

Index

- Arabidopsis thaliana*, 225
Drosophila, 225
 2D electronic spectroscopy, 147, 150–151
 3PEPS, 345
- absorption spectra, 137, 139, 141
 anharmonic oscillator, 341
 artificial light-harvesting systems, 171, 312, 328
- bacterial reaction centres, 182–184
 bacteriochlorophylls (BChls), 77–79, 125–132, 134–135, 137–138, 140, 174, 180, 191
 bacteriorhodopsin, 237–238, 241
 bath frequency cut-off, 172
 bath spectral density, 25, 31–32, 34, 43, 47–48, 137, 167, 169, 174–175, 343
- Bell inequality, 284
 bio-inspired quantum materials, 311–334
 birds, 219
 Bloch theorem, 335
 Bloch–Redfield master equation, 27, 32, 34, 79, 81, 183, 185, 194–195
 Born–Oppenheimer surface, 202, 213
 bosonic bath, 22, 25, 30, 48–50, 302, 304
 Brillouin zone, 336
 Brownian oscillator model, 37, 47, 103, 118
- carbon nanotube, 335
 carbon nanotubes, 335–349
 carotenoid–porphyrin–fullerene, 229
 CD spectrum, 139–140
 charge separation, 5, 28, 131, 148, 168, 179–192, 195, 205, 216, 257, 313, 316–317, 324, 327, 332
 charge transfer, 131
 chemical compass, 218–236, 309, 315, 333–334
 circular dichroism, 131
 Cluster N, 233
 coherence, 144, 158
 coherences, 144
- completely positive maps, 17, 304
 conical intersection, 246–249, 257
 Condon approximation, 132
 consciousness, 12
 cryptochrome, 218, 223
 crystal structure, 131, 138, 140
 cumulant approximation, 131, 136–137, 141–143
- Decoherence, x, xvii, 12, 14, 22, 27, 162–163, 172–173, 175, 220, 293, 305
 deep tunnelling, 199
 deep-tunnelling ET reactions, 208
 delocalization, 145
 density matrix renormalization group (DMRG), 47–52
 density of states, 132, 134
 dipole–dipole coupling, 133
 DNA photolyase, 231
 Drude–Lorentzian spectral density, 171
- Earth’s magnetic field, 218
 elastic through-bridge tunnelling, 201
 elastic tunnelling, 203, 211–214, 269, 271–272
 Electron Paramagnetic Resonance, 220
 electron transfer, xviii, 6–7, 124–125, 127–131, 140–143, 179–183, 187, 189–190, 194, 197, 198–217, 219, 221, 223–226, 228, 230–231, 268, 270, 275–276, 314, 332
 electron transfer rate, 141–143
 electron transfer reactions, 223
 electron tunnelling, 7, 10, 214, 267, 269, 273, 276
 electronic excitations, 131
 electronic spectroscopy, 5, 16, 79, 82–120, 147, 150–151, 189
 enantiomer, 264–265, 267, 275–276
 enantiomers, 265, 267, 275
 energy gap time series, 132, 136, 138, 142
 energy transfer efficiency, 160, 162, 170–172

- entanglement, x, xi, 48–49, 267, 277–310, 348
 environment-assisted quantum transport (ENAQT), xi,
 10, 159–175
 European robins, 233
 evolution, x, 11–13
 exciton, 133–135, 139, 338
 exciton binding energy, 338
 exciton–exciton annihilation, 339
 exciton–exciton interactions, 339
 excitonic coupling, 139
 excitonic TDM, 133
- Fenna–Matthews–Olson complex, 147–150,
 153–156
 Fermi golden rule, 343
 Fermi’s golden rule, 56, 249, 271
 Feynman diagrams, 95, 153
 flavin adenine dinucleotide, FAD, 224
 fluctuations, 131, 134–135, 140–142, 200
 fluctuation–dissipation process, 30–31, 34–35, 136
 Förster resonance energy transfer (FRET), 32–33,
 53–81
 Förster’s rate expression, 54, 56–59
 four-wave mixing, 343
 Franck–Condon, 132, 136
- Gauss–Markovian fluctuations, 161
 generalized Förster resonance energy transfer,
 53–81
 generalized Förster theories, 65–72
 geomagnetic field, 218
- Haken–Strobl model, 31, 160, 168
 Heisenberg equation, 342
 heterodyne detection, 89, 111, 151
 hierarchical equation of motion, 31, 35
 Hilbert space, 15–18, 20, 31, 90, 100
 homogeneous broadening, 75, 103, 194
 hopping, 199
 Hyperfine interaction, 219
- inelastic tunnelling, 212, 271–272
 infrared, 267, 270–271, 275
 inhomogeneous broadening, 103, 108
- J-aggregates, 319–320, 325
- Kraus representation, 18, 20–21
 Kubo number, 173
- LH2, 156
 Landau–Zener transitions, 203–204, 250
 light-harvesting complex, 131
 light-harvesting 2 (LH2) complex of purple bacteria,
 77–78, 125–128, 130–132, 134–135, 138–140,
 156, 191–192, 194, 196–197, 318–319, 322, 328
 light-harvesting complex II (LHCII), 55, 79–81,
 192–195
- light–matter interaction, 82–84, 89
 Lindblad master equation, 17, 27–28, 161–163,
 175
 Lindblad operator, 161–162
 linear absorption, 131
 linear response theory, 133
 lineshape function, 131, 133–134, 136–138
 Liouville pathways, 92
 Liouville–von Neumann equation, 15–17, 21–22, 35,
 38–40
 local correlations, 287
 Lorentz absorption lineshape, 94
 low field effect, 220
- macroscopic polarization, 88
 magnetic compass, 218, 222
 magnetic field effects, 227
 magnetic orientation, 218
 magnetometry, 315, 332
 magnetoreception, 220
 maquette proteins, 332
 Markovian bath, 26–27, 52, 160
 matrix product states (MPS), 50–51
 MD simulation, 131–132, 143
 mean field approximation, 342
 mixed-state entanglement, 281
 mole rats, 236
 molecular aggregates, 76, 319–322, 324–325, 328,
 332
 multichromophoric Förster resonance energy transfer
 (MC-FRET), 73, 77–81
 multi-dimensional electronic spectroscopy,
 82–119
- nanotube self-assembled, 325
 navigation, 218
 neurobiology, 233
 noise-assisted quantum transport, 164
 non-completely positive maps, 17, 19
 non-linear optical response, 343
 non-local correlations, 277, 281–282, 286, 288,
 306
 non-Markovian, 26, 33–35, 37, 43, 79, 171–172, 176,
 296, 304
 non-Markovianity measure, 171
 non-rephasing pathways, 97, 104, 151
- OD spectrum, 131, 133, 135, 138–141
 odourant, 264–276
 Ohmic spectral density, 34, 169
 olfaction, 264–268, 271, 275
 open driven systems, 278, 291–293, 310
 open quantum system, v, xi, 11, 14–52, 83,
 159–175
 optical properties, 131
 optical spectra, 131, 136
 optical transitions, 100, 125, 131, 269, 337,
 339

- optimal quantum transport, 169–170
 origin of life, xviii, 12
- parametric down conversion, 293–295
 path integral techniques, 35, 44–47
 Pauli master equation, 17, 42
 Peierls instability, 336
 phase cycling, 344
 phonon, 269–271, 275
 photochemical, 6, 223, 230–231, 245–247, 252, 257, 260
 photo-induced processes, 82, 88
 photoisomerization, 237, 239–241, 257–259, 261–262
 photon-echo, 150, 343
 photon-echo spectroscopy, 155
 photosynthesis, 148, 157
 photosynthetic charge separation, 179–180, 183
 photosynthetic energy conversion, 180
 photosynthetic organisms, 131
 photosystem I (PSI), 179, 192, 317–319
 photosystem II (PSII), 79, 179, 185–188, 190, 194
 pigment molecule, 131–133, 139
 pigment–protein complexes, 5, 22, 28, 123–140, 197, 313, 328, 348
 polaron transformation, 38–44
 populations, 145
 potential energy crossing, 246
 potential energy surfaces, 182, 202–203, 242, 244, 247, 249–250
 protein electron transfer, 198, 270
 proton tunnelling, 7
 pump–probe experiment, 88, 258
 pure-dephasing model, 161, 170
 purple bacteria, 77, 124–125, 128, 130, 156, 179–180, 190, 318, 322, 328
- QC calculations, 131–132, 135
 quantum beating, 153
 quantum beats, 146, 220
 quantum chemistry (QC), 131
 quantum coherence, 144
 quantum dynamical map, 19
 quantum localization, 169, 172, 174
 quantum many-body theory, 131
 quantum master equations, 17, 21
 quantum materials, 311–334
 quantum mechanics postulates, 15–16
 quantum networks, 159–160, 164
 quantum observable, 16
 quantum Zeno regime, 163, 169, 172, 174
 quasi-adiabatic propagator path integral (QUAPI), 44–45, 47
 quenching, 124, 190, 331
- radical pair mechanism, 218
 radical pair materials, 312, 314, 332
- radicals, 223
 radiofrequency magnetic field effects, 229, 233
 reaction centre, 131, 143, 155
 receptor, 264–265, 267–269, 271–273, 275–276
 reorganization energy, 10, 29, 31–32, 160, 169, 171–172, 174, 180, 203, 212, 214–215, 269, 272–275
 resonant tunnelling, 199
 response functions, 84, 86, 104
 retinal, 6, 14, 237–263
 rhodopsin, 6, 14, 227, 237–241, 245–246, 252, 255–258, 262, 264
 rotating wave approximation (RWA), 95, 97
 Rydberg constant, 338
- scent, 267–268, 276
 Schiff base retinal, 252
 Schrödinger equation, 14–15, 17, 21, 32, 242, 249–251
 second-order perturbative time-convolution master equation, 24, 35–37, 170
 second-order perturbative time-convolutionless master equation, 24
 self-assembly, 12, 313–314, 319, 324, 327–330, 332
 shape, 264
 single-walled carbon nanotubes (SWNT), 335–340, 346–348
 singlet–triplet interconversion, 219
 smell, 264–265, 267, 271, 275
 spectral function, 137, 142–143
 spectroscopy, 276
 spin dynamics, 221
 spin Hamiltonian, 221
 spin relaxation, 220
 spin-selective reaction, 221
 Stark spectroscopy, 182, 188–189
 static disorder, 138
 stochastic resonance, 175
 Stokes shift, 31, 154
 structured chromophoric assemblies, 316
 super-Ohmic spectral density, 42–43
- third-order polarization, 88, 95, 97–98
 three-pulse-photon-echo peakshift (3PEPS) spectroscopy, 345–348
 tight binding model, 337, 340
 tobacco mosaic virus (TMV), 328–329
 transition density cube method, 62–63
 transition dipole interaction, 62, 64, 78
 transition dipole moment (TDM), 132
 tunnelling, 267, 269–271, 273–274, 276
 tunnelling pathways, 7, 205, 207, 209
 two colour electronic coherence photon echo spectroscopy, 155
 two-dimensional electronic spectroscopy, 150–151

Index

399

- | | |
|--|---|
| two time anisotropy spectroscopy (TTAS), 156 | vibronic states, 132 |
| two-level system, 131 | virus-templated chromophore assemblies, 328 |
| vibration, 266–267, 269–276 | Wick's theorem, 30, 36 |
| vibrational coherences, 117, 190, 194 | Zeeman interaction, 219 |
| vibronic mode, 137 | |