

Index

A

- Activation energy
 - in double exchange, 119, 121, 124, 389, 410, 412
 - hopping electron, 125, 389, 400, 405, 409, 421
 - from polaron trap, 396
- Anderson, E.E., 161, 312
- Anderson, P.W., 116, 118, 127
- Angular momentum, L , S , J , 9–11, 25, 37, 42, 50, 52, 55, 63, 64, 71, 88, 187, 188, 222, 224, 289, 356, 358, 362, 371
- Anion-cation, 24, 107, 113, 122, 127, 137, 193, 438
- Anisotropy
 - crystal-field, 201, 202, 204, 205, 207–213, 216, 220–222, 224–227, 237, 240, 241, 244
 - magnetocrystalline, 7, 37, 52, 133, 174, 176, 201, 204, 226, 228–250, 254, 274, 294, 309, 406–407, 410
 - shape, 201, 249, 251, 252, 258, 259, 265, 293, 295, 298, 309
- Approach to saturation, 234, 256–257, 299
- Aufbau occupancy diagrams
 - high and low-spin states, 75–79, 89, 108, 217
 - J-T and S-O stabilized, 84–86, 217, 219, 221
 - octahedral site, 97, 98, 109, 123, 129, 217
 - tetrahedral site, 97, 129

B

- Ballhausen, C.J., 64, 69, 91, 113, 243, 263, 264
- Bardeen, J., 418

- BCS ensemble wavefunction, 418, 419, 444, 445, 447
- $\text{Bi}^{3+} - \text{Fe}^{3+} \text{M}-\text{O}$ hybrid excited state, 371–375
- Bismuth Faraday anomaly, 376
- Bi-YIG anomalous Faraday effect, spectral model, 365–367
- Bleaney, B., 215, 225
- Bloch–Bloembergen, 7, 19, 28, 252, 295, 297, 334, 356, 385, 416
- Boltzmann statistics, 11, 237
- Bozorth, M., 5, 229, 256
- Brillouin theory
 - curve shapes, 17, 18, 445
 - function, 13, 15, 19, 130, 131, 133, 155, 156, 165, 196–197, 202, 215, 238, 265, 289, 302, 411, 442
- Button, K.J., 23, 24, 137, 192, 329, 334, 351

C

- Canting
 - iron sublattice, 185, 190, 193, 195, 197, 221, 237–239, 246, 249, 256, 265, 302, 303, 305, 345, 365, 369, 377, 379, 386, 398, 401, 421, 433, 437, 438
 - rare-earth garnet effect, 184–189
- Charge carriers, 142, 386, 396, 417, 422
- Charge transfer probability, 386–389, 392, 393, 397–399, 403, 405, 409, 411, 413, 418, 420, 422, 426
- Chemical bonding
 - covalent, 23, 42, 88–101, 103, 107, 109, 113, 121, 122, 124, 129, 134, 168, 174, 222, 228, 344, 388, 392, 402, 419, 424, 431, 440, 455
 - ionic, 40, 49, 73, 90, 92, 99, 103, 112, 387
 - metallic, 88, 107, 408
- Chikazumi, S., 229, 236

- Co²⁺ exchange isolation
 in LiTiferrite, 176, 307
 in YIG, 176, 179
 Coherence length, 416–418, 424, 445,
 450–452, 454
 Colossal magnetoresistance (CMR), 386,
 401–403, 405, 407, 409
 Concentration threshold $x_s > x_r$, 428
 Condensation, 86, 171, 411, 419, 420, 439,
 440, 442–443, 447–451, 453, 456
 Conductivity
 normal vs super, 386
 Cooper, L.N., 418
 Correlation exchange, 121
 Covalent electron transfer, 94, 122
 Covalent electron transfer theory (CET), 413,
 437, 444, 445, 447, 449–452, 454
 Critical current density, 447–450
 Critical magnetic field, 439, 445–447, 450,
 452, 453
 Critical rf field, 311, 337
 Cross transfers, 365
 Crystal, 37, 40, 43–45, 48–73, 75, 76, 80, 82,
 83, 86–92, 97–99, 101, 107–109,
 113–115, 118, 121, 129, 130, 132,
 134–136, 138, 141–143, 147, 152,
 169, 175, 177, 182, 183, 185–192,
 201, 202, 204, 205, 207–213, 216,
 220–222, 224–228, 231–234, 236,
 237, 240, 241, 244, 254–256, 258,
 261–265, 267, 268, 273, 274, 284,
 286, 287, 289–292, 295, 304, 306,
 307, 319, 325, 360, 372–374, 385,
 386, 388, 396, 397, 402, 404, 412,
 420, 431, 432, 438
 Crystal sites, 360
 Crystal systems, 44–45

D
 Degenerate orbital states, 49, 80
 Delocalization, 24, 94, 114, 120–124, 126,
 379, 380, 398, 402, 413, 430, 438
 Demagnetizing factor, 5, 308
 Demagnetizing field, 5, 6, 234, 257–259, 273,
 292, 312, 313, 315, 317, 318, 345,
 411
 D_{4h} vs. C_{3v} distortions, 420
 Dillon, F., 317, 360, 381, 382
 Domain wall resonance, 273, 319, 338

E
 Effective linewidth in polycrystals, 299
 Elastic constants, 81, 232, 233

 Electric-dipole transition, 357, 358, 360, 361
 Electron correlation energy, 123
 Energy level diagrams, 69, 97, 226, 261, 289,
 348, 357, 375
 Exchange
 double, 119, 121, 124, 389, 410, 412
 energy, 19, 24, 113, 116, 118, 122, 143,
 161, 162, 168, 186, 196–197, 216,
 235, 237, 243, 252, 265, 302, 304,
 320, 339, 346, 347, 350, 365, 388,
 389, 394, 405, 419–420
 integral, 21, 25, 92, 113, 119, 226, 375,
 390, 394, 399, 424, 436
 resonance, 29, 264, 344–351, 355
 semicovalent, 122, 123
 super, 23, 24, 107, 109, 111, 113, 115–117,
 119–122, 126, 127, 129–131, 133,
 134, 136, 139, 140, 142–144, 146,
 152, 161–168, 173, 183, 193, 201,
 222, 366, 371, 372, 375, 376, 378,
 379, 385, 397–399, 401, 402, 410,
 430
 trap, 124, 421, 438, 439
 Exchange resonance, 344–351
 Extinction coefficient k , 355, 361, 381

F
 Faraday, 42, 70, 193, 305, 318, 330, 332–333,
 343, 353–355, 366, 367, 369,
 374–376, 379–381, 413, 414
 Faraday rotation, 42, 70, 193, 305, 318, 330,
 332–333, 343, 353–355, 366,
 374–376, 379–381
 Ferrites
 garnets, 155, 156, 158–161, 165, 167–170,
 175–185, 189, 190, 192–194, 197,
 202, 220, 238–240, 245, 246, 249,
 250, 294, 298–300, 302, 307, 343,
 360–366, 372, 373, 379, 380
 hexagonals, 48, 153, 169, 190–193, 240,
 260, 295, 322, 323
 spinel, 46, 77, 153, 167–169, 175, 176,
 178, 179, 216, 224, 240, 244, 249,
 257, 305, 307
 Ferromagnetic limit, in CMR manganites, 401,
 402

G
 Geller, S., 159–161, 166, 175, 177, 178,
 183–185
 Giant molecule concept, London's $\nabla n_s = 0$
 condition, 419

Gilbert, 297, 334, 335
 Gilleo, A., 158, 160, 161, 175–178
 Ginzburg–Landau theory, 416, 417, 419, 450
 Goodenough, J.B., 119, 124–129, 141, 144,
 243, 386, 397, 399, 402, 403, 409
 Goodenough–Kanamori (G–K) rules,
 125–129
 Griffith, J.S., 202, 222, 291
 Group theory, 57, 64–68, 70, 71, 79, 204

H

High-magnetization limits, 195–196
 High-temperature superconductivity (HTS), 1,
 386, 407, 409, 413, 423, 426, 438
 Hole carrier, 386, 429
 Holstein polaron theory, 394–396
 Hopping electrons, 170, 176, 179, 386, 394,
 395, 397
 Hund's rule, 24, 40, 42, 49–51, 53, 55, 59, 68,
 72, 75, 89, 91, 92, 98, 107, 109,
 119–123, 129, 130, 143, 211, 213,
 291, 385, 389, 397, 398, 402,
 403, 420
 Hysteresis loop parameters, 251

I

Initial permeability, 192, 251–253, 319
 Integral
 exchange, 21, 25, 119, 390, 394, 424,
 436
 overlap, 22, 55, 88, 90–92, 95, 96, 104,
 110–114, 119, 126, 135, 138, 147,
 305, 321, 354, 371, 374, 375, 379,
 394, 410, 412, 426
 transfer, 92, 95, 107, 109, 115, 119, 124,
 173, 365, 371, 429, 452
 Intersublattice exchange, 163, 345
 Intersublattice optical transitions, 376–380
 Intracublattice exchange, 159, 163
 Ionization potential, 75, 92, 99, 379, 387
 Ising approximation, 24–25, 118, 347
 Itinerance, 24

J

Jahn-Teller effect
 static vs. vibronic, 80, 81, 403, 404, 412
 vs. S-O stabilization, 84–86, 219–221
 Jonker, G.H., 145, 192, 402, 403, 409
 J-T vs. S-O stabilization in exchange field,
 219, 265

K

Kerr, 343, 361–363, 366, 367, 381, 382
 Kittel, C., 33, 99, 121, 157, 233, 323, 453

L

Landau–Lifshitz, 297, 334
 Landé *g*-factor, 173, 204
 Langevin theory, 12–15, 18, 202, 289
 Laporte's rule, 358, 376, 380
 Large-polaron radius, 424, 428, 452
 Larmor precession, 26–27, 327, 330, 356
 Lattice energy, 73, 90, 339, 373, 407
 Lax, B., 23, 24, 137, 192, 329, 334, 351
 Linear combination of atomic orbitals (LCAO)
 model, 89, 90, 94
 Line broadening, homogeneous vs.
 inhomogeneous, 33, 297, 298
 Local vs. collective properties
 electronic, 1, 49, 89, 288
 magnetic, 1, 3, 37, 39, 40, 42, 43, 47, 49,
 50, 55, 64, 70, 71, 73, 89, 96, 101,
 107, 113, 139, 151, 156, 168, 180,
 191, 201, 202, 210, 288, 380, 414
 magnetoelastic, 43, 70, 80, 82, 84, 87, 142,
 174, 176, 179, 201–269
 London equations, 413–416, 424
 London, F., 20
 Lorentzian and Gaussian shapes, 33, 297, 313,
 360, 363, 380
 Low-field magnetic loss, 322
 Low-spin states, 55, 73, 75–79, 89, 108, 305,
 420, 423, 438
 Low, W., 64, 211, 225, 226

M

Magnetic dilution
 in ferrites, 157, 161, 168, 171, 306, 412
 in low concentrations, 306
 with magnetoelastic percolation, 307,
 410–412
 Magnetic exchange trap, 438, 439
 Magnetic sublattices, 121, 131, 151,
 156, 303
 Magnetism
 Antiferro, 4, 8, 15–16, 19, 21, 22, 109,
 113, 116, 117, 119, 123, 126,
 129–140, 143–145, 151–154,
 398–403
 Dia, 8–11, 15, 26, 422, 428, 456
 Ferri, 4, 8, 34, 129, 131, 151–197,
 273, 346

Magnetism (*cont.*)

- Ferro, 4, 8, 15–16, 21, 22, 24, 102, 108, 109, 116, 119–126, 129, 131, 140, 144, 146, 149, 151, 152, 385, 399, 401–404, 413, 420, 438
- para, 8–11, 15, 16, 108, 137, 202–212, 219, 220, 275, 289, 292, 348, 380, 399, 412
- Magnetoelastic condensation
 - in octahedral sites, 77, 80, 84, 87
 - in tetrahedral sites, 77, 82, 175, 176, 213
- Magnetoelastic constant, 232
- Magnetoelastic percolation, 307, 425, 428, 440
- Magneto-optical transitions
 - charge transfers, 378
 - diamagnetic, 358, 359
 - paramagnetic, 358, 359
- Magneto-resistance, 19, 25, 144, 386, 401–402, 406, 408, 438, 439
- Magnetostatic waves, 307, 317
- Magnetostriction Local-site distortion model, 246
- Magnons, 307, 309, 315, 379. *See* Spin waves
- Meissner effect, 414, 438, 445, 456
- Metal-insulator transition, 401, 402, 408, 438
- Metallic oxides
 - perovskites, 397, 399, 401
 - simple, 397, 400
- Microwave signal damping
 - Bloch–Bloembergen, 295, 297, 334, 356
 - Gilbert, 297, 334
 - Landau–Lifshitz, 334
- Molecular
 - bonding, 75, 115, 344, 351
 - field, 19–24, 131–134, 153–156, 164–165, 193–196
 - orbitals, 89, 114, 115
- Molecular-field coefficient, 25, 130, 131, 164–166, 168, 170, 171, 174, 180, 183, 184, 196, 197, 265, 302, 345, 406, 407
- Molecular-orbital model
 - bonding/antibonding orbitals, 102, 103, 379
 - for H_2^+ ion, 97, 124, 171, 365, 371, 398
 - normalization issues, 95, 103, 262
 - one-electron approximation, 76, 213
- Morish, A.H., 133, 154, 229
- N**
- Na^+Cl^- ionic molecule, 99, 104
- n-type superconductivity, 436, 437

O

- Occupation probability, 12, 347
- O_h to D_{3d} symmetry, 47, 67
- O_h to D_{4h} symmetry, 64, 66, 143, 431
- Operator equivalents, 63, 64, 71, 211, 212, 226, 227
- Orbit, 9, 26, 37, 50, 79–82, 215, 219, 222, 226, 361, 371
- Orbital shell, 10, 38, 50, 104
- Orgel, E., 68, 69, 265–267
- Oscillator strength, 357

P

- Pauli principle indistinguishability, 19–20, 80, 114, 345
- Penetration depth, 414, 443–445, 448
- Percolation threshold, 425, 428, 440
- Periodic table, 1, 38–40, 99, 101, 151
- Permittivity tensor, 343, 352–353, 366, 376
- Perovskites, 1, 46, 48, 77, 129, 131, 135, 136, 140–142, 146, 175, 226, 387, 399, 401, 407, 420, 430, 433, 437, 443, 451, 453
- Perturbation hierarchy, 54–55, 210
- Phonons, 81, 274, 280–287, 289, 300, 301, 304, 307, 309, 355, 439, 441, 442
- Pippard theory, 416, 417, 450–452
- Point-charge model, 49, 89, 97, 211, 227, 263, 431
- Polarization
 - circular, 27, 30, 31, 299, 312, 317, 327–333, 335, 336, 344, 346, 353, 355, 356, 358, 361, 362, 381
 - linear, 27, 30, 31, 329, 330, 332–333, 343, 353
 - rotation, 193, 371
- Polarons
 - range, 389, 395, 411, 422
 - small vs. large, 388–392
- Propagation constant, 329, 352, 353, 355
- Pryce, M.H.L., 61, 68, 209, 219

R

- Rare-earth impurities in YIG
 - loss from Mn^{3+} ions, 174
 - low-temperature loss, 174
- Rare-earth ions ($4f^n$), 43, 62, 71–73, 121, 177, 180–185, 187, 188, 197, 202, 203, 227, 228, 241, 249, 302, 303, 306, 380, 422
- Refractive index n , 355, 361, 381

Relaxation

- direct process, 284
 - longitudinal, 28, 34, 274–278, 287, 296, 319
 - Orbach process, 282, 284–286, 291, 303
 - Raman process, 281–285, 287, 291, 303, 309
 - spin–lattice, 28–30, 32, 34, 78, 87, 88, 173, 215, 219, 241, 244, 246, 274, 275, 278–287, 291, 295, 299–301, 305, 318, 319, 326, 385
 - spin–spin, 274, 291
 - transverse, 34
- Relaxation time
- temperature dependence, 274, 278, 282, 300
- Remanence ratio, 233, 234, 254–257
- Remanent magnetization, 254
- Resonance
- antiferromagnetic (AFMR), 288, 351
 - domain wall, 273, 318–320, 338
 - exchange, 29, 264, 344–351, 355
 - ferromagnetic (FMR), 31, 231, 240, 267, 281, 292–295, 300, 318, 343, 348, 370
 - line broadening, 30, 33, 297–300
 - line shape, 33, 328, 356, 385
 - paramagnetic (EPR), 27, 33, 80, 99, 204, 207, 209, 215, 224, 261, 288–292, 295, 332, 343, 431
- rf peak-power threshold, 311, 315
- RKKY exchange mechanism, 121
- Rutile lattice, 135, 137, 138

S

- Schloemann, E., 298, 299
- Schrieffer, J.R., 418
- Selection rules
- electric-dipole, 13, 288, 292, 343, 344, 354–360, 376, 377, 379, 380
 - magnetic-dipole, 288, 343, 348, 352, 355, 357, 376, 379, 380
- Semicovalent, 121–123, 126, 413
- Single ion anisotropy, 205, 228, 236, 240, 242
- Slater, J.C., 69, 70, 73, 124, 127, 222
- Smit, J., 169, 191, 192, 229, 333
- Snoek's law, 324–327
- Spherical harmonics, 52, 53, 56, 61, 62, 64, 70
- Spin dynamics, 80, 216, 274, 397, 412, 419, 440
- Spin-echo in EPR
- spin decoherence time (τ_2), 291, 296
 - spin relaxation time (τ_1), 290, 291

Spin-flip, 30, 122, 123, 189, 287, 357

Spin Hamiltonian

- D and E parameters, 210, 221, 290
- for d^1 ion, 207
- for d^3 ion, 221
- for d^5 ion, 224

Spin orbit coupling

- and S-O stabilization, 83, 215
- and spin-lattice relaxation, 78, 219, 241, 244, 286, 306

Spin-order frustration, 161

Spin waves, 19, 29, 307–311, 313–315, 317, 385

Stevens, K.W.H., 63, 211, 212, 216, 225, 226, 228

Subsidiary absorption at high power, 315–317

Sugano, S., 78, 79, 222, 266, 267, 373

Suhl, H., 312, 314–317, 337

Superconductor condensation energy, 439, 440, 442, 448–451, 453, 456

Superexchange

- correlation, 121, 410
- delocalization, 121, 124, 126, 379, 380, 398, 402, 413, 430, 438
- virtual vs. real, 116, 379

Susceptibility tensor, 297, 327, 328

Symmetry

- cation sites, 46, 47
- lattice, 25, 40, 45, 47, 80, 87, 137, 138, 175, 188, 190, 204, 214, 215, 228, 231, 232, 235, 251, 290, 291, 319, 322, 377, 385, 396, 404, 440

T

Tanabe, Y., 78, 79, 222, 266, 267, 373

Temperature

- critical, 417, 421, 422, 426–430, 432, 434, 436–439, 441, 444, 445, 450–455
- Curie, 15–18, 22, 25, 128, 129, 134, 144, 145, 147–149, 154, 155, 158, 161, 170, 171, 173, 174, 178, 183, 192, 193, 215, 236, 252, 296, 305, 320, 347, 350, 375, 376, 380, 389, 394, 397, 401–403, 405–408, 410, 412, 439
- Debye, 283, 303, 394, 395, 407, 410, 412, 426
- Néel, 22, 128, 131, 132, 135–141, 146, 148, 149, 193, 215, 397, 421

Tensor

- combined $[\varepsilon] \cdot [\mu]$, 352–355
- permeability, 3, 328, 333–336, 352

- Tensor (*cont.*)
 permittivity, 352, 366, 376
 susceptibility, 297, 327, 328
- The $\Delta S = 0$ transition rule, 376–380
- Thermomagnetism, 156, 171, 173, 177, 178,
 180, 182, 184, 196, 406, 410, 412
- Thermomagnetism of dilute magnetic oxides,
 410, 412
- The T_N , $T_c = 0$ condition, 421, 422, 428
- Ti³⁺ in alums
 Cs alum, 207
 Rb alum, 206, 207, 209, 210, 215, 261,
 285, 287, 289, 290
 spin-lattice relaxation, 285–287
- Tinkham, M., 351, 453
- Transition-metal ions ($3d^n$), 22, 24, 39–43,
 53–55, 59, 62, 63, 73, 76, 78, 84,
 87, 89, 109, 126, 127, 139, 141,
 167, 174, 182, 183, 187, 193, 202,
 204, 209–211, 222, 228, 241, 242,
 274, 289, 291, 305, 306, 350, 386,
 396, 400, 413, 422, 423
- Transition probability, 378
- Transport
 polaronic, 94, 99, 125, 409, 413, 432
 spin, 99, 115, 116, 121–125, 143, 302,
 385–456
- Trigonal bipyramid site, in M-type Ba ferrite,
 191, 225, 240
- Two-fluid model, 426
- Type-II superconductors, 418, 450–455
- V**
- Valence-bond model Heitler–London H₂
 molecule, 20, 99, 103–105, 107
- Van Santen, J.H., 145, 192, 402, 403, 409
- Van Vleck, J.H., 55, 63, 188, 202, 203, 234,
 265, 286, 287
- W**
- Wijn, H.P.J., 169, 191, 192, 229
- Wittekoek, S., 361, 367, 368
- Wolf, W.P., 187, 188, 236
- Wolfsberg–Helmholtz approximation, 109
- Z**
- Zeeman effect
 and Boltzmann statistics, 289, 348
 and Kramers doublets, 205, 206, 208, 225,
 262, 284, 289, 348, 349
- Zero-spin polarons, 419–423
 and carrier statistics, 418–419