

Index

a

- AC cables 605
- accelerator magnets 114ff, 330ff, 368, 419ff, 448ff, 571, 616, 622, 684, 1238f
- accelerator magnets of colliders
 - fast-cycled synchrotrons 481ff
 - functions and type 448ff
 - magnetic design 455ff
 - magnet training 472ff
 - margins and stability 471f
 - mechanical design 467ff
 - protection 475ff
- accelerator ring 1238
- AC Josephson effect 70, 146, 809, 883, 933f
- AC levitation 586ff
- AC losses 635, 672, 1240
 - analytical computation 98f
 - calorimetric method 95, 97f, 576
 - hysteresis losses 93, 99, 442, 576, 611
 - multi-filamentary superconductors 93
 - transport current and external magnetic fields 93, 98
- AC rotating machines
 - homopolar machines 675
 - induction machines 675
 - refrigeration system 677
 - synchronous machines 675ff
- active shielding 525f, 533f, 667, 999
- additional positive feedback (APF) 955
- adiabatic demagnetization 855, 925
- adiabatic quantum flux parametron (AQFP) 1121ff
- advanced light source (ALS) 925
- air-core rotor 677, 679
- air-core stator 677, 679
- air-gap length 677
- aluminium 604

- Ambegaokar Baratoff relation (Josephson junctions) 70
- American Superconductor Corporation (AMSC) 47, 334ff, 355ff, 540, 569ff, 606f, 633ff, 683ff
- AmpaCity project 610, 612, 718
- analog readout 940ff
- analog-to-digital converters (ADCs)
 - cooling 1127
 - HTS technology 1131
 - Josephson junctions 1130
 - LTS technology 1131
 - Nyquist rate converters 1126ff
 - oversampling converters 1127, 1129
 - pulse counting and decimation 1130
 - samplers 1125f
 - SNR 1127
- ancilla qubits 1180
- Anderson–Kim model 239
- Andreev reflection 50, 55, 73
- anisotropic superconductor 667
- antenna 724, 728ff
- antiferromagnets (AF) 28ff, 62, 158, 229
- arithmetic logic unit (ALU) 1112, 1141ff
- armature resistance 683
- array readout principle 942
- artificial defects 80
- astroparticle physics 844
- astrophysics 498, 851, 855, 861, 868, 873, 1089, 1241
- A15 structure 42, 81, 105
- Atacama Cosmology Telescope (ACT) 876
- ATLAS detector magnets 491ff
- atomic force microscopy (AFM) images 73, 272, 358f
- axial noise field
 - partitioned superconducting tubes 789ff
 - semi-infinite highly permeable tube 788f

- axial noise field (*contd.*)
 – semi-infinite superconducting tubes 785ff
 axions 498, 855, 857, 974, 1088ff
- b**
 backscattering processes 54
 back-up power capacity 664
 balance/common mode rejection ratio (CMRR) 1024f
 band gap 850, 906, 1183ff
 bandpass filter 726
 Bardeen–Cooper–Schrieffer (BCS) theory 27, 49, 102, 131, 182, 1234
 Bean London model 430
 Bean's critical state model 795
 Beta-pyrochlore oxide superconductors 34
 Bi-2212 *see* $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$
 bias current 298, 809ff, 831, 867ff, 902ff, 934, 940f, 950, 954, 1089, 1113ff, 1126
 bicrystal junctions 249f, 306ff
 biomagnetic fields 773, 780, 992ff, 1008
 biomagnetic measurement technique 992
 biomagnetism
 – babySQUID register 1008
 – dewar/cryostat 999f
 – Fetal MCG/MEG-SARA 1005ff
 – gradiometers 995
 – helmet system 1001ff
 – high- T_c SQUIDs 1012
 – liver iron susceptometry 1010f
 – magnetic field imaging 1000, 1003ff
 – magnetic marker monitoring 1011f
 – magnetorelaxometry 1011f
 – micro-SQUID systems 1008ff
 – NMR signals 1012
 – shielding 997ff
 Biot–Savart law 765
 $(\text{Bi},\text{Pb})_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_x$ (Bi-2223) tapes 30, 152, 193, 336ff
 $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ (BSCCO) 4, 154, 174, 176, 250, 308ff, 345ff, 355, 641, 649ff, 792ff, 934, 1105, 1213ff
 $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_x$ (Bi-2212) round wire 174, 330ff
 blackbody radiation 843
 Bloch oscillations 829, 831ff, 837f
 Bloch vector 1165
 Bohr magnetons 1047, 1056
 boil-off method 95f
 borides 28ff, 137, 140
 boron carbides 28ff, 138, 341
 box heat exchanger design 624f
 bremsstrahlung energy losses 845
 Bronze route (BR) 111, 119ff
 BSCCO-2223 pancake coils 574f
 BSCCO-2223 wire 576
 bubble chamber 368, 487, 512, 844ff
 Buck's cryotron 1241
 buffered chemical polishing (BCP) 745ff, 749f, 755f
 bulk $(\text{Nd}_{0.33}\text{Eu}_{0.33}\text{Gd}_{0.33})$ -123 compounds 236
 bulk high- T_c superconductors (HTS) 195, 231f, 403, 592
 bulk high-temperature superconductor (HTS) and levitation
 – double image dipole model 405f
 – high-speed loss 410f
 – hysteresis loss 408ff
 – magnetomechanical stiffness 405ff
 – practical bearing considerations 412ff
 – rotor dynamic issue 411f
 bulk resonators 725
 bulk YBCO superconductors
 – flux creep 238ff
 – mechanical properties 241f
 – thermodynamic and thermal properties 242ff
 bypass switches (BPS) 561
- c**
 cable in conduit conductors (CICC) 119ff, 374, 380, 425, 438, 498, 548ff, 1239
 calibration-free method 97f
 call controlled overpressure (CT-OP) 337
 calorimeters
 – cryogenic calorimeter 851, 853ff
 – electromagnetic calorimeter 845, 851
 – hadronic calorimeters 851
 calorimetric method 95, 97f, 576
 Can Superconductor tubes (CSTs) 803
 Can Superconductor vessels (CSV) 803
 Canted Cosine Theta (CCT) 466f
 carbides 40f
 Carnot refrigeration power 626f
 carry-look ahead (CLA) adder 1139
 carry-save serial adder (CSSA) 1138f, 1147
 cascaded integrator comb (CIC) 1156f
 Cavern hydroelectric power stations 613
 centrifugal barrel polishing (CBP) 745ff
 charge coupled devices (CCDs) 919, 940
 charge noise 835, 838, 1167, 1180
 charge qubits 297, 1163, 1167, 1170ff, 1177, 1180, 1241
 charging effects 73f, 830
 chemical mechanical planarization (CMP) 293f

- chemical solution deposition (CSD)
 techniques 83, 256, 268f, 368
- Cherenkov radiation 845, 850
- circuit breaker (CB) 443f, 561f, 634, 637,
 648, 694ff
- circuit quantum electrodynamics (cQED)
 1070, 1090f, 1164, 1172, 1180
- cloud chamber 844ff
- CMS detector magnet 489, 493ff
- coated conductors (CC) 76ff, 91, 94, 145f,
 166ff, 247ff, 356ff, 650ff, 669, 683, 771, 1236
- coating techniques 143, 145f
- Cobaltates 28, 34
- code-division multiplexing (CDM) 943, 946
- cold isostatic pressing (CIP) 199, 204, 331,
 333
- cold mass support system 509ff
- cold seeding method 201
- common mode rejection ratio (CMRR)
 1024, 1027, 1037
- compressed air energy storage (CAES) 664
- Compton scattering 846
- conduction cooled lead 517, 570, 620ff, 626ff
 – Carnot refrigeration power 626f
 – optimal shape factor for 620
 – optimized heat loads 619f
 – temperature profiles for 622f
 – thermal conductivity and electrical
 resistivity 620f
- conductor cross section 424, 457, 495, 526,
 604, 682, 1237
- conductor fabrication 105, 116ff, 143, 329,
 551, 563
- conformal mapping method 783f
- continuous transposed cable (CTC) 635f,
 652ff, 658
- continuous tube forming and filling (CTFF)
 process 341
- continuous wave (CW) 734, 739, 752, 754ff,
 931, 933
- conventional decoupling techniques 771
- conventional modulation scheme 955
- cooling capability 687
- Cooper pairs 4ff, 54ff, 69f, 77ff, 105f, 134,
 159, 173ff, 281ff, 318, 740ff, 809, 828ff,
 907ff, 936, 943, 1163ff, 1236ff
- Cooper-pair tunneling 282, 833, 838, 840
- coplanar resonator 725, 1228
- coplanar stripline (CPS) 295, 812, 815
- copper armature winding 676
- copper Litz conductor 677
- copper windings 442, 655, 670, 674, 690
- coreless transformer 648f
- core pinning 78f, 85ff
- cosmic microwave background (CMB) 861,
 876f, 1203
- cosmology 843, 868, 1089
- co-wound tape 563f
- critical current density 16ff, 89, 101, 110ff,
 129ff, 166ff, 195ff, 232ff, 252ff, 284ff, 308,
 328f, 334, 346, 356f, 407, 424ff, 456ff, 502,
 567, 569, 795, 809, 907, 1123, 1131, 1139ff,
 1210
- critical currents 16ff, 60, 71, 87, 127, 138,
 153, 268f, 298, 340, 355f, 457, 813, 1129,
 1177
- critical-state model 407
- critical temperature (T_c of superconductor)
 3ff, 56f, 68, 106, 147, 152ff, 166ff, 193ff, 367f,
 406ff, 421ff, 487, 627, 638, 669, 711, 741ff,
 813, 836, 863ff, 968, 981, 1044ff, 1127, 1217f
- cross-type design 288
- cryocooler coldheads 685
- cryocooler compressors 677
- cryocoolers 652, 686, 688, 814
- cryogenic calorimeter 851, 853ff
- cryogenic cooling system 728
- cryogenic current comparator (CCC) 837f,
 1096ff
- cryogenic-receiver front end (CRFE) systems
 728
- cryogenics 148, 375, 383ff, 393ff, 526ff, 567,
 670, 736ff, 855, 959, 1034, 1241
- cryogenic temperature 366, 383, 412f, 524ff,
 548ff, 605ff, 632, 658, 677ff, 737, 764, 896,
 940ff, 1013, 1156
- Cryomech AL-330 coolers 686f
- cryostats 9, 210f, 368ff, 456, 488ff, 526ff,
 560, 570ff, 596f, 605ff, 632, 641, 647ff, 667,
 676ff, 752, 925, 937f, 941, 958, 979ff, 999ff,
 1020ff, 1075, 1103f, 1215
- crystalline defects 78f
- crystallographic structures 166, 251
- cuprate high-temperature superconductors
 (HTS) 28ff, 152ff, 1058
 – metallurgical aspects 153ff
 – structural aspects 152f
 – superconductive coupling 158ff
 – T_c optimization 156
- current leads 244, 338, 347, 363, 366ff, 392,
 422ff, 509ff, 558ff, 570, 616ff, 632, 635,
 647ff, 669, 686, 1157, 1239
- current limiting reactor (CLR) 641
- current source converter (CSC) 667f
- current–voltage characteristics 66ff, 101,
 162f, 262, 281, 882, 904, 1177, 1195, 1211ff
- CVD technologies 267f

d

- dark count rate (DCR) 915ff, 919, 927
 DC commutators 675
 DC Josephson effect 69, 809, 883
 DC resistance 1ff, 871, 873, 970
 DC SQUID *see* direct current SQUID (DC SQUID)
 decoder 1112, 1146, 1151
 decoherence 1166f, 1171, 1180
 delay lines 723f, 730, 1148, 1158, 1226, 1230
 demultiplexers 1130, 1143ff
 density of states/electron density of states 33, 58
 dephasing rate 1166
 depinning current 85
 detector readout
 – analog readout 940ff
 – digital event readout 940, 944f
 – resonant circuit readout 940, 943f
 diamond nitrogen defect microscopy 1042f
 Dicke model 1185
 diesel generators 664
 diffusion cooling time 864
 diffusion-like equation 100
 diffusion technique 144f
 digital circuits
 – arithmetic logic unit 1141ff
 – binary ripple counter 1146f
 – decoder 1146
 – demultiplexers and multiplexers 1143, 1145
 – multipliers 1147f
 – serial adders 1138f
 – SFQ design guiding principles 1136f
 – shift registers 1141ff
 digital data processors
 – bit-serial processor (Core1) 1150ff
 – digital channelizer 1157f
 – digital correlators and autocorrelators 1157ff
 – digital filters 1156f
 – parallel-serial processor (flux-1) 1152f
 – time-to-digital converters 1154ff
 digital decimation filter (DDF) 1156ff
 digital event readout 940, 944f
 digital superconducting quantum interference devices (digital SQUIDs)
 – Josephson junctions 247, 828, 1197f
 – RSFQ technique 248, 1196, 1199
 – superconducting transformer 1198
 digital to analog-converters (DACs) 813, 944, 1125
 dipoles 113, 339, 405ff, 419ff, 448ff, 496, 533, 590, 780ff, 850, 857, 934, 961, 992, 1021, 1043ff, 1089, 1164ff, 1238
 direct current injection 983
 direct current SQUID (DC SQUID) 186f, 296f, 318, 830ff, 868ff, 940f, 949f, 952ff, 968ff, 977ff, 1046, 1069ff, 1081ff, 1101ff, 1163ff, 1178ff, 1196ff, 1240
 distributed generation units (DGs) 694ff
 disturbance spectrum 471
 double image dipole model 405ff
 double pancakes (DP) 492, 539f, 548, 550, 563, 575
 double relaxation oscillation SQUID (DROS) 955
 drift chamber 844f, 847
 2D superconducting filters 726, 1227
 dual mode resonators 725

e

- Earnshaw's theorem 406f, 413, 584
 e-beam lithography 1188
 eco-climb 598
 eddy-current losses 677, 689
 eddy-current testing 977, 982ff
 E–J power law 795, 800
 electric motors 193, 387, 577, 592, 674, 1030
 electric power 347, 355, 363, 483, 524, 631, 660ff, 674, 1111, 1117, 1239
 electric power grid 631
 electric ships 674
 electric short-circuit fault 631
 electric utility grid 616
 electrodynamic forces 624
 electrodynamic levitation (EDL) 588ff, 593f, 596f
 electrolytic capacitor 663
 electromagnetic calorimeter 845, 851
 electromagnetic fields 98, 734ff, 762ff, 857, 865, 876, 889, 1184f, 1202, 1208
 electromagnetic force 208ff, 425ff, 468, 472, 586
 electromagnetic interference (EMI) 384, 610, 780, 958
 electromagnetic radiation 843, 850, 861, 1240
 electromagnetic resonator 1182
 electromagnetic (EM) shield 676, 687ff
 electromagnetic suspension (EMS) 585f, 593ff, 698
 electromagnetic waves 940, 1021, 1183f
 electron beam lithography 292f, 910, 1044f
 electron-doping 30, 157
 electron holography 1042f

- electronic circuits 281f, 725, 768, 771, 1176
 electronic gradiometers 774, 1023
 electronic mass anisotropy 88
 electronic paramagnetic resonance (EPR) 763, 974
 electron–phonon time 864
 electropolishing (EP) 357, 362, 739
 energy bands 53, 831, 850, 883, 885
 energy gap (of superconductors) 5ff, 67ff, 130, 173, 284, 296, 306, 741, 836, 873, 883, 904ff, 934ff, 1207ff
 Energy Recovery Linacs (ERLs) 739, 754
 energy relaxation 874, 904, 907, 1166f, 1180
 energy storage system
 – auxiliary services 660
 – bulk energy management 662
 – flywheels 670ff *see also* flywheel energy storage system (FESS)
 – frequency regulation 663
 – load imbalance 661
 – parameters of 660ff
 – power quality and UPS 663f
 – pulse power, leveling of 664
 – pumped hydro and CAES 664
 – SMES 664ff *see also* superconducting magnetic energy storage (SMES)
 – stability 662f
 epitaxial thin films 170, 1054
 etch-back planarization 294
 European X-ray FEL (XFEL) 740, 757
 evershed bearing design 584
 exciters 690
 extra-high voltage level (EHV) 603
- f**
 facility for rare isotope beams (FRIB) 579, 740, 757
 Faraday's law 583, 586, 1125
 fast safety discharge (FSD) 558ff, 564f
 fault current 194, 248, 328, 347, 355, 363, 383, 392, 612, 621, 628, 631ff, 645ff, 697
 fault torque 677, 687ff
 Fe based superconductors (FBS) 35f, 341ff
 – electronic applications 185ff
 – material preparation 169ff
 – superconducting properties 171ff
 – wires and tapes 180ff
 femtosecond (FS) laser 931, 934
 femtosecond optical pulses 934
 Fermi momentum 741
 ferromagnet 58ff, 88
 ferromagnetic metal 57ff
 ferromagnetism 33ff, 57ff, 1055
 field angle scaling law 88
 field current 677, 684, 690
 field effect devices
 – Josephson field effect transistors 1177f
 – Majorana fermions and topological qubits 1178ff
 – nanoSQUIDS 1178
 field mapping technique 211f, 531
 filamentary NbTi copper composite wire 435
 filamentization 112, 114
 filters 248, 383, 556, 686ff, 723ff, 747, 772, 820, 854, 910ff, 935, 944, 961, 980, 1069ff, 1130, 1156ff, 1165, 1172, 1200, 1226ff
 finite-element-analysis (FEA) 679
 finite element method (FEM)
 – AC losses 100
 – multiply-connected superconductors 793ff
 – planar/axial symmetry 791
 – Poisson's equation 791
 – screening current and inductance calculations 797f
 – simply-connected superconductors 791ff, 795
 – superconducting and μ -metal shielding 796f
 first-order gradiometers 772, 961, 996, 1001, 1007, 1009, 1022
 floating-point processing units (FPUs) 1153f
 flux buffer 1114
 flux jumps 112ff, 211, 243, 328, 373, 426ff, 471, 487f, 528, 950
 flux line distribution 681
 flux lines 8ff, 76ff, 93ff, 105ff, 177, 234ff, 329, 647, 681, 743, 784ff, 1234ff
 flux motion 77ff, 238, 240, 1236
 flux pinning
 – artificial pinning centers 78ff, 82f, 87
 – Bi-2223 81
 – core pinning 78f, 85ff
 – crystalline defects 78f
 – electronic mass anisotropy 88
 – flux lines 76ff, 84ff
 – flux motion and dissipation 76ff
 – magnetic pinning 79, 87f
 – MgB₂ 80f, 83
 – Nb–Ti 81, 83f
 – Nb₃Sn 81, 83f
 – pinning force, experimental determination of 83f
 – spatial inhomogeneities 78f
 – T_c pinning 78
 – YBCO 80ff, 87, 90
 flux plots 679

- flux quantization 6ff, 949f, 1055, 1070, 1132, 1168, 1240
 flux qubits 297, 1167, 1169f, 1180, 1188f, 1241
 flux transformer 772f, 996f, 1007, 1074, 1096ff, 1107, 1197
 flux vortex 1186, 1188, 1234
 flywheel energy storage system (FESS) 415, 660, 670f
 – components of 670f
 – PM/YBCO bearing 672
 – superconducting bearings 671f
 forbidden band 850
 forced two-phase helium cooling system 488, 512ff
 fossil energy 694
 free electron lasers (FELs) 450, 739, 757, 932
 frequency-domain multiplexing (FDM) 876, 941ff
 frequency tuners 736f
 fullerenes 28, 41f
 full tensor magnetic gradiometer (FTMG) 1027ff
 full-width half maximum (FWHM) 361, 845, 852, 854, 874, 877f, 913ff, 1126
 fundamental RF input power couplers (FPCs) 736f
 fuses 562, 631
 fusion magnet
 – DEMO 565ff
 – ITER magnet system 546 *see also* ITER magnet system
 – Nb₃Sn conductors 545
 – NbTi conductors 545
 – quench detection 557ff
 – quench protection 557ff
 – superconducting tokamak 546
 – toroidal field system 544
- g**
 gadolinium barium copper oxide (GdBCO) 205, 216, 219
 gaseous detectors 846ff, 852
 gaseous helium (GHe) 652, 688f
 gate turn-off (GTO) thyristors 562
 Geiger counters 847
 geometrical resonances 73
 Gifford–McMahon (G–M) cold heads 390, 677
 Ginzburg–Landau theory 14ff, 89, 234
 global disturbance effect 694
 global thermal instability (GTI) 755
 gradiometers 297, 322, 772
- grain boundaries (GB) 24ff, 80ff, 111, 133ff, 156ff, 166ff, 195ff, 243ff, 249ff, 306ff, 339ff, 345, 355, 744ff, 987, 1055, 1071, 1213ff, 1235ff
 gravimetry 1020, 1036f
- h**
 hadronic calorimeters 851
 Hairpin filter 726
 half-wave resonator (HWR) 735, 740
 heat exchangers 368ff, 384ff, 397, 420, 513ff, 554, 624ff, 688
 heat load 366ff, 393ff, 422, 482, 512, 553, 571ff, 616ff, 647ff, 669
 heavy-fermion (HF) superconductors 27, 36ff
 helium 605, 625, 677
 high energy physics (HEP) 123, 329, 338f, 368, 374, 448ff, 498, 628, 738, 757, 1108, 1238 *see also* accelerator magnets of colliders
 higher order mode (HOM) dampers 736f
 higher order multipole fields 454, 460, 479f
 high field Q-slope (HFQS) 747, 753, 755f
 high gradient magnetic separators (HGMS) 573ff
 high pressure water rinsing (HPR) 747
 high temperature superconducting (HTS) 31, 159, 251, 421, 491ff, 616ff
 high-temperature superconductor (HTS) 421, 592, 595, 934, 1233
 – accelerator and synchrotron magnets 573, 579f
 – ADCs 1131
 – AMSC 7 tesla conduction cooled magnet 569ff
 – antenna 730
 – crystal growth 32, 160, 222ff, 575f
 – first generation 356
 – induction heating 573, 576ff
 – magnetic separation 573ff
 – magnetic shields 803
 – samplers 1126
 – second generation 356, 363
 – Sumitomo 8-tesla conduction-cooled magnet 571f
 – transformers 638, 645ff
 high voltage (HV) 369, 551ff, 603ff, 634ff, 645ff, 664ff, 713ff, 819, 846f
 high voltage direct current (HVDC) grid 603, 713ff
 high voltage vacuum circuit breakers 634
 Hilbert-transform spectroscopic system 936

- hot electron bolometers (HEBs)
 - responsivity 868ff, 872
 - YBCO 874
 - hot isostatic pressing (HIP) 334, 340, 345
 - hot seeding technique 201, 219
 - Hot-spot model 906ff
 - HTS *see* high temperature superconducting (HTS)
 - HTS-cables
 - AC cables 605
 - advantages 605, 612, 614
 - aluminium bus bars 613
 - Cavern hydroelectric power stations 613
 - coaxial 3-phase MV-cable 609
 - cold dielectric cables 607
 - current leads 347, 616f
 - DC cables 605
 - economic benefits of 612ff
 - life-grid installations 605
 - low voltage 613f
 - medium voltage 605, 609ff
 - power transmission capacity 611
 - projects 605f, 616
 - single-phase cables 607ff
 - warm dielectric cables 607
 - HTS current leads
 - benefits 627
 - conduction cooled lead 517, 570, 627
 - see also* conduction cooled lead
 - cryogenic copper properties 618f
 - design operating current 574, 616, 621
 - heat load 422, 616, 627
 - objective 616
 - short duration overcurrent heating 623, 628
 - SMES 616
 - tape stacks 625f
 - temperature profiles for 622f
 - types of 616f
 - utility systems 616
 - vapor cooled current leads 623ff *see also* vapor cooled current leads
 - HTS rotating machines
 - AC machines 675
 - applications of 674ff, 683, 690
 - configurations of 675ff, 681
 - cooling systems 674, 685ff, 691
 - DC machines 675
 - design process 682
 - EM shield 676, 688ff
 - excitors 690
 - field plot 680
 - HTS wire 682ff, 691
 - magnetic field distribution 681
 - pole construction 684ff
 - rotary seal assembly 688
 - rotor and stator components 674, 676, 679, 681, 683, 690
 - rotor cryostat configuration 687f
 - stator windings 676f, 679, 682, 686, 690
 - wind turbine 674f, 679, 686, 690f
 - H-type microstrip antenna 729
 - hybrid physical–chemical vapour deposition 142, 145f, 148
 - hydrogen 139ff, 267, 331, 333, 367ff, 487ff, 567, 605, 670, 737ff, 930
 - hydrogen-related Q-disease 743
 - hysteresis losses 24, 93ff, 113, 408ff, 442, 576, 611
- i*
- IBAD *see* ion beam assisted deposition (IBAD)
 - $I_C R_N$ product (of Josephson junctions) 146, 185ff, 312ff
 - ideal conductor 4, 6, 339
 - ideal diamagnetism 3, 6ff, 14, 24, 1096
 - inductive fault current limiters
 - saturated iron core 636ff, 641
 - shielded iron core 632, 635f, 638, 640
 - inductors 631f, 634, 1115, 1118, 1120f, 1163, 1183
 - Information and communication technologies (ICTs) 696, 705, 930
 - inorganic scintillators 849
 - insulated gate bipolar transistors (IGBT) 562, 668, 715
 - interface-engineered junction (IEJ) 318f
 - internally cooled cabled conductors (CiCC) 127
 - International System of Units 808, 836
 - International thermonuclear experimental reactor (ITER) project 122f, 338, 347, 374, 489, 498, 544ff, 1239
 - intrinsic detection efficiency (IDE) 908ff, 915ff
 - intrinsic gradiometers 1023
 - intrinsic Josephson effect 31, 34, 71, 159, 185
 - intrinsic Josephson junctions (IJJs) 934
 - $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_8$ (BSCCO) 1213
 - IVCs 1214ff, 1221
 - THz emission 1213
 - ion beam assisted deposition (IBAD) 184f, 256, 355ff, 367
 - templates 184f, 356ff
 - ion irradiation 90, 322
 - ionisation energy loss 845
 - ionization chamber 845, 847, 849

- iron-based superconductors (FBS) 29ff, 62, 166ff, 328ff
- iron-core rotor 679
- iron core stator 679
- isotope effect 131f
- ITER *see* International Thermonuclear Experimental Reactor (ITER) project
- ITER magnet system
- central solenoid system 547
 - characteristics of 547f
 - CICC 548, 552ff, 565
 - concentric zones of 549
 - model coils 551f
 - plasma discharges 547
 - poloidal field system 547
 - preliminary design approach 548
 - toroidal field system 544, 547f, 1239
 - voltages 559
- j**
- Jaynes–Cummings model 1185
- J_c anisotropy 80, 83, 176ff
- J_c scaling law 118ff
- Johnson–Nyquist noise 870, 1074f, 1077
- Josephson arbitrary waveform synthesizer (JAWS) 812, 819
- Josephson arrays
- 2D array 1208ff
 - distributed array 1209
 - 1D lumped array 1209
 - intrinsic Josephson junctions (IJJs) 1208, 1213ff *see also* intrinsic Josephson junctions (IJJs)
 - quasilumped design 1208f
- Josephson constant 808f, 837
- Josephson devices 57, 69, 171, 250, 267, 1177, 1198, 1207, 1213
- Josephson digital logic 1111f *see also* logic circuits
- Josephson effects 31ff, 61, 69ff, 146, 159, 185f, 281f, 808ff, 828ff, 883f, 933f, 949, 954, 1176, 1240
- Josephson energy 833, 1168, 1171f
- Josephson field effect transistors 1177f
- Josephson frequency 70, 884, 1082f, 1130
- Josephson junctions 16, 248, 289, 807, 1125ff, 1163ff, 1182f, 1240f
- charge qubit 297, 1170ff
 - flux qubits 297, 1169f, 1180, 1241
 - quantum phase slip effect 1187
- Josephson oscillations 829, 832, 839, 1069, 1213
- Josephson plasma frequency 1167
- Josephson transmission line (JTL) 1113, 1116, 1123, 1136, 1148, 1199
- Josephson voltage standards (JVSs) 295
- DC measurements 811ff, 821
 - development of 807f, 810ff, 820f
 - measurements and SI units 808f
 - PJVSs, binary-divided arrays 809, 811, 814ff, 821 *see also* programmable Josephson voltage standards (PJVS)
 - pulse-driven arrays 813, 819ff
- joule heat 329, 471, 475, 528, 565, 588, 616, 623, 628, 638f, 648, 652, 1227
- jumping-ring experiments 586
- k**
- Kim Anderson model 441
- Kim's model 795f
- kinetic inductance detectors (KIDs) 933
- Korea Electric Power Research Institute (KEPRI) 606, 641f
- l**
- Large coil task (LCT) 546, 552, 1239
- Large Hadron Collider (LHC) 113ff, 329ff, 368ff, 448ff, 489f, 626, 629, 737ff, 1238
- laser ablation technique 171, 1230
- laser molecular beam epitaxy (MBE) 142, 171, 258
- lead (Pb) 7, 9, 26, 499, 718, 813, 832, 851, 1068, 1103, 1107, 1233
- lead (current leads) 6f, 244, 338ff, 363, 366ff, 387ff, 420ff, 491ff, 524, 558ff, 570ff, 616ff, 632ff, 650ff, 669, 686f, 772, 829f, 958, 969ff, 1044, 1222, 1239
- least significant bit (LSB) 1128f, 1146, 1152
- Lenz's law 583
- lift-off effect 985
- light detection and ranging (LIDAR) systems 920
- linear synchronous motor (LSM) 595
- line defects 78f (AU: Found as crystalline defects)
- Linimo maglev train 593
- liquid nitrogen 4, 30, 96f, 152, 195, 250, 355, 412f, 421, 509, 569, 597, 605ff, 616ff, 632, 649ff, 672, 675, 711, 723, 768f, 871, 964, 979, 999ff, 1105, 1236ff
- liquid nitrogen LN₂ cryostat 195ff, 393, 398, 632, 638, 653, 979
- load imbalance 661
- load line 422f, 471f
- logic circuits
- AQFP 1122f
 - energy-efficient RSFQ 1135

- eSFQ 1120f, 1123, 1142, 1241
- latching logic 185, 1111f, 1116, 1195, 1197
- low energy logic 1111, 1117ff
- RSFQ logic 281, 289, 1112ff, 1130, 1135ff, 1195ff
- London's equations 11, 14ff, 1049
- loop antenna 729
- Lorentz force 18ff, 77ff, 105ff, 206, 329, 407, 456, 552, 571, 666, 801f, 910, 1234
- low-field Q-slope (LFQS) 753f
- low-temperature bake (LTB) 747
- low temperature scanning laser microscopy (LTSLM) 1217f
- low temperature superconductors (LTS) 605, 616, 1233
- ADCs 1131
- rotating machine 684f
- low voltage (LV) 67, 358, 603f, 612ff, 646ff, 675, 697ff, 812ff, 1136, 1211
- LTS Josephson junctions
 - circuits, applications and requirements 295ff
 - junction characterization 283f
 - Nb-Al/AlO_x-Nb junction technology 281, 284ff
- m**
- Mach-10 rocket 593
- macroscopic pinning 88
- macroscopic quantum tunneling (MQT) process 1186
- maglev-assist launch system 598
- magneplane system 593
- magnesium diboride (MgB₂)
 - application 141ff
 - intrinsic and extrinsic properties 130ff
 - polycrystals synthesis 139ff
 - single crystals 130ff
 - thin films 129ff, 258
- magnetically shielded rooms (MSRs) 344f, 963, 993ff
- magnetic biasing 413, 584f
- magnetic field 3ff, 75, 92, 664, 676, 682, 791, 1178f, 1233f
- magnetic flux 3ff, 52ff, 72, 76ff, 93ff, 107, 133, 175ff, 198ff, 248, 296, 403f, 459, 498ff, 550, 583ff, 646ff, 664, 677, 714ff, 743ff, 773, 809, 828ff, 884, 949, 953ff, 979ff, 996ff, 1024, 1044ff, 1071ff, 1081, 1096ff, 1127, 1168ff, 1177ff, 1195ff
- magnetic flux leakage (MFL) technique 980
- magnetic flux quantum 3ff, 60, 72, 133, 175, 1127, 1199, 1202
- magnetic force microscopy (MFM) 73, 1042f
- magnetic forces 73, 206ff, 426, 495ff, 550, 583, 1042
- magnetic iron 441, 677, 679, 681, 1021
- magnetic levitation (MAGLEV) 363, 412, 583ff
- magnetic levitation and transportation
 - AC levitation 586ff
 - air and space launch 598
 - clean-room environments 597
 - cryostats and vehicle design 597
 - electrodynamic levitation (EDL) 588ff, 593, 596f
 - electromagnetic suspension 585f
 - guideway design 596f
 - HTS 592, 595ff
 - magnetic biasing 584f
 - magnetic forces 583
 - propulsion 588, 592ff, 598
 - static stability 584
 - tuned resonators 591
- magnetic marker monitoring (MMM) 1011
- magnetic microscopies 963, 967, 974, 1043
- magnetic permeability 404, 584, 587, 646, 649, 967, 982, 1046, 1182f
- magnetic pinning 79, 87f
- magnetic relaxation 240
- magnetic resonance imaging (MRI) 1238
 - adiabatic magnets 527ff
 - coil configurations 525f, 533, 537
 - field mapping and shimming 531ff
 - HTS applications 523, 539f
 - HTS coil design 767ff
 - medical diagnosis 536ff
 - safety issues 535
 - signal-to-noise ratio 762, 764f
 - solenoidal field 530f
 - spatial field homogeneity 524
 - stress analysis 529f
- magnetic shields
 - AC shielding applications 780, 798ff
 - FEM 780ff *see also* finite element method (FEM)
 - HTS 780, 795, 799f, 803
 - image surface gradiometers 781ff
 - low-field magnetic measurements 780, 803
 - partitioned superconducting tubes 789ff
 - semi-infinite highly permeable tube 788f
 - semi-infinite superconducting tubes *see* semi-infinite superconducting tubes
 - space applications 780, 801ff
 - superconducting disk 780, 783ff
- magnetic source imaging (MSI) 992ff
- magnetization AC losses 95, 97f

- magnetocardiogram (MCG) 992ff, 1000f, 1005ff, 1012
 magnetoencephalography (MEG) 247, 276, 763, 792, 950, 992ff, 1240
 magnetometry
 – dipole and monopole field sources 1047f
 – dipoles ferromagnetic patches 1055f
 – pairing symmetry tests 1054f
 – semiconductor packaging 1055ff
 – vortex trapping, YBCO thin films 1053f
 magnetorelaxometry (MRX) 1011f
 Majorana fermions 61, 1178ff
 mass density 499, 655, 666, 671, 1021
 Matthias rules paradigm 29
 Maxwell's eddy current model 589
 Maxwell's equation 15, 100, 112, 213, 407, 430, 587, 589, 737, 795, 1023
 M-Bahn 593
 MCG *see* magnetocardiogram (MCG)
 medium field Q-slope (MFQS) 753ff
 medium voltage (MV) 603, 641, 668
 MEG *see* magnetoencephalography (MEG)
 Meissner–Ochsenfeld effect 3, 7, 10, 1195
 mercury 2f, 7, 26, 1233
 Mermin–Wagner theorem 27f
 metal flux methods 170
 metal/insulator/absorbate/metal (MIAM)
 systems 73
 metal–insulator (MI) contact 51ff
 metallic conductors 604
 metallic dewars 964
 metallic oxides 4
 metal-organic vapour-phase epitaxy (MOCVD) 256, 267f, 363
 metamaterials (MMs) 935f
 – negative index of refraction 1182
 – quantum metamaterials 1184f
 – split-ring resonators 1182f
 – tunable metamaterials 1183
 metrology 107, 281, 807ff, 828ff, 844, 1066ff, 1099ff, 1241
 MgB₂ *see* magnesium diboride (MgB₂)
 Mg-self-flux method 142
 microbolometers 937
 microcalorimeters 861ff, 925, 927, 1240
 microstrip antennas 729
 microstrip filter 726f, 1228
 micro-strip gas chamber (MSGC) 849, 852
 micro-strip gas detectors (MSGC) 845, 848f, 852
 microstrip line 295, 727, 811f, 815f, 1114, 1229
 microstrip resonators 725, 1088
 microwave devices 248, 723f, 1226ff
 microwave impedance spectroscopy 940
 microwave kinetic inductance detector (MKID) 943f, 1181
 microwave power 295, 725, 727, 810ff, 816f, 835, 885
 minimum conductor volume 633
 minimum quench energy (MQE) 428
 mixed-signal circuits 297f, 1125ff
 – ADCs *see* analog-to-digital converters (ADCs)
 – samplers 1125f
 mixer *see* superconductor–insulator–superconductor (SIS) mixers
 modified variable threshold logic (MVTL)
 gates 1112
 Monte Carlo method 264
 Moore's law 1164, 1241
 MRI *see* magnetic resonance imaging (MRI)
 multipacting (MP) 748, 750ff
 multiply-connected superconductors
 – in high fields 795
 – in low fields 793f
 – trapped flux 794
 multi-seed bulk 215f
 multi-wire proportional chambers (MWPCs) 844f, 847ff
- n**
- nanolithography 322, 874
 nanomagnets 1047
 National Bureau of Standards (NBS) 811, 977
 National High Magnetic Field Laboratory (NHMFL) 331, 334ff, 460, 573, 628
 National Institute of Standards and Technology (NIST) 250, 281, 811, 816f, 820
 natural convection two-phase cooling system 513, 515
 Nb–AlO_x–Nb technology 284, 289ff
 NbN technology 248f, 252, 277
 Nb₃Sn 81ff, 106ff, 136ff, 173ff, 328ff, 457ff, 517, 523ff, 544ff, 574, 744, 958ff, 1235ff
 Nb technology 249, 252, 277
 Nd_{1+x}Ba_{2-x}Cu₃O_y (NdBCO) 218
 Nd_{2-x}Ce_xCuO₄ (NCCO) 153, 157, 225ff
 negative index of refraction 1182
 network model 439
 neutron detectors 849
 niobium 3ff, 52ff, 184, 282, 288, 487ff, 736ff, 817, 889, 963, 982ff, 1044, 1068ff, 1082ff, 1103ff, 1113f, 1235
 niobium-on-copper (Nb–Cu) cavities 737

- NMR *see* nuclear magnetic resonance (NMR)
no-insulation winding technique 539f
noise equivalent power (NEP) 860, 870ff,
 876f, 933, 938
noise-equivalent temperature (NET) 870f
noise thermometer (SQUID thermometers)
 1066ff, 1074
nondestructive evaluation (NDE)
 – eddy current testing 982ff
 – SQUID microscopes 986ff
 – static magnetic fields 977ff
nondestructive testing (NDT) 247, 780, 799,
 803, 933, 977
non-inductive (bifilar) coils 634f
normal/insulator/normal (NIN) junctions
 66f
normal/insulator/superconducting (NIS)
 junction 67f
normal-metal interface 54
nuclear emulsions 845f
nuclear magnetic resonance (NMR) 85,
 119ff, 148, 338, 478, 523ff, 565, 572, 974,
 1012, 1238
 – adiabatic magnets 527ff
 – coil configurations 525f
 – field mapping and shimming 531ff
 – HTS applications 539f
 – safety issue 534
 – solenoidal field 530f
 – solid-state and solution 534ff
 – spatial field homogeneity 524
 – spectral resolution 523
 – stress analysis 529f
 – superconductor 526f
 – temporal stability 524f
nucleation 195ff, 257ff, 318, 357ff, 373,
 744
null-flux suspension system 593
Nyquist rate converters 1126ff
- o**
- Oak Ridge National Laboratory (ORNL)
 545, 738f, 1239
octagonal disc resonator 725
ohmic heating 443, 748
ohmic resistance 77, 809, 812
OPERA2D 502f
Operand Routing Networks (ORNs) 1153f
optical beam lithography 813
optical coupling efficiency (OCE) 914f
optical micrographs 1044f, 1059
organic scintillators 849
outer intercoil structures (OIS) 550
- overpressure (OP) processing 331, 333ff,
 337f, 348
oversampling converters 1127, 1129
oxide dispersion strengthened (ODS) 332
oxide superconductors 33ff, 230, 251
oxygen-controlled quench melt-growth
 (OQMG) process 217
- p**
- pancake coils 492, 571, 573f, 635
pancake vortices 31f, 159f, 1235
partial differential equations (PDEs) 99, 624
particle accelerator magnets 616
particle physics 27, 448, 487ff, 738, 844ff,
 861, 868, 1089
partitioned superconducting tubes 789ff
passive magnetic shims 481
passive shielding 526, 533f, 998f
passive transmission lines (PTLs) 1113f,
 1122, 1136, 1141, 1143, 1153
Pauli principle 27, 850
permanent magnet (PM) 6ff, 193ff, 240ff,
 403ff, 578, 584ff, 671, 674ff, 977ff
perovskite-type layers 171f
phase qubits 1163f, 1166ff, 1179f, 1185, 1241
phase-slip flux qubit 1188f
phonon-electron time 864
phonons detectors 853
phonon spectrum 125, 130f
photoconductive antennas (PCAs) 931, 933f
photomultiplier 849
photon absorption 905, 907ff, 922, 940, 943
photon energies 843, 861ff, 890, 902ff, 933
photoswitches 934
physical vapour deposition (PVD) techniques
 256ff, 269ff
Physikalisch-Technische Bundesanstalt (PTB)
 281, 811ff, 994, 999, 1067ff
piezo scanners 1046
pinning centers 19ff, 76ff, 110ff, 135ff, 159,
 166ff, 206f, 239, 339f, 1235ff
pinning effect 20, 79, 87, 111, 198
pinning mechanism 83, 87, 94, 111, 171ff,
 207
planar defects 80
planarization 289, 293f, 357, 361
planar superconducting filters 726, 1229
planar superconducting resonators 725
Planck constant 1068, 1186, 1207
plasma frequency 809, 908, 1167, 1177
plastic detectors 847
point defects 79f, 137, 175, 178
POISSON 502f
Poisson's equation 791

- poles 406, 479, 488ff, 583, 679, 684, 726
 - powder-in-tube (PIT) technique 81, 83, 120, 130, 142, 180, 1236
 - applications 347f
 - $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_x$ (Bi-2212) round wire 330ff
 - iron-based superconductors (FBS) 328, 341ff
 - process 124
 - strain sensitivity 345ff
 - power cables 328, 347, 603f, 616, 628, 1235
 - in densely populated areas 603f
 - high voltage 603
 - low voltage 603
 - medium voltage 603
 - power conditioning systems (PCS) 660, 665, 667ff, 934
 - power engineering 1234, 1237, 1239
 - power generators 674
 - power-law model 101
 - power transformers 645, 647, 652, 654ff
 - power transmission cables 76, 366, 374, 616
 - $\text{PrBa}_2\text{Cu}_3\text{O}_y$ (PBCO) barrier 318f
 - precipitates 20f, 80, 118, 135, 199, 236, 276, 341, 426, 743f, 1235
 - programmable Josephson voltage standards (PJVS) 811f, 814ff, 821
 - applications of 818f
 - microwave circuit designs of 815
 - multi-bit d/a converters 814
 - SINIS junctions 812, 817
 - SIS junctions 816
 - SNS junctions 816f, 820
 - proportional chambers 844f, 847
 - Propulsion 347, 588, 592ff, 598, 675, 686, 691
 - proximity effect (PE)
 - ferromagnetic metal 59
 - metal-insulator contact 51ff
 - normal-metal interface 54ff
 - pulsed laser ablation 171
 - pulsed laser deposition (PLD) 82, 142, 171, 256ff, 363
 - pulse-driven Josephson arrays 819
 - PVD *see* physical vapour deposition (PVD) techniques
- q**
- quadrupoles 113, 139, 419, 448ff, 579, 1238
 - quality factor (filters/resonances) 724, 736, 753, 809, 935, 943, 984, 1084f, 1227ff
 - quantization 6ff, 53ff, 819, 839, 949f, 1055, 1070, 1126ff, 1168, 1195ff, 1240
 - quantronium 1171
 - quantum bits (qubits) 52, 292, 297, 723, 839, 1081ff, 1163ff, 1176ff, 1191, 1241
 - decoherence 1166f
 - flux qubits 1169f
 - quantum cascade lasers (QCLs) 875, 930ff, 936
 - quantum computers 61, 1163ff, 1176, 1180
 - coherent oscillation 1163, 1171
 - decoherence process 1166, 1180
 - DiVincenzo criteria 1165, 1176, 1180
 - entanglement 1163, 1165, 1180, 1185
 - flux qubits 1169f
 - logical single-qubit gate operations 1165
 - macroscopic quantum coherence 1163
 - medicine 1163
 - quantum error correction 1164f, 1180
 - quantum gates 1165, 1180, 1182
 - Shor's algorithm 1165, 1169
 - superposition 1163ff
 - transmon qubits 1091f, 1172f, 1179, 1182
 - two-qubit gates 1164f
 - quantum error correction 1164f, 1180
 - quantum gates 1165, 1180, 1182
 - quantum Hall effect (QHE) 838f, 1100f, 1107
 - quantum information circuits 1180ff
 - quantum Josephson transmission 1184f
 - quantum metamaterials 1184f
 - quantum metrology 807ff, 828ff, 1241
 - quantum mixer theory
 - large-signal equivalent circuit 886
 - noise properties 889
 - small-signal problem 887f
 - quantum phase slip (QPS)
 - condensation energy barrier 1186
 - constant current steps 1189f
 - flux vortex 1186
 - Josephson junctions 1187
 - phase-slip flux qubit 1188f
 - quantum mechanical tunneling 1186
 - superconducting nanowires 833ff, 838f, 1185ff
 - quantum processor 1163
 - quantum standards 807ff
 - quarter-wave resonator (QWR) 735, 740
 - quasi-one junction SQUIDs (QOJs) 1128
 - quasiparticles 4ff, 49ff, 68, 245, 296, 312ff, 829ff, 853, 862, 882ff, 903ff, 934, 1167, 1178ff, 1195, 1234
 - Qubit *see* quantum bits (qubits)
 - quench and melt growth (QMG) processes 216
 - quench-back heaters 445f
 - quench melt growth (QMG) method 205

- quench protection circuit (QPC) 508, 561f
 quench protection dump resistor 506f
 quench protection system 114f, 491ff, 690
 quench protection units (QPU) 561
- r**
- RabiTS *see* Rolling Assisted Biaxially Textured Substrates (RabiTS)
- radiation and particle detectors
- bubble chamber 844ff
 - characteristic quantities 844f
 - charged and neutral particles 843ff
 - Cherenkov detectors 850f
 - cloud chamber 844ff
 - cryogenic calorimeter 851, 853
 - electromagnetic calorimeter 845, 851
 - gaseous detectors 847ff
 - hadronic calorimeters 851
 - nuclear emulsions 846
 - plastic detectors 847
 - scintillators 849f
 - solid-state detectors 849f
 - spark chamber 846
- radio frequency (RF) 52, 107, 147, 296, 319, 358, 734ff, 752, 761, 984, 1081ff, 1208, 1234
- radio frequency SQUID (RF SQUID) 296, 952f, 968ff, 1012, 1068ff, 1083ff
- Raman spectroscopy 133, 921
- ramp-edge junctions 307f, 312, 316ff
- rapid single-flux-quantum (RSFQ) 60, 248ff, 281ff, 1112ff, 1130, 1136ff, 1195
- rare earth oxy-fluoride (REOF) compounds 343
- Rare Isotope Beams (RIB) 579, 740
- REBCO bulk superconductors
- doping strategy 207f
 - mechanical properties 206f
 - melt processing thermodynamics 197ff
 - powder compacting process 199
 - single grain fabrication 202ff
 - texture process 199ff
- reciprocal quantum logic (RQL) 1117ff, 1122f, 1141, 1241
- reciprocating magnetic separation unit (RMSU) 573ff
- reflection high-energy electron diffraction (RHEED) images 261, 263, 358, 360f
- refrigeration 420ff, 492ff, 539, 545f, 570, 595, 616ff
- refrigeration-cooling systems 674
- refrigerators 377, 442, 491ff, 548, 570, 584, 675ff, 925f
- residual resistivity ratio (RRR) 107, 143, 339, 472, 488, 618, 620, 737, 757
- resistive fault current limiters
- AMSC/Siemens/Nexans team 640f
 - challenges of 637ff
 - high voltage vacuum circuit breakers 634
 - HTS elements 632ff
 - maximum electric field 633
 - maximum limited fault current 633
 - minimum conductor volume 633
 - non-inductive (bifilar) coils 634f
 - REBCO wire 639
 - straight element 635
 - wire based projects 640f
- resistively and capacitively shunted junction (RCSJ) model 310, 1189, 1221
- resistively shunted junction (RSJ) model 186, 309, 323, 828, 832
- Resistor Coupled Josephson Logic (RCJL) 1112
- resonance fluorescence 1185
- resonance frequency 14, 411, 724f, 765, 809, 936, 1046, 1170, 1183, 1226, 1229
- resonant circuit readout 940, 943f
- resonant tunneling diodes (RTDs) 931, 933
- resonators 724ff
- microwave passive devices 723f
 - responsive load 662
- RF SQUID *see* radio frequency SQUID (RF SQUID)
- ring imaging Cherenkov detector (RICH) 851
- Rolling Assisted Biaxially Textured Substrates (RabiTS) 256, 355ff
- rotary seal 688
- rotating machines
- copper windings 674
 - HTS 674 *see also* HTS rotating machines
 - LTS 684f
- rotation symmetric arranged tape-in-tube (ROSAT) conductor 332
- rotor cryostat 676, 686ff
- RS flip-flop (RSFF) 1146, 1199
- R(C)SJ model *see* resistively and capacitively shunted junction (RCSJ) model
- ruthenate-cuprate hybrid 34
- Rutherford cables 127, 329f, 336, 438, 486, 492, 495, 1236
- s**
- saddle winding 419
- SAFARI instrument 877
- Sagnac microscopy 1042

- samarium barium copper oxide (SmBCO) 202, 204, 215, 217ff
 samplers – analog input signal 1125
 – bias current 1126
 – HTS circuits 1126
 – Josephson junctions 1125f
 – oscilloscope chip 1126
 – sample-and-hold stage 1125
 s-bender scanners 1046
 scaling laws 84, 88, 110ff, 136, 475, 547, 751
 scanning electron micrograph 871, 1045, 1060
 scanning electron microscopy with polarization analysis (SEMPA) 1042f
 scanning Hall bar microscopy 1042
 scanning magnetoresistive microscopy 1042
 scanning SQUID microscopy (SSM)
 – advantages 1042f
 – disadvantages 1042f
 – history of 1043f
 – magnetic microscopies 1042f
 – magnetometry 1047 *see also* magnetometry
 – pnictide superconductors 1057, 1059
 – scanning SQUID sensors 1044ff
 – spin susceptibility 1059f
 – susceptometry 1048 *see also* susceptometry
 – thermal isolation 1046
 scanning tunneling microscopy (STM) 73, 909
 scattering process 52f, 264
 scintillators 843, 845, 849f, 855, 927
 screening currents 112, 213, 429ff, 774f, 782ff, 949, 953ff, 1023
 second-order gradiometer 962, 996
 self-amplified spontaneous emission (SASE) 739
 self-centering support system 510f
 self field 77, 98, 114ff, 134ff, 177ff, 236ff, 338ff, 355, 363, 482, 577, 655, 909
 self-flux method 170, 222
 self-healing distribution grids 706
 semi-infinite highly permeable tube
 – axial noise field 788
 – transverse noise fields 788f
 semi-infinite superconducting tubes
 – axial noise field 786f
 – transverse noise fields 787f
 sensors 297, 585, 697, 860ff, 995ff, 1074ff, 1125, 1194ff
 SFCL *see* superconducting fault current limiter (SFCL)
- Shapiro steps 71, 146, 187, 295, 809f, 812, 828ff, 885, 1189, 1210ff
 shielding factor (SF) 780ff, 979, 998f
 Shubnikov phase 8ff, 105f, 207
 signal-to-noise improvement ratio (SNIR) 780, 785, 792ff
 signal-to-noise ratio (SNR)
 – ADCs 1127
 silicon detectors 850, 852, 855
 Silsbee hypothesis 17
 simply-connected superconductors
 – in high fields 795
 – in low fields 791ff
 single Cooper pair circuits
 – Bloch oscillations 831ff
 – pump modes 835
 – quantum metrology 836ff
 – quasiparticle tunneling 835
 – small Josephson junction 830
 – superconducting nanowires 833ff
 single crystals
 – high Tc cuprate superconductors 221
 – $\text{La}_{1.85}\text{Sr}_{0.15}\text{CuO}_4$ 226
 – $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ 227
 – $\text{Nd}_{2-x}\text{Ce}_x\text{CuO}_4$ 228
 – $\text{YBa}_2\text{Cu}_4\text{O}_8$ 222ff
 – $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ 222ff
 single-electron transistor (SET) 292, 836, 1101, 1171
 single flux quantum (SFQ) 9, 285ff, 306ff, 813, 828, 938, 940ff, 1111ff, 1129f, 1135ff, 1196ff, 1241
 SIS *see* superconductor–insulator–superconductor (SIS) mixers
 SIS Josephson junctions 57, 281, 283f, 306
 SmartGrids
 – definitions of 702f
 – distribution grids 693, 704
 – economical and sociological locks 708
 – EMS and DMS 698
 – energy storage devices 698
 – European energy landscape 698
 – flexible grid operations 709
 – innovations 705, 707
 – intermittent generation, integration of 709
 – power grid 693, 696, 704, 708
 – scientific and technological locks 707f
 – security and reliability 709
 – SFCL 709ff
 – smartmeters 696f
 – SMES 718
 – structure of 697

- superconducting cables 698, 717f
- switching devices 697
- transmission system 693f, 703f
- triggers of 701f
- value chain of 696
- smartmeters 696f, 702, 708
- SMES *see* superconducting magnetic energy storage (SMES)
- SNS *see* spallation neutron source (SNS)
- SNSPD *see* superconducting nanowire single-photon detector (SNSPD)
- software-defined radio (SDR) 944, 1125
- software gradiometers 993, 997
- solar energy 699, 714
- solenoids 336, 418ff, 449ff, 487ff, 529f, 547, 571, 634, 649, 666f, 786ff, 848ff, 1233, 1237
- solid-state detectors 844f, 849f
- solid state quantum bits (qubits) 297
- somatosensory evoked field (SEF) 1002ff
- spallation neutron source (SNS) 737ff, 757
- spark chamber 845f
- spin density wave (SDW) 38f, 167f
- spinning reserve 662f
- spintronics 58, 61
- spiral fin heat exchanger design 624f
- SPIRAL2 project 740
- split-ring resonators (SRRs) 740, 936, 1182f
- sputter techniques 261ff
- SQUID *see* superconducting quantum interference device (SQUID)
- stacking faults 80, 321
- STAR magnet 496
- stator 204, 412ff, 585, 588, 671f, 674ff
- step-edge junctions 249, 307, 313ff, 323
- Stirling cryocooler 384ff, 730
- STJ *see* superconducting tunnel junction (STJ)
- Stokes's theorem 11
- strain sensitivity 110, 125f, 345ff
- stripline resonators 1171, 1173
- subradiance 1185
- sub-transient reactance 677
- Sumitomo Heavy Industries (SHI) 390, 687
- Sumitomo 8-tesla conduction-cooled magnet 571f
- superconducting bearings 403f, 671f
- superconducting bolometers 248f, 267, 276, 936
- superconducting cables
 - HTS-cables 605ff *see also* HTS-cables
 - LTS cables 605
 - power cables 603f
 - SmartGrids 717f
- superconducting disk 780, 783ff
- superconducting fault current limiter (SFCL)
 - 628, 799
 - fuses 631
 - inductors 631f, 634, 637ff
 - principle of 631, 637
 - resistive FCL 632, 641 *see also* resistive fault current limiters
 - saturated iron core 636ff, 641
 - shielded iron core 632, 635f, 638, 640
 - SmartGrids 709ff
- superconducting generators 674, 684
- superconducting magnetic bearings (SMB) 240, 660, 671f
- superconducting magnetic energy storage (SMES) 363, 660, 1239
 - advantages of 665
 - conductor 666f
 - efficiency 665, 668, 671
 - frequency regulation 663, 665, 669
 - HTS current leads 616
 - magnetic field 664, 666
 - Nb–Ti conductors 669
 - power conditioning system (PCs) 660, 665, 667ff
 - power quality control 665, 669
 - schematic representation of 665
 - SmartGrids 718
 - solenoid and toroid coil 667
- superconducting magnets
 - AC losses 440ff, 471, 482, 528f, 552, 556, 576
 - cryogenic stabilization 423ff, 429
 - current supply 420ff
 - degradation 422f, 426
 - energy disturbances 424, 426, 428
 - filamentary wires and cables 434ff
 - flux jumping 426, 431ff, 488
 - load line 422f
 - magnetization 431f
 - minimum quench energy 426ff
 - quench protection 435, 443f, 446, 491ff, 502
 - saddle windings 419
 - screening currents 429ff, 438f
 - solenoid windings 418, 502
 - toroidal coils 419, 490f, 493
 - training 422f, 425ff, 429, 438
- superconducting microwave components
 - advantages of 723
 - antenna 724, 728ff
 - CRFE systems 728
 - delay lines 723f, 730
 - filters 723ff
 - resonators 723ff

- superconducting microwave components (*contd.*)
 - superconducting transmission line 723
 - superconducting nanowires 829ff, 902ff, 940, 944, 1185ff
 - superconducting nanowire single-photon detector (SNSPD) 940, 944f
 - applications 919ff
 - detection efficiency 908f, 913ff
 - fabrication and characterization 910ff
 - hot-spot model 906ff
 - optical coupling 910ff
 - principle of operation 904ff
 - spectral detection efficiency 917ff
 - superconductor tunnel junction 922ff *see also* superconducting tunnel junction (ST)
 - two-temperature (2T) approach 862, 874, 903f
 - vortex-assisted photon detection model 908ff
- superconducting pickup coils
 - MRI application 762ff
 - SQUID measurements 763, 772f
- superconducting quantum interference device (SQUID) 70, 162, 247, 296f, 780ff, 903, 1176, 1240
 - ADCs 1027, 1127f, 1131
 - biomagnetism 104, 950, 955, 1013 *see also* biomagnetism
 - bi-SQUID 958
 - cryogenic detectors 846, 853
 - cryogenic requirements 963ff
 - current measurements 969ff
 - differential measurements 960
 - digital *see* digital superconducting quantum interference devices (digital SQUIDS)
 - electromagnetic methods 1029ff
 - flux qubits 1168ff
 - future applications 1037f
 - geomagnetics 1021ff
 - HTS limitations 960f
 - impedance measurements 971f
 - laboratory measurements 1020f
 - magnetic field sensing 967ff
 - magnetic susceptibility 972
 - magnetometers 213, 297, 383, 774f, 952ff, 967ff, 980ff, 993ff, 1020ff, 1074ff, 1131, 1176, 1195ff
 - metamaterials 1183
 - modulation schemes 955
 - NDE 977, 986 *see also* nondestructive evaluation (NDE)
 - resistance measurements 971
- rf and dc 952ff
- sensitivity 956ff
- slew rate limitations 960
- TES bolometers 868, 872, 876f, 940ff
- types 952ff
- variable temperature susceptometer 972ff
- voltage measurements 971
- superconducting radio frequency (SRF)
 - ATLAS 740
 - cavity fabrication 745
 - cavity surface preparation 745ff
 - CEBAF 739
 - continuous wave mode 734, 756
 - critical magnetic field 756f
 - cryomodule 736ff
 - elliptical TM-mode cavities 734
 - FELs 739
 - field emission and processing 752f
 - figures of merit 735
 - FLASH 740
 - LEP2 738
 - multipacting 750
 - quench 748ff
 - Q vs. E curves 753
 - storage rings 739
 - superheating critical field 744
 - TEM-mode cavities 734
- superconducting solenoidal-detector magnets
 - coil electrical connections 511f
 - cold mass support system 509ff
 - cryogenic heat sink 511
 - cryogenic stability 487f
 - forced two-phase helium cooling system 512ff
 - high temperature superconducting leads 517
 - LHC detector magnets 489ff
 - low mass thin detector magnets 488f
 - magnet power supply and coil quench protection 505ff
 - natural convection two-phase cooling system 515ff
 - thin solenoids 498f
 - two-stage 4.2 K coolers 517f
- superconducting transformers
 - advantages 645
 - copper conductor 646
 - coreless transformer 648f
 - cryostat and cooling system 650ff
 - fault current limitation 648
 - HTS conductor 652
 - HTS transformers 653f
 - leakage inductances 647
 - losses 647

- magnetically coupled windings 646
- superconducting materials 649f
- total size and weight 646f
- windings, insulation and bushing 652f
- superconducting transition 1ff, 78, 145, 181, 207, 223, 250, 329, 723, 866, 875, 903ff, 940, 963, 1077, 1186ff
- superconducting tunnel junction (STJ) 295f, 933, 937
 - applications 925ff
 - performance 924f
 - signal generation 923f
- superconductor/insulator/superconducting (SIS) junctions 281ff, 306ff, 810ff, 861, 882ff
- superconductor–insulator–superconductor (SIS) mixers 296, 829, 853
 - IF match circuit 892f
 - mixer block 893
 - mixer fabrication 889f
 - noise measurements 893f
 - quantum mixer theory 886
 - RF match circuit 892
 - sideband-separating mixers 895ff
 - single sideband mixers 895
 - superconducting tunnel junctions 882ff
 - tuning structure 891f
 - waveguide probes 891
- superconductor–normal conductor–superconductor (SNS)
 - junctions 146, 250, 282, 295, 318ff, 816ff
- superdirective antenna arrays 729
- super-fluorescence 1185
- superradiance 1185
- SupraTrans II 595
- susceptometry 1010f, 1046, 1048, 1057, 1059
 - diamagnetic particles and disks 1050ff
 - planar geometry 1048ff
 - switching 146, 185, 295, 668, 697ff, 811ff, 884, 909, 936, 944, 1070, 1111ff, 1127ff, 1135ff, 1167, 1198, 1211, 1228f, 1241
- switching devices 697, 715
- synchronous reactance 682f
- systematic geometric errors 479

- t**
- Tavis–Cummings model 1185
- TBCCO *see* $Tl_2Ba_2CaCu_2O_{8+\delta}$ (TBCCO)
- T_c pinning 78
- temporal stability 524f
- terahertz (THz)
 - basic science 930
 - biological/medical sensing 930
 - continuous-wave sources 931
 - imaging systems 931ff
 - industrial application 930ff
 - ITC applications 930, 932
 - superconductive devices 933ff
 - time domain spectroscopy 930ff
- terminal voltage 476, 682, 690
- TES *see* transition edge sensor (TES)
- TES bolometer 868, 872, 876f, 940ff
- tetra-methyl-tetra-selenium-fulvalene (TMTSF) 40f
- thermal detectors 854, 869, 940
- thermal evaporation 142, 258f
- thermal fluctuations 13ff, 172ff, 231ff, 289, 310, 829, 870
- thermal gradient methods 199
- thermally optimized current leads
 - cryogenic copper properties 618f, 628
 - in vacuum 619ff
- thin films 22ff, 68, 80ff, 129ff, 166ff, 193ff, 247ff, 282ff, 306ff, 355, 380, 404, 726ff, 765ff, 780, 807ff, 861ff, 890, 906ff, 934ff, 953ff, 995ff, 1023ff, 1044ff, 1069ff, 1081ff, 1107, 1176ff, 1241
- 3D-filters 726
- thin film superconductors
 - deposition techniques 256f
 - HTS film growth and characterization 269f
 - material requirements 250ff
- THz spectroscopy 248, 276, 930, 1220
- THz time domain spectroscopy (THz-TDS) 930ff
- tilt bicrystal junctions 309f, 313, 317
- time-domain multiplexing (TDM) 941ff
- time-projection chamber (TPC) 848
- time-to-digital converters (TDCs) 1146, 1154ff
- $Tl_2Ba_2CaCu_2O_{8+\delta}$ (TBCCO) 154, 248, 934f
- toggle flip flop (TFF) 1114, 1130, 1137, 1145, 1156ff
- top seeded melt growth (TSMG) methods 201, 203f
- toroidal magnets 491, 498
- toroid coil 419, 492
- torque tube cylinder 687f
- total owning cost (TOC) 645, 657f
- transfer fabrication process 548
- transient electromagnetics (TEM) 734f, 1020f, 1031ff
- transition edge sensor (TES) 860f, 867ff, 933, 937, 940, 942f, 1240
 - CMB and IR astronomy 876
 - high energy resolution 878

- transition edge sensor (TES) (*contd.*)
 - linear response 877f
 - low threshold energy and calorimetry 878
 - responsivity 868ff
 transmission electron microscopy (TEM)
 - 135, 180, 311ff, 358, 361f
 transmon qubits 1091f, 1172f, 1179, 1182
 transport AC losses
 - analytical computation 98f
 - boil-off method 95f
 - external magnetic fields 98
 - voltage taps 95f
 transport current 17ff, 76ff, 93ff, 110ff, 235, 329, 429ff, 604, 714, 1234
 Transrapid TR-07 vehicle 594
 transverse fields 114, 419, 451ff, 784ff
 transverse noise fields
 - partitioned superconducting tubes 789ff
 - semi-infinite highly permeable tube 788f
 - semi-infinite superconducting tubes 785ff
 trapped magnetic flux density 215
 trilayer deposition process 285
 tunable metamaterials 1183
 tunable microwave devices 1226
 - electrical tuning method 1227f
 - magnetic tuning method 1228f
 - mechanical tuning methods 1226f
 - optical tuning method 1229f
 tunneling 33, 49ff, 66ff, 132ff, 159, 187, 281ff, 312ff, 807ff, 829ff, 882ff, 909ff, 931ff, 1167ff, 1177ff, 1235, 1240
 twin planes 80
 two-dimensional electron layer (2-DEL) 1055
 two gap superconductivity 132
 two-level systems (TLS) 1166f, 1181, 1185, 1241
 type-I superconductors 3ff, 795
 type-II superconductors 3ff, 93f, 404, 407, 795, 1234
- u**
- ULF-NMR/MRI *see* ultra low-field (ULF) NMR/MRI
- ultra low-field (ULF) NMR/MRI 762f, 773ff
- uninterruptible power supply (UPS) 663f
- v**
- valence band 61, 850
- vapor cooled current leads
 - Carnot refrigeration power 626f
 - energy balance 623f
 - heat exchangers 624ff
 - performance of 625f
- vapor enthalpy 624
- variable speed drive (VSD) 677
- Vectorview 1001ff
- very high field superconducting magnet
 - collaboration (VHFSCM) 330ff
- very low impedance (VLI) cables 717
- virial theorem 666
- volt 54, 295f, 449, 452, 654, 808, 821, 829, 843ff, 861, 971
- voltage disturbances 663
- voltage pulses 902ff, 940, 944, 1113, 1117, 1130, 1197, 1199
- voltage source converter (VSC) 667f, 671
- volume defects 80
- vortex-antivortex pairs (VAP) 909
- vortex-assisted photon detection model 908ff
- vortex configuration 21
- vortex matter 232ff, 1235
- w**
- wave equation 100
- weak/weakly interacting massive particles (WIMPs) 851, 855ff, 878, 974, 1089
- Weston cells 808
- Wiedemann Franz law 420f
- Wilson chamber 846
- wind-and-react approach 335
- wind energy 695
- winding pack (WP) 476, 550, 559
- window-type process 289
- wind turbine 674f, 686, 714
- wind turbine generators 675, 679, 686, 690f
- wire-in-channel (WIC) technique 126f
- wires
 - high critical current density 123f
 - standard critical current density 122f
- x**
- X-ray astronomy 843
- X-ray diffraction (XRD) 141, 342, 358ff
- y**
- $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ (YBCO) 4ff, 55, 77ff, 94, 152ff, 174ff, 195ff, 231ff, 247ff, 308ff, 337f, 355ff, 444, 526ff, 597, 641, 650ff, 667ff, 711, 724ff, 765ff, 780ff, 863ff, 934f, 1053ff, 1105, 1198, 1221f, 1228ff
- YBCO *see* $\text{YBa}_2\text{Cu}_3\text{O}_7$ (YBCO)
- YBCO coated conductors
 - Al_2O_3 358ff
 - 2G HTS wires 355, 363
 - RABiTS and IBAD technology 355ff
- $\text{Y}_3\text{Fe}_5\text{O}_{12}$ (YIG) film 1229