

Editor's Appendix :

New Developments Regarding Electron Correlation Effects in $\text{Hg}_{0.8}\text{Cd}_{0.2}\text{Te}$

Fritz Herlach

With 1 Figure

Since the publication of the data shown in Fig. 2.16, a great deal more experimental data has become available and this has resulted in profound changes in the interpretation of the results. The breaks in the $\log(\sigma_{\perp})$ vs $\log(B)$ plots in Fig. 2.16 are no longer regarded as indicating a transition related to Wigner condensation of the electrons or charge density waves. It was shown that these breaks depend on the current passed through the sample [A.1]. Recently it has been suggested that the breaks are due to a surface layer which provides a shunt resistance [A.2]. Extensive measurements as a function of temperature and magnetic field have revealed that the conductivity is thermally activated. This was first shown for the low field range [A.1] and later extended to magnetic fields up to 35 T [A.3]. It is possible to give a consistent interpretation of these results by assuming "magnetic freeze-out" of conduction electrons which occurs when in a strong magnetic field the distance between the conduction band and the impurity levels becomes of the order kT . This analysis is based on both the Hall effect and the magnetoresistance; the carrier density in the conduction band is determined from the σ_{xy} component of the conductivity tensor which is related to the measured quantities ϱ_{\perp} (transversal magnetoresistance) and $\varrho_{\text{H}} = R_{\text{H}}B$ (Hall resistivity; R_{H} = Hall constant, B = magnetic induction) by [A.4]

$$\sigma_{xy} = \varrho_{\text{H}} / (\varrho_{\text{H}}^2 + \varrho_{\perp}^2). \quad (\text{A.1})$$

In the high field limit $\omega_c\tau \gg 1$, the charge carrier density is then given by

$$n = |\sigma_{xy}|B/e. \quad (\text{A.2})$$

The activation energies determined from σ_{zz} , n and $\sigma_{xx} = \varrho_{\perp} / (\varrho_{\perp}^2 + \varrho_{\text{H}}^2)$ are given in Table A.1 (see also Fig. A.1). The consistency of the analysis is strengthened by finding the same values for the activation energy from both σ_{xy} and $\sigma_{zz} = 1/\varrho_{\parallel}$ (ϱ_{\parallel} : longitudinal magnetoresistance).

While experimental data obtained at Leuven/Nijmegen and Köln are in complete agreement, at Köln a different interpretation is given to these and some additional results. The idea of an electron correlation effect is maintained by interpreting the magnetotransport data as if the effect were caused by changes in the mobility rather than the carrier concentration. The thermally activated conductivity is interpreted as resulting from a transition of the electron gas to a viscous liquid [A.5]. Several arguments are given against magnetic freeze-out: it

Table A.1. The activation energies of thermally activated conduction in $\text{Hg}_{0.8}\text{Cd}_{0.2}\text{Te}$ at different magnetic fields as determined in Fig. A.1

B [T]	Activation energy		
	from σ_{zz} [meV]	from $\sigma_{xy}B/e$ [meV]	from σ_{xx} [meV]
4	0.33	0.40	
6	0.50	0.51	0.28
8	0.68	0.75	0.39
10	0.82	0.85	0.48
12	0.94	1.05	0.53
14	1.03	1.14	0.56
	± 0.05	± 0.1	± 0.1

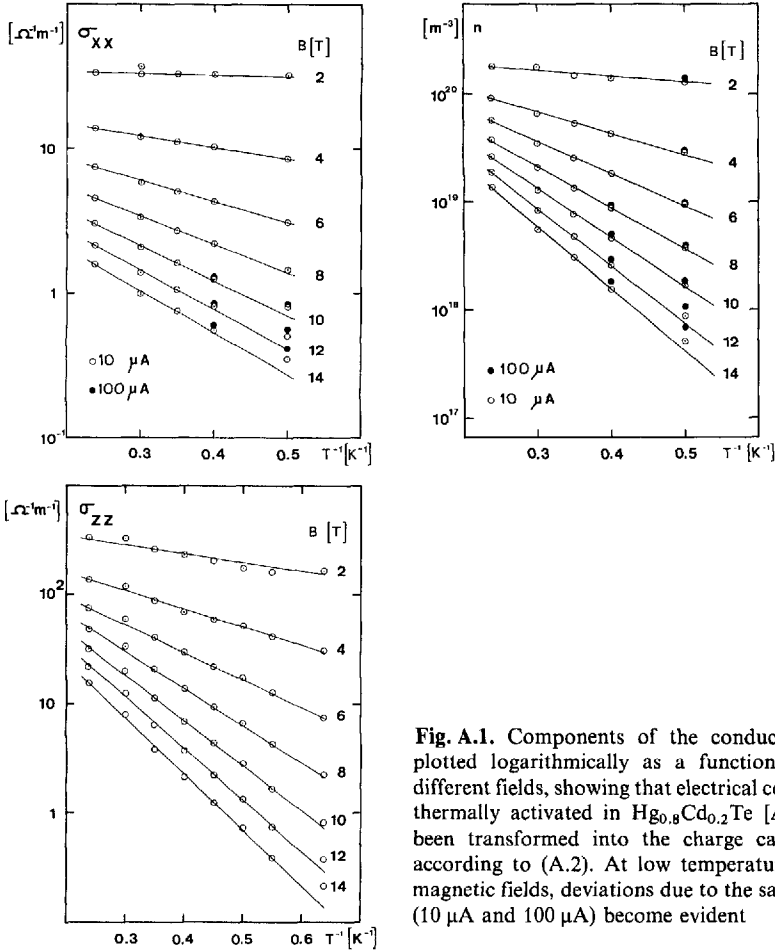


Fig. A.1. Components of the conductivity tensor plotted logarithmically as a function of $1/T$ for different fields, showing that electrical conductivity is thermally activated in $\text{Hg}_{0.8}\text{Cd}_{0.2}\text{Te}$ [A.3]. σ_{xy} has been transformed into the charge carrier density according to (A.2). At low temperatures and high magnetic fields, deviations due to the sample current (10 μA and 100 μA) become evident

is pointed out that earlier experiments in zero magnetic field have not revealed any impurity levels (i. e. no ionized impurity scattering) to which freeze-out could occur. A complete survey of earlier work on HgCdTe and other narrow gap semiconductors is given in [A.6]. The transient response of electrical current to an applied voltage step does not show – within the range of magnetic field, temperature and applied electric field of these experiments – the typical delay depending on the applied voltage as is seen in InSb and which is indicative of impact ionization. In the voltage-current characteristics, a negative resistance and instabilities due to avalanche formation have been seen in InSb but not yet in HgCdTe. Finally, measurements of the differential photoconductivity and the specific heat have been carried out in strong magnetic fields and the results are reported to support the assumption of a thermally activated mobility and electron correlation effects [A.7].

References

- A.1 G. De Vos, F.Herlach: In *Application of High Magnetic Fields in Semiconductor Physics*, ed by G. Landwehr, Lecture Notes in Physics, Vol. 177 (Springer, Berlin, Heidelberg 1983) p. 378
- A.2 J.P.Stadler, G.Nimtz, B.Schlicht, G.Remenyi: *Solid State Commun.* **52**, 67 (1984)
- A.3 G. De Vos: Ph. D. Thesis, Katholieke Universiteit Leuven (1984);
G. De Vos, F.Herlach, H.Myron: In preparation
- A.4 R.Mansfield, L.Kusztelan: *J. Phys.* **C11**, 4157 (1978)
A.Raymond, J.L.Robert, R.L.Aulombard, C.Bousquet, O.Valassiades, M.Royer: In *Physics of Narrow Gap Semiconductors*, ed. by E.Gornik, H.Heinrich, L.Palmetshofer, Lecture Notes in Physics, Vol. 152 (Springer, Berlin, Heidelberg 1982) p. 387
- A.5 B.Schlicht: Ph. D. Thesis, Universität Köln (1983)
- A.6 R.Dornhaus, G.Nimtz, B.Schlicht: *Narrow-Gap Semiconductors*, Springer Tracts Mod. Phys., Vol. 98 (Springer, Berlin, Heidelberg 1983)
- A.7 J.Gebhardt, G.Nimtz, B.Schlicht, J.P.Stadler: Submitted to *J. Phys. C*

Subject Index

- Alcator *see* Tokamak
- Alloys, dilute magnetic
 - (Kondo) 248
 - magnetoresistance 270
- Alpha helix 148
- Anderson localisation 75
- Animal magnetic field detection
 - bees 191
 - birds, homing pigeons 191
 - dolphins 191
 - magnetoreceptors 192
- Antiferromagnet 332
 - MnF₂ 333
 - Néel state 125
 - Néel temperature 139
 - spin-Peierls transition 130
 - spin waves 125
- Approximation
 - Born 31
 - constant damping 59
 - generalized Born (GBA) 31, 103
 - kinetic 41
 - lowest order Born (LOBA) 40
 - lowest order correlation (LOCA) 36, 102
 - phenomenological damping 42
 - random phase (RPA) 35
 - T*-matrix (TMA) 32
 - self-consistent (STMA) 32
- Armature 305
- Bacteria
 - cell wall 185
 - magnetotactic 190
- Bacteriophages 160
- Band structure, multivalley 53
- Benzene, diamagnetic susceptibility 147
- Biological particles
 - chromatin 183
 - linear magnetic dichroism 182
- Biomagnetism 190
- Biomolecules, high field nuclear magnetic resonance 145, 147
- Biopolymers 157
- Bolometer, microwave 50
- Capacitor bank
 - crowbar circuit 256, 258
 - crowbar diodes 258
 - solid dielectric switch 285
 - spark gap 271, 290
 - thyristor switching 265
 - transmission line type 261
- Capacitor discharge
 - damping parameter 254
 - waveform 254
- Cellulose 149
- Charge density wave 337
 - graphite 278
- Chemical reactions, magnetic field dependent 144
- Chloroplasts 149
- Coil
 - field/current ratio 252
 - filling factor 252
 - force-free 262
 - geometrical parameters 251
 - inductance 253
 - insulation, epoxy 258
 - mechanical deformation 259
 - pulsed field
 - ac resistance 257
 - acoustic monitoring 259
 - construction 258
 - insulation failure 259
 - maraging steel 270
 - metal fatigue 275
 - neon cooled 264
 - nondestructive 251
 - reinforced 259
 - saw effect 259
 - solid helix 252, 262
 - wire-wound 252
 - single-turn 249
 - stress distribution 260
 - wire-wound, design 255
- Collagen 149
- Compressibility sum rule 35
- Conductivity, dynamic
 - Götze-Wölfle method 43, 102

- Conductivity, dynamic (continued)
 Mori formalism 43
- Conferences
 high magnetic fields 4
 magnet technology 2
 magnetism 4, 115
 megagauss 249, 343, 346
 semiconductors 4
- Copper
 heat capacity 253, 255
 high strength alloys 227, 259
 resistivity 253, 255
- Copper-steel laminates 226
 yield stress 228
- Copper-zirconium high strength
 conductor 239
- Cotton-Mouton constant 151
 Cotton-Mouton effect 150
- Crystal field
 crystalline electric field, CEF 113, 118
 Hamiltonian 119, 121
 Tb^{+++} 119
- Current transformer 309
- Cyclotron mass 46
- Cyclotron motion: energy, radius 310
- Cyclotron resonance 51, 319
 2D electron system 92
 GaP, camel's back structure 323
 Landau levels, nonparabolicity 321
 line shape, Lorentzian 53
 linewidth 55, 323
 megagauss 53, 319
 GaP, CdS, CdSe, Te, Ge 322
 InSb, GaAs 313, 320, 322
 molecular lasers 53, 319
 polaron pinning effect 319
 quantum effect in GaSb, GaP 276
 Roth's relation 321
 strip-line technique 55
 submegagauss 268
- Cylindrical implosion
 cascades 295
 electromagnetic 258
 speed of inner wall 302
 stability 294
- Damping, collisional 19, 29, 36, 40
- De Haas-Shubnikov effect *see* Shubnikov-
 de Haas effect
- de Haas-van Alphen effect 115, 132
 pulsed field 133
- Density of states
 Dingle temperature 29
 free electrons 19
 Landau 40
- Detector, far infrared 137
- Diamagnetism, Landau 85, 97
- Dingle temperature 29, 46, 70, 133
- Eddy current heating 257
- Einstein relation 40, 57, 58
- Electric charge, fractional 90
- Electric subbands 62
 constant energy contours 66
 inversion layers 61
- Electrical resistivity, plasma 282
- Electromagnet *see* Magnet
- Electromagnetic implosion
 driving efficiency 301
 flash x-ray 300
 maximum speed 303
 numerical simulation 301
- Electron correlation effects 49, 277, 337
- Electron gas, 2D 278
 cyclotron resonance 92
 degeneracy factor 67
 density of states 68
 Dingle temperature 70
 dynamic conductivity 92
 Fermi energy 68
 filling factor 67
 Hall effect 76
 Landau levels 67
 level broadening 68
 magnetoresistance 69
 Shubnikov-de Haas oscillations 70
- Electron-phonon interaction 57
- Electron spin resonance, etc. *see* Spin
 resonance, etc.
- Electrons
 density of states 28
 effective mass approximation 63
 energy spectrum, semiclassical
 approximation 25
 in lattice 23
 Peierls approximation 24, 28
 ionized impurity scattering 45
 many-body effects 63
- Energy density, high explosive 294
- Energy storage
 density at high power 279
 flywheel 261
 superconducting coil 274
- Epoxy, fiberglass reinforced 230
- Equation of state of solids 280
- Exchange field 128
- Exchange interaction 74, 128, 332
 Dzyaloshinsky 130
 higher order 129
 isotropic Heisenberg 129

- Exciton 271, 327
 - diamagnetic shift 329
 - GaSe 328
 - InSe 271
 - hydrogen-like states 327
 - PbI₂ 329
- Excitonic matter 337
- Excitonic phase 336
- Experiments
 - elementary particles 2
 - magnetism 3
 - semiconductors 3
 - single shot 247
 - solid state 2
- Explosively accelerated metal plates 293
 - efficiency 294
 - Gurney energy 293
 - shaped charge effect 294
 - spalling 294
- Faraday rotation 139, 311, 314
 - anomalous behaviour, GaSe 317
 - exciton effect, GaSe 319
 - interband, CdS, GaSe, GaP 315
 - nonlinear 318
 - Verdet constant 314
- Fermi surface 3, 24, 26, 29
- Ferrimagnet 334
 - spin-canted order 129, 334
- Ferrofluids 189
- Ferromagnet
 - metamagnetic transition 127
 - Co(S_xSe_{1-x})₂ 128
- Ferrons 319
- Fibrin gel, neutron diffraction 187
- Fibrinogen 184
- Flashbomb, argon 311
- Flux compression
 - by shock front 296
 - diffusion of initial flux 295
 - electromagnetic 249, 298
 - experimental results 299
 - theta-pinch 298
 - z-pinch 300
 - explosive-driven 249
 - configurations 293
 - experimental results 297
 - field turnaround 292
 - implosion speed 292, 294
 - reversible implosion 339
- Flux compression generator
 - bellows 291
 - experimental results 307
 - helical, contact jumping 306
 - helical-coaxial 305
- Flux compression generator
 - rail gun 306
 - rocket-borne plasma gun 306
 - transformer-coupled 306
- Flux concentrator 262
- Flux diffusion
 - cylindrical geometry 282
 - Joule heating 281
 - plane geometry 280
 - with variable resistivity 281
- Flux diffusion speed 279
- Flywheel
 - alternator 274
 - energy storage 261
 - Kapitza 248
- Fusion device
 - aspect ratio 237
 - closed confinement systems 207
 - equilibrium magnetic field 207
 - Ignitor 210
 - induction field 207
 - linear
 - electron beam heating 239
 - hybrid magnet 239
 - laser heating 239
 - pulsed magnet 239
 - stored energy 238
 - stress analysis 238
 - magnetic mirror 206, 237, 243
 - Elmo Bumpy Torus 206, 242
 - open confinement systems 237
 - reverse field pinch 206, 241
 - stellarator 205, 237
 - theta pinch, Scyllac 240
 - tokamak 207
 - toroidal field 207
 - torsatron 237
- Fusion reactor
 - conference on engineering problems 206
 - Lawson criterion 210
 - LINUS reversible implosion 339
- g*-factor 28, 46, 74, 114
 - effective 321
- Galvanomagnetic effects 37
- Gauge argument 88, 89
- Gauge transformation 85
- Götze-Wölfle method 43, 102
- Graphite, magnetoresistance, charge density waves 277
- Green's functions, single electron 30
- Hall effect 41, 50, 76
- Heat conductivity 58

- Heterojunction, GaAs-(GaAl)As 79, 90, 93, 98, 278
- Heterostructures 61, 67, 79, 90, 98, 278
- Human body, magnetic field induced temperature change 196
- Hydrogen, metallic 338
- Impurities
 density of states 32
 Gaussian potential 33, 69, 77
 level broadening 30
 point 32, 42, 77
 screening 34
 effective potential 34
 Kohn anomaly 37
 spectral functions 31, 33, 52
- Impurity potential 42
- Impurity states 327
- Ionized impurity scattering 45, 353
- Itinerant electrons
 molecular field approximation 126
 Pauli susceptibility 115, 125
 spin fluctuations 136
 Stoner-Edwards-Wohlfahrth model 126
- Keratine 149
- Kramers-Kronig analysis 92
- Kubo formula 42, 57, 58, 69, 99
- Landau counting 28, 78
- Landau levels
 broadening 19
 Kane model 321
- Laser light, Bragg diffraction 165
- Laser
 free electron 137
 HCN, pulsed 271
 optically pumped 137
- Level broadening 31
- Liner 293, 298
 liquid metal 340
- Liquid crystal 170
 cholesteric 162, 172
 magnetic correlation length 172
 orientational fluctuations 171
 polymer 166
 pretransitional behaviour 168, 170
 thermotropic 170
- Localisation 81
 Anderson 75
 mobile (delocalised) state 82
 "weak" 76
- Macromolecules
 chains, persistence length 153
- Macromolecules
 diamagnetic anisotropies 147
 diamagnetic susceptibility 146
 electrostatic persistence length 159
 paramagnetic anisotropy 149
 paramagnetic moment 149
- Magnet
 Bitter stack 7
 Bitter type, Alcator 229
 design 205
 history of development 4
 hybrid 9, 12
 insulation 229
 liquid nitrogen cooled 229
 polyhelix 9
 superconducting 14
- Magnet cooling, liquid nitrogen 233
- Magnet laboratory
 Braunschweig 13
 Francis Bitter NML 10
 Grenoble 10
 Nijmegen 12
 Oxford 13
 pulsed magnetic fields 14, 264
 Sendai 13
 Wroclaw 12
- Magnet technology, conferences 2
- Magnetic birefringence 150
 experimental setup 151
- Magnetic deformation, vesicles or micelles 174
- Magnetic field induced temperature change, live organisms 196
- Magnetic field
 general 1
 pulsed 247
 ultrastrong 249, 278
- Magnetic freeze-out 48, 351
- Magnetic impurities 134
- Magnetic material, amorphous 135
- Magnetic moments, elementary 114
- Magnetic monopole 1
- Magnetic orientation
 bacteriophages 160
 biological particles 149
 chloroplasts 181
 diamagnetic anisotropies 167
 egg lecithin 178
 erythrocytes 184
 haemoglobin 184
 micelles 177
 nucleic acids 164
 polymers 169
 purple membranes 181
 t-RNA 184

- Magnetic separation
 - bacteriophages 183
 - red blood cells 188
 - with ferrofluids 189
- Magnetic stress 249
- Magnetism
 - exchange interaction, four-spin
 - exchange 130
 - itinerant electrons 115, 125
 - relaxation time 131
 - Casimir-Du Pré relations 131
 - Dingle temperature 133
 - measurement by EPR 131
- Magnetite, in dolphins and rays 191
- Magnetization
 - Arrot plots 127
 - C₆Eu 129
 - Eu, Pr 120
 - Ni-Pt alloys 126
 - Tb, Ni, Fe, Co 124
 - Y - 1.2 at. % Tb, 0.9 at. % Dy, 1.0 at. % Er 122
 - yttrium-based alloys 121
- Magnetization measurement
 - by Faraday rotation 139, 334
 - YIG 334
 - calibration 117
 - compensation coil 116
 - eddy current heating 117
 - megagauss 313
 - pulsed field 116, 271
 - relaxation effects 117
 - reversible susceptibility 313
 - vibrating coil method 118
- Magneto-Seebeck coefficient 59
 - transverse 97
- Magnetobiology 190
 - cell division 195
- Magnetocaloric effect 117, 136
- Magnetoconductivity
 - dynamic 51
 - (LOCA) 99
- Magnetophonon effect 266
- Magnetoconductance 38
 - Corbino disc geometry 74
 - dilute magnetic alloys 270
 - Einstein relation 40
 - graphite 277
 - Hall conductivity 41
 - longitudinal conductivity 41
 - "measurable resistivity" 37
 - measurement 272
 - negative 136, 270
 - negative change 45
 - Shubnikov-de Haas regime 43
- Magnetoconductance
 - Titeica's formula 40, 52
 - transverse conductivity 38
- Magnetostriction, measurement in pulsed fields 276
- Magnetotactic bacteria 190
- Magnetotransmission 277
- Magnetotropism 193
 - pollen tubes of lily 194
- Megagauss 278
 - cyclotron resonance 53, 319
 - electromagnetic implosion 298
 - electromagnetic linear pinch 338
 - experiments 249
 - elementary particle physics 341
 - solid state 250
 - Faraday effect 314
 - first conference 249
 - flux compression 290
 - high pressure 337
 - laser spectroscopy 313
 - neutron stars, white dwarfs 339
 - nuclear fusion devices 339
 - plasma focus 304, 340
 - plasma implosion 304
 - properties of conductor materials 284
 - single-turn coil 285
 - expansion 288
 - experimental results 287
 - flash x-ray 288
 - waveform 289
 - with explosive-driven generator 290
 - target for particle beam 341
 - Zeeman effect 329
 - In, Na, Pb, Au, Ag 330
 - instrumentation 311
 - nonlinear 331
- Membranes 173
 - artificial 176
 - biological 179
 - phospholipid 180
 - retinal chromophore 180
 - retinal rods 179
 - rhodopsin molecules 180
 - lecithin 174
 - persistence area 175
- Mice, magnetic field induced temperature change 196
- Micelles 173, 177
 - magnetic orientation 177
- Microemulsions 177
- Molecular beam epitaxy 61
- Mori formalism 51, 77, 100, 104
- MOSFET 21, 61, 70, 79
- Mott rule 58

- Nucleic acids 158, 164
diamagnetic anisotropy 148
- Ohm standard, SI system 21
- Onsager relations 57
- Paschen-Back-effect 271, 331
- Pauli spin paramagnetic susceptibility 115, 125
- Peptide bond 148
- Percolation 83
- Phase transition
gas-liquid type 336
semimetal-semiconductor 336
- Phonons, acoustic 93, 323
- Photosynthesis 181
- Pick-up coil 116, 133
- Plants
growth in magnetic fields 193
magnetotropism 193
- Plasma
characteristics 206
confinement time 209
current density 208, 212, 216
density 209, 226
electrical conductivity 220, 282
instability 205
- Plasma heating
auxiliary 217
neutral beam 207, 211
ohmic 208, 209
radio-frequency 207
- Poisson summation formula 30, 43, 59
- Polaron effect, piezoelectric 324
- Polaron pinning effect, CdS, CdSe 324
- Poly- γ -benzyl-L-glutamate 166
- Polybenzamides 156
- Polycarbonates, Cotton-Mouton constant 155
- Polyelectrolyte 157
cholesteric lyotropic 166
Cotton-Mouton constant 157
lyotropic nematic 162
polysaccharide 162
xanthan 162
- Polyethylene, Cotton-Mouton constant 153
- Polyethylene melt, Cotton-Mouton constant 168
- Polymer, orientational correlation 168
- Polymer chains
flexible 152
semiflexible 152
- Polymerisation
biological 186
reaction in magnetic field 185
- Polystyrene, Cotton-Mouton constant 155
- Polystyrene sulphonate 158
- Polytyrosine glutamic acid 158
- Pressure, ultrastrong 337
- Pulsed current
measurement 309
Rogovski belt 309
- Pulsed energy, sources 278
- Pulsed field facility
Amsterdam 263
Braunschweig 274
Genève 272
Leiden 274
M.I.T. 273
Nijmegen 264, 349
Osaka 270
Rutherford Laboratory 275
Sendai 265
table 264
Tokyo 275
Toulouse 265
- Pulsed field
bubble chamber 275
de Haas - van Alphen effect 133
experiments
elementary particles 275
solid state 263
field measurement 308
pick-up coil, calibration 308
RC integrator, errors 308
inductive storage 274
magnetization measurement 116, 271
magnetostriction measurement 276
sample heating 281
submegagauss 251
waveform, flat top 248, 261
- Pulsed power 304
- Quantisation condition, Onsager 25
- Quantisation rules, Bohr-Sommerfeld 132
- Quantum Hall effect 21
bound states 78
edge currents 86
for holes 80
fractional 76, 89
fractional charge 90
gauge argument 84
localisation 21, 81
mobility gap 87
periodic potential 88
precision measurements 79
- Quantum limit 3, 29, 47
extreme 3
- Radiation reaction 341
- Rail gun 306
- Relaxation kernel 51

- Scattering
 - acoustic phonon 323
 - ionized impurity 45, 353
- Semiconductors
 - heterostructures 61, 67, 79, 90, 98, 278
 - narrow gap 28
- Shaped charge effect 294
- Shock wave
 - particle speed 280, 283
 - precursor 309
 - Rankine-Hugoniot relations 283
 - speed of the shock front 283
- Shubnikov-de Haas effect 266, 269, 277
 - Bi and Bi-Sb alloys 276
- Shubnikov-de Haas oscillations 18, 20, 27
 - 2D electron gas 70
 - period 46
- Silk 149
- Skin depth
 - sine wave 257
 - transient 281
- Skin effect, transient 279
- Solids
 - equation of state 280
 - volume compression 285
- Spectrometer, time-resolved
 - image converter 312
 - rotating mirror 312
- Spin degeneracy 65, 66, 80
- Spin glasses 134
- Spin resonance
 - exchange splitting 138, 271
 - far infrared 137, 271
 - ruby 331
- Spin splitting 44, 45, 72
 - energy 310
- Spin system
 - dimensionality 113, 135
 - Heisenberg 113
 - Ising 113, 135
 - random 135
- Spin waves 123
 - antiferromagnet 125
 - dispersion relation 123
 - Tb metal 124
- Spin-flip
 - multiple 135
 - transition 332
- Spin-flop phase 332
- Spin-orbit interaction 66
- Středa formula 83, 89
- Stress
 - magnetic 249
 - von Mises 214, 225
- Superconductor
 - high field 3, 272
 - ternary molybdenum chalcogenides 272
 - transient response 273
 - upper critical field 272
- Susceptibility, diamagnetic 44
- Thermoelectric power 58
- Thermomagnetic effects 57, 96
- Titeica formula 40, 52
- Tokamak
 - Alcator A 231
 - Alcator C 206, 210, 224, 227
 - Alcator
 - cooling system 232
 - liquid nitrogen cooling 233
 - confinement time 209
 - DITE 231
 - equilibrium field 221, 224, 226
 - Frascati FT 231, 235
 - high field 235
 - initial temperature 220
 - Kurchatov 235
 - liquid nitrogen cooling 231
 - magnetic field system 207
 - magnetic flux 218, 222
 - ohmic heating 210, 217
 - ORMAK 231
 - peak current 220
 - plasma aspect ratio 220, 225
 - plasma minor and major radius 209
 - plasma temperature 226
 - plasma trade-off considerations 209
 - poloidal field 209
 - Princeton Large Torus 206
 - stress analysis, toroidal field coil 213, 217
 - TFTR 206
 - toroidal field 209, 211, 216, 222
 - radial stress 214
 - resistive power 214
 - stored energy 214, 224
 - tension stress 213
- Transformer
 - ohmic heating 218
 - Alcator C 224
 - air core 218
 - flux requirements 219
 - interface with TF coil 224
 - iron core 218
 - peak field 224
 - peak stress 222
 - simplified design 221
 - stored energy 225
- Transport phenomena, nonlinear 40

- Two-dimensional electron system *see*
Electron gas, 2D
- Valley degeneracy 65
- Valley splitting 71
- Vesicles (micelles) 173
- Vesicles, Cotton-Mouton constant 175
- Wave number, Thomas-Fermi 36
- Wiedemann-Franz law 58, 98
- Wigner condensation 50, 76, 79, 159,
337, 351
- Wigner crystal 89
- Zecman effect
- megagauss 311, 329
 - Na-D lines 271
 - R_1 and R_2 lines in ruby 271