336
- cross-section, 55, 59, 91, 95, 235, 237–239, 245–247, 249, 292–295
- crystalline-electric-field (CEF), 278–288, 291, 295
- damping, 70, 73, 80, 81, 88, 90, 115, 118, 129, 130, 235, 246
- Debye-Waller, 55
- decoupling, 63, 74, 241

- degenerate helix (DH), 210, 216, 222, 223, 231, 238, 240
- delocalized, 13, 24, 42, 131
- density matrix, 46
- dipolar, 264–267, 276, 287, 288, 295, 296, 310, 336
- dipolar Hamiltonian, 265, 300
- dipole–dipole interaction, 264, 267, 297, 315, 338
- disconnected diagrams, 93, 96, 97, 100, 106
- disorder line, 215, 217, 219, 224, 226, 231, 233
- doublet, 7, 287, 288
- dynamical interaction, 43, 44, 60
- Dyson's equation, 72, 73, 302
- Dyson–Maleev (DM), 39, 41, 43, 44, 56, 62, 65, 70–72, 76, 92, 131, 159–161, 177, 187, 189
- easy-plane anisotropy, 159, 177, 191, 196, 207, 208
- elastic, 57, 58, 238, 277, 287, 314
- entropy, 47, 204, 205
- equation of motion, 59, 61, 63, 65, 118, 177, 187, 241
- Euler's constant, 3
- Ewald's method, 267, 274, 297, 315
- exchange anisotropy, 34, 149
- exchange bound state, 150
- exchange integral, 3
- exponential integral function, 3, 4, 268
- face centered cubic (FCC), 45, 46, 50, 203, 205–207
- ferromagnetic (F), 214, 220, 226, 230, 232, 331, 333, 336–338
- Feynman diagram, 96, 165, 171–175, 181
- film, 242, 243, 245, 249, 252, 253, 258, 263
- finite-size, 270, 299, 317, 318, 327, 334, 337
- first-order, 62, 64, 65, 73, 76, 95, 100, 129, 170, 171, 176, 177, 199
- five-layer, 256
- four-layer, 254, 255
- Fourier, 15, 16, 25, 42, 56, 63, 94, 160, 168, 189, 241, 242, 301, 308
- fourth nearest neighbour (FNN), 217, 223
- free energy, 46, 47, 52, 75, 200, 207, 210, 213, 297
- frustration, 204, 205, 214, 219, 227
- Goldstone theorem, 45, 65, 180, 187, 196
- granpartition function, 46, 93
- Green function, 65, 70, 72, 73, 95, 241, 244–248
- ground state, 8, 10, 11, 13–15, 36, 37, 45, 162, 177, 190, 195, 197–199, 204–206, 212, 216, 218, 223, 228, 230, 232, 265, 275, 277, 281, 284, 287, 288, 292, 296, 300, 308, 330, 338
- $H_1$ , 215, 218, 220, 226, 230, 232
- $H_2$ , 215, 218, 221, 226, 231, 232
- $H_3$ , 231, 232
- harmonic approximation, 44, 45, 50, 57, 59, 213, 235–237, 297, 302
- harmonic Hamiltonian, 42, 46, 64, 233, 289
- heat capacity, 48, 50, 52, 53, 200
- Heisenberg Hamiltonian, 5–7, 14, 33, 38, 40–42, 45, 73, 131, 189, 196, 204, 241, 242, 258, 273
- helix, 36, 188, 195, 196, 198, 206, 207, 218, 238, 297
- hexagonal (H), 203, 204, 224, 243, 260, 263
- hierarchy, 63, 74
- high- $T_c$  superconductors (HTCS), 201, 202, 264
- Holstein-Primakoff (HP), 39, 40–44, 56, 62, 65, 70, 72, 177, 187
- honeycomb (HON), 227, 233
- hydrogen molecule, 1
- incommensurate, 215, 221, 320, 326–328, 338
- inelastic, 58, 59, 238
- inelastic neutron scattering (INS), 158, 285, 290, 292, 295
- infinite degeneracy, 210, 216
- interaction picture, 92, 94
- internal energy, 47, 50, 52, 53, 200, 315
- irreducible, 105, 106
- Ising, 157, 204, 239, 265, 287, 289, 297, 300, 307, 310, 314, 318, 334, 336, 337
- isotropic ferromagnet, 38, 91, 131, 148, 167, 177, 178, 180
- kinematical consistency, 159, 160, 162, 165, 176, 187
- kinematical interaction, 40, 44, 72

- Landé factor, 6, 265, 286, 287
- linear chain (LC), 16, 19, 35, 37, 197, 199, 201
- linked cluster theorem, 93, 96, 97, 302
- local axes  $\xi, \eta, \zeta$ , 188, 265
- localized, 13, 40, 42, 135
- long range, 34, 264, 267, 296, 297, 307, 315
- long range order (LRO), 53, 201, 203–206, 216, 217, 224, 239, 265, 288, 296, 297, 304, 306, 307, 316, 328, 329
- long wavelength, 77, 80, 81, 88, 198, 200, 201, 306
- loose packed, 197, 198
- lowering, 12, 40, 56, 189, 284, 286
- magnetic moment, 32, 33, 58
- magnetization, 48, 50, 53, 76, 287, 316
- magnon, 31, 42, 46, 59, 73
- matching of matrix element (MME), 177, 187
- matrix Dyson equation, 169
- matrix Green function, 167
- MC step (MCS), 314, 315, 319
- Mermin-Wagner theorem, 53, 265, 296
- meromorphic function, 99, 103, 109
- modulated, 326, 327, 329, 337, 338
- Monte Carlo (MC), 296, 297, 306, 307, 314, 316, 319, 322, 326, 337
- multilayers, 241, 242, 249, 250
- nearest neighbour (NN), 6, 9, 13, 14, 16, 19, 23, 32–34, 36–38, 44, 51, 136, 150, 159, 188, 197, 204, 208, 227, 242, 243, 263, 287, 296, 297, 307, 310, 311, 334, 337
- next-nearest-neighbour (NNN), 9, 158, 188, 219, 227, 311
- non-collinear, 36, 188, 215, 218, 220, 221, 226, 235, 238
- normal modes, 31, 249, 252–256, 260
- normal ordering (NO), 40, 62, 160, 162, 177
- order by quantum disorder, 207
- order by thermal disorder, 208, 214, 297
- order parameter, 48, 201, 238, 301, 302, 304, 316, 318, 320–322, 326, 327, 329, 331
- overlap integral, 2
- paramagnetic, 316, 322, 325, 329, 333, 336–338
- periodic boundary conditions (PBC), 9, 11, 19, 20, 33, 242, 252, 316, 317
- perturbation expansion, 59, 72, 92, 159, 167, 176, 180, 183, 187, 302
- phase diagram, 218, 224, 225, 228, 337
- planar ferromagnet, 159, 167, 169, 170, 192
- planar rotator, 265, 289, 296, 297, 300, 307
- polylogarithm function, 85, 88
- principal value (P), 30, 61, 116, 119, 124, 125
- proper self-energy, 72, 105, 106, 169, 170, 180–183, 186, 303
- quantum fluctuations, 197, 206, 207, 216, 217, 223, 238
- quartet, 7
- quasi-elastic neutron scattering (QENS), 239
- quintuplet, 10
- raising, 12, 40, 56, 189, 284, 286
- random phase approximation (RPA), 241, 246
- rare earth, 34, 36, 264
- reducible self-energy, 70, 105, 106, 180
- renormalization, 70, 73, 78, 80, 88, 118, 129, 235, 246
- residue theorem, 99, 103, 109
- retarded Green function, 59–61, 70, 241
- rhombohedral (R), 203, 208, 210, 213, 239, 240
- Riemann function, 47, 183
- ring, 14, 19, 23, 24, 30, 31
- second-order, 65, 67, 69, 70, 73, 76, 77, 79, 80, 90, 100, 102, 118, 120, 130, 180, 186, 302
- self-energy, 65, 68, 70, 74, 76–80, 90, 98, 100, 102–105, 113, 120, 124, 171, 174, 175
- semi-infinite, 261–263
- short range, 288, 296, 297, 315, 316
- simple cubic (SC), 16, 35, 45, 46, 49, 50, 52, 74, 75, 77–79, 89, 107, 114, 122, 143, 148, 157, 177, 197, 199–201, 243, 260, 263, 270

- single-ion anisotropy, 34, 149, 154, 155, 158, 160
- single-ion bound state, 150
- singlet, 4, 6, 11, 37
- snapshots, 315, 320, 322, 325–327, 330
- soft line, 206, 239
- soft mode, 160, 162, 183, 196, 239, 258, 260, 306
- specific heat, 289, 315, 318–322, 326, 327, 329, 331, 336–338
- spectral intensity, 60, 61
- spherical harmonics, 279–281
- spin reduction, 197, 201
- spin wave, 12, 14, 31, 33, 34, 42, 59, 129, 154, 158, 159, 162, 205, 233, 238, 239, 242, 252, 256–263, 289, 290, 292, 295, 301, 305, 306
- spiral, 36, 188, 196
- spontaneous magnetization, 75
- square (SQ), 16, 35, 136, 143, 197–199, 201, 202, 214, 217, 218, 227, 296, 298, 300, 308, 311, 313, 334
- staggered magnetization, 316, 318–320
- step-function, 59, 60, 64, 126
- Stevens' operator equivalents, 281, 282
- stripe, 297, 308, 310–314, 316–318, 321, 322, 326, 327, 329, 330, 337
- structure factor, 55, 73, 238, 314, 316, 320, 322, 325, 326
- sublattice magnetization, 201, 316
- surface magnon, 262, 263
- susceptibility, 48, 49
- temperature Green function, 91, 92, 94, 95, 100, 105, 167, 168, 170
- tetragonal (T), 51, 198, 217, 274, 275, 288
- tetragonal phase, 316, 322, 324–327, 331, 337
- thermodynamic limit, 19, 22, 25, 30, 135
- third nearest neighbor (TNN), 188, 219, 227
- third-order, 105, 120
- time evolution, 57, 60, 64, 67, 91, 92
- T-matrix, 112–114, 116–118, 124, 129
- torque equation, 32, 249
- transition metal, 33, 196
- transition temperature, 315, 316, 318, 338
- triangular (TR), 143, 157, 203, 219, 224, 227
- trilayer, 247, 252, 253
- triplet, 4, 6, 10, 11
- two-magnon band, 18, 24, 26, 29, 133, 134, 137, 138, 140–144, 154, 158
- two-magnon bound state, 18, 25, 131, 133
- two-spin deviations, 14, 19, 131, 153–155, 157
- two-spin wave band, 16, 117, 133
- two-spin wave bound states, 132
- ultrathin films, 297, 307
- variational theorem, 75
- Watson's integral, 177
- Wick's theorem, 93, 95, 100, 106, 168
- zero-order, 63, 94, 95, 195
- zero-point, 199, 201, 206, 235
- zone boundary (ZB), 26, 90, 133, 135
- zone corner (ZC), 34, 128, 129, 137, 144, 149, 150, 157, 158