Alfvén frozen-in theorem, 314
Alfvén ratio $r_A$, 313
Alfvén wave, 320
Amplitude equation, 72
Anisotropic energy fluxes, $\Pi_{\perp}$ and $\Pi_{\parallel}$, 192
Anisotropic turbulence, 89
$E_{u_{\perp}}(k)/(2E_{u_{\parallel}}(k))$, 29
Anisotropic energy fluxes, $\Pi_{\perp}$ and $\Pi_{\parallel}$, 192
Cylindrical ring spectrum, 189
Energy exchange between $u_{\parallel}$ and $u_{\perp}$, 192
Normalization for the ring spectrum, 188
Ring-to-ring energy transfers, 191
Rotating turbulence, 437
Spherical ring spectrum, 187
Thermal convection, 281
Anti-dynamo theorems, 387
Arrow of time from energy flux, 71
Binary fluid mixture, 290
Energy flux, 292
Energy spectrum, 292
Burgers turbulence, 461
Combined energy transfer, 463
Conservation laws, 462
Detailed energy conservation, 463
Energy flux, 464
Energy spectrum, 464
Force-free inviscid, 461
Pao’s model, 465
Real-space profile, 461
Structure functions, 465
Turbulence phenomenology, 464
Circulation, 17
Circulation theorem: Kelvin, 18
Combined energy transfer, 45
Burgers turbulence, 463
Hydrodynamic turbulence, 45
Kinetic helicity, 127
Magnetic helicity, 339
MHD turbulence, 329
Scalar turbulence, 219
Shell model, 455
Tensor turbulence, 445
Vector turbulence, 298
Compressible flow
Adiabatic process, 470
Conservation laws, 469
Governing equations, 467
Internal energy, 468
Polytropic process, 469
Sound wave, 470
Total energy, 469
Compressible turbulence, 90, 467
Burgers turbulence, 472
Compressible components, 474
Craya-Herring basis, 473
Dynamic pressure, 474
Energy flux, 479
Energy flux of compressible component, 479
Energy flux of incompressible component, 479
Energy transfers, 476
Incompressible components, 473
Locality of interactions, 478
Modal internal energy, 477
Modal kinetic energy, 477
Nearly incompressible flow, 471
Thermodynamic pressure, 469, 474
Computation of energy transfers using experimental data, 75
Conservation laws, 16
Burgers turbulence, 462
Compressible flow, 469
Enstrophy, 17
Kinetic energy, 16
Kinetic helicity, 17
MHD turbulence, 312
Cross helicity, 314
Magnetic helicity, 314
Mean square vector potential, 315
Total energy, 314
Shell model, 454
Tensor turbulence, 444
Coriolis force, 430
Correlation function
Second order, 206
Second order (Fourier space), 173
Second order (real space), 197, 239, 366
Third order (real space), 200, 240, 366
Craya-Herring basis, 136
\hat{e}_{1,2}(k), 136
Compressible turbulence, 473
Energy transfers, 144
Enstrophy transfers, 146
Equations of motion, 138, 142, 226, 301, 322
Kinetic helicity transfers, 147
Magnetohydrodynamics, 321
MHD turbulence, 353
Mode-to-mode transfer, 144, 226, 301, 353
Parity transformation, 139
Scalar field, 225
Vector turbulence, 300, 301
Detailed conservation
Burgers turbulence, 463
Craya–Herring components in hydrodynamic turbulence, 145
Helical components in hydrodynamic turbulence, 164
Hydrodynamic turbulence, 45
Kinetic helicity in hydrodynamics, 127
Magnetic helicity, 339
MHD turbulence, 330
Scalar turbulence, 219
Shell model, 455
Tensor turbulence, 445
## Subject Index

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vector turbulence, 298</td>
<td></td>
</tr>
<tr>
<td>Dissipation tensor, 199</td>
<td></td>
</tr>
<tr>
<td>Dynamic pressure, 474</td>
<td></td>
</tr>
<tr>
<td>Dynamo, 386</td>
<td></td>
</tr>
<tr>
<td>Analogy between the vorticity, 408</td>
<td></td>
</tr>
<tr>
<td>Anti-dynamo theorems, 387</td>
<td></td>
</tr>
<tr>
<td>Bifurcation analysis, 397</td>
<td></td>
</tr>
<tr>
<td>Bound on Rm, 389</td>
<td></td>
</tr>
<tr>
<td>Definitions, 387</td>
<td></td>
</tr>
<tr>
<td>Dynamic model, 396</td>
<td></td>
</tr>
<tr>
<td>Dynamo transition, 397</td>
<td></td>
</tr>
<tr>
<td>Energetics, 389</td>
<td></td>
</tr>
<tr>
<td>Energy transfer, 399</td>
<td></td>
</tr>
<tr>
<td>Kinematic models, 389</td>
<td></td>
</tr>
<tr>
<td>Large-Pm dynamos, 403</td>
<td></td>
</tr>
<tr>
<td>Large-scale dynamos, 405</td>
<td></td>
</tr>
<tr>
<td>Roberts dynamo, 391</td>
<td></td>
</tr>
<tr>
<td>Role of helicities, 407</td>
<td></td>
</tr>
<tr>
<td>Six-model model, 389</td>
<td></td>
</tr>
<tr>
<td>Small-Pm dynamos, 401</td>
<td></td>
</tr>
<tr>
<td>Tetrahedron helical dynamo model, 393</td>
<td></td>
</tr>
<tr>
<td>Dynamo transition, 397</td>
<td></td>
</tr>
<tr>
<td>Ekman friction, 481</td>
<td></td>
</tr>
<tr>
<td>Energy flux, 482</td>
<td></td>
</tr>
<tr>
<td>Energy spectrum, 482</td>
<td></td>
</tr>
<tr>
<td>Ekman turbulence, 66</td>
<td></td>
</tr>
<tr>
<td>Electron MHD turbulence, see EMHD turbulence, 420</td>
<td></td>
</tr>
<tr>
<td>Elsässer variables, 312</td>
<td></td>
</tr>
<tr>
<td>EMHD turbulence, 420</td>
<td></td>
</tr>
<tr>
<td>Energy transfer, 425</td>
<td></td>
</tr>
<tr>
<td>Turbulence phenomenology, 423</td>
<td></td>
</tr>
<tr>
<td>Energetics arguments, 14</td>
<td></td>
</tr>
<tr>
<td>Hydrodynamic turbulence, 63, 80</td>
<td></td>
</tr>
<tr>
<td>Energy exchange between $u_\parallel$ and $u_\perp$, 192</td>
<td></td>
</tr>
<tr>
<td>Energy flux, 82</td>
<td></td>
</tr>
<tr>
<td>3D hydrodynamic turbulence, 82</td>
<td></td>
</tr>
<tr>
<td>Burgers turbulence, 464</td>
<td></td>
</tr>
<tr>
<td>Compressible turbulence, 479</td>
<td></td>
</tr>
<tr>
<td>FENE-p model, 449</td>
<td></td>
</tr>
<tr>
<td>Field theory, 179</td>
<td></td>
</tr>
<tr>
<td>Hydrodynamic turbulence, 82</td>
<td></td>
</tr>
<tr>
<td>Kolmogorov’s theory, 82</td>
<td></td>
</tr>
<tr>
<td>MHD turbulence, 359</td>
<td></td>
</tr>
<tr>
<td>Passive scalar turbulence, 230</td>
<td></td>
</tr>
<tr>
<td>Passive tensor turbulence, 447</td>
<td></td>
</tr>
<tr>
<td>Passive vector turbulence, 306</td>
<td></td>
</tr>
<tr>
<td>Energy flux</td>
<td></td>
</tr>
<tr>
<td>Shell model, 457</td>
<td></td>
</tr>
<tr>
<td>Energy spectrum</td>
<td></td>
</tr>
<tr>
<td>2D hydrodynamic turbulence, 119</td>
<td></td>
</tr>
<tr>
<td>3D hydrodynamic turbulence, 82</td>
<td></td>
</tr>
<tr>
<td>Burgers turbulence, 464</td>
<td></td>
</tr>
<tr>
<td>FENE-p model, 449</td>
<td></td>
</tr>
<tr>
<td>Helical turbulence, 130</td>
<td></td>
</tr>
<tr>
<td>MHD turbulence, 358</td>
<td></td>
</tr>
<tr>
<td>Passive scalar turbulence, 230</td>
<td></td>
</tr>
<tr>
<td>Passive tensor turbulence, 447</td>
<td></td>
</tr>
<tr>
<td>Passive vector turbulence, 306</td>
<td></td>
</tr>
<tr>
<td>Energy transfers, 434</td>
<td></td>
</tr>
<tr>
<td>Compressible turbulence, 476</td>
<td></td>
</tr>
<tr>
<td>Enstrophy, 12, 268</td>
<td></td>
</tr>
<tr>
<td>Enstrophy flux, 119</td>
<td></td>
</tr>
<tr>
<td>2D hydrodynamic turbulence, 119</td>
<td></td>
</tr>
<tr>
<td>3D Hydrodynamics, 111</td>
<td></td>
</tr>
<tr>
<td>Equations of motion for Fourier modes</td>
<td></td>
</tr>
<tr>
<td>Craya–Herring basis, 142, 301, 322, 226</td>
<td></td>
</tr>
<tr>
<td>Fourier basis, 27</td>
<td></td>
</tr>
<tr>
<td>Helical basis, 163, 325</td>
<td></td>
</tr>
<tr>
<td>Euler turbulence, 90</td>
<td></td>
</tr>
<tr>
<td>Experimental and numerical results, 437</td>
<td></td>
</tr>
<tr>
<td>© in this web service Cambridge University Press</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.cambridge.org">www.cambridge.org</a></td>
<td></td>
</tr>
<tr>
<td>Subject Index</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>Enstrophy supply rate, 32</td>
<td></td>
</tr>
<tr>
<td>Kinetic energy supply rate $F_u(k)$, 28</td>
<td></td>
</tr>
<tr>
<td>Kinetic helicity supply rate, 31</td>
<td></td>
</tr>
<tr>
<td>Fast Fourier transform (FFT), 74</td>
<td></td>
</tr>
<tr>
<td>FENE-p model</td>
<td></td>
</tr>
<tr>
<td>Turbulence phenomenology, 449</td>
<td></td>
</tr>
<tr>
<td>Vector energy flux, 449</td>
<td></td>
</tr>
<tr>
<td>Vector energy spectrum, 449</td>
<td></td>
</tr>
<tr>
<td>Field theory</td>
<td></td>
</tr>
<tr>
<td>Kinetic energy flux, 179</td>
<td></td>
</tr>
<tr>
<td>Kinetic energy flux (2D), 182</td>
<td></td>
</tr>
<tr>
<td>Mode-to-mode energy transfer, 174, 181</td>
<td></td>
</tr>
<tr>
<td>Mode-to-mode kinetic helicity transfer, 184</td>
<td></td>
</tr>
<tr>
<td>Shell-to-shell kinetic energy transfer, 179</td>
<td></td>
</tr>
<tr>
<td>Shell-to-shell kinetic energy transfer (2D), 182</td>
<td></td>
</tr>
<tr>
<td>Finance model, 494</td>
<td></td>
</tr>
<tr>
<td>Cascade of wealth, 494</td>
<td></td>
</tr>
<tr>
<td>Equilibrium regime, 496</td>
<td></td>
</tr>
<tr>
<td>Wealth distribution, 494</td>
<td></td>
</tr>
<tr>
<td>Flow on a sphere, 484</td>
<td></td>
</tr>
<tr>
<td>Modal energy, 486</td>
<td></td>
</tr>
<tr>
<td>Spherical harmonics, 485</td>
<td></td>
</tr>
<tr>
<td>Flow with a scalar, 215</td>
<td></td>
</tr>
<tr>
<td>Flow with a tensor, 443</td>
<td></td>
</tr>
<tr>
<td>Flow with a vector, 295</td>
<td></td>
</tr>
<tr>
<td>Flow with an active tensor field: FENE-p model, 448</td>
<td></td>
</tr>
<tr>
<td>Flux</td>
<td></td>
</tr>
<tr>
<td>Kinetic energy flux, see energy flux, 82</td>
<td></td>
</tr>
<tr>
<td>MHD turbulence, 343</td>
<td></td>
</tr>
<tr>
<td>Scalar energy, 222</td>
<td></td>
</tr>
<tr>
<td>Stably stratified turbulence, 251</td>
<td></td>
</tr>
<tr>
<td>Tensor energy, 446</td>
<td></td>
</tr>
<tr>
<td>Thermal convection, 266</td>
<td></td>
</tr>
<tr>
<td>Vector turbulence, 298</td>
<td></td>
</tr>
<tr>
<td>Four-third law and energy flux, 369</td>
<td></td>
</tr>
<tr>
<td>Four-third law and scalar energy flux, 242</td>
<td></td>
</tr>
<tr>
<td>Fourier mode, 4, 23</td>
<td></td>
</tr>
<tr>
<td>Energy, 5</td>
<td></td>
</tr>
<tr>
<td>Enstrophy, 31</td>
<td></td>
</tr>
<tr>
<td>Kinetic energy, 27</td>
<td></td>
</tr>
<tr>
<td>Kinetic helicity, 30</td>
<td></td>
</tr>
<tr>
<td>Vorticity, 29</td>
<td></td>
</tr>
<tr>
<td>Fourier series, 23</td>
<td></td>
</tr>
<tr>
<td>Fourier space description</td>
<td></td>
</tr>
<tr>
<td>Navier-Stokes equations, 27</td>
<td></td>
</tr>
<tr>
<td>Pressure, 24, 74</td>
<td></td>
</tr>
<tr>
<td>Fourier space description of hydrodynamics, 23</td>
<td></td>
</tr>
<tr>
<td>Galerkin truncation, 72</td>
<td></td>
</tr>
<tr>
<td>Gyrokinetic turbulence, 483</td>
<td></td>
</tr>
<tr>
<td>Mode-to-mode energy transfer, 484</td>
<td></td>
</tr>
<tr>
<td>Helical basis, 157</td>
<td></td>
</tr>
<tr>
<td>$\hat{e}_\pm(k)$, 157</td>
<td></td>
</tr>
<tr>
<td>Energy transfers, 165</td>
<td></td>
</tr>
<tr>
<td>Enstrophy transfers, 167</td>
<td></td>
</tr>
<tr>
<td>Equations of motion, 163, 325</td>
<td></td>
</tr>
<tr>
<td>Helical decomposition, 157</td>
<td></td>
</tr>
<tr>
<td>Kinetic helicity transfers, 166</td>
<td></td>
</tr>
<tr>
<td>Magnetohydrodynamics, 325</td>
<td></td>
</tr>
<tr>
<td>MHD turbulence, 354</td>
<td></td>
</tr>
<tr>
<td>Mode-to-mode transfer, 165, 301, 354</td>
<td></td>
</tr>
<tr>
<td>Vector turbulence, 301</td>
<td></td>
</tr>
<tr>
<td>Helical mode</td>
<td></td>
</tr>
<tr>
<td>$u_+$, 158</td>
<td></td>
</tr>
<tr>
<td>$u_-$, 160</td>
<td></td>
</tr>
<tr>
<td>Circularly polarized, 159</td>
<td></td>
</tr>
<tr>
<td>Elliptic polarization, 161</td>
<td></td>
</tr>
</tbody>
</table>
Maximal helical mode, 158
Mixture of $u_+$ and $u_-$, 161
Planes polarization, 161
Helical turbulence, 126
   Energy flux, 130
   Energy spectrum, 130
   Kinetic helicity flux, 131
   Kinetic helicity spectrum, 131
Homogeneous and isotropic turbulence,
   28, 196–197, 239, 365
Hydrodynamic turbulence
   Combined energy transfer, 45
   Detailed energy conservation of
      Craya–Herring components, 145
   Detailed energy conservation of
      helical components, 164
   Detailed kinetic energy
      conservation, 45
   Detailed kinetic helicity
      conservation, 127
dissipation length $l_d$, 84
Dissipative regime, 91
energetics arguments, 80
Energy flux $\Pi_u(k)$, 82
Energy spectrum $E_u(k)$, 82
Enstrophy flux, 111
Field theory (see Field theory), 172
Fluctuations in the energy flux, 91
Four-fifth law, 203–204
Heisenberg’s theory, 98
Intermittency correction, 210
Kolmogorov’s constant $K_{Ko}$, 82
Kolmogorov’s length, 84
Kolmogorov’s theory, 79
Kolmogorov’s wavenumber, 84
Pao’s model, 92
Shell-to-shell energy transfer, 88
Transition wavenumber between
   inertial and dissipation $k_{DI}$, 81
Two-dimensional
   Energy inverse cascade, 119
   Enstrophy forward cascade, 119
   Kraichnan’s theory, 119
Incompressibility approximation, 9
Inertial waves, 432
Integral form
   Enstrophy, 14
   Kinetic energy, 14
Intermittency
   $\beta$ model, 210
   Hydrodynamic turbulence, 210
   Kolmogorov’s log-normal model,
      210
   Log-Poisson model, She-Leveque
      model, 211
   MHD turbulence, 370
   Multifractal model, 210
   Thermal convection, 278
Inviscid flows, 16
Kinematic viscosity, 9
Kinetic energy, 12
   Also KE, 12
   density $E_u(r)$, 12
   modal $E_u(k)$, 26, 158
   total $E_u$, 12, 26
Kinetic energy transfers
   2D hydrodynamics, 55
   Arrow of time, 71
   Computation using data, 75
   Computation using experimental
      data, 77
   Craya–Herring basis, 144
   Dar et al., 45
   Energy flux, 59
   Frisch, 67
   Hydrodynamics, 44
   Kraichnan, 67
Mode-to-Mode energy transfer, 44
Shell-to-shell transfer, 68
Variable energy flux, 63
Variable scalar energy flux, 222
Verma, 45
Kinetic helicity, 12, 30
density $H_K(r)$, 12
modal $H_K(k)$, 138, 158
Thermal convection, 267
total $H_K$, 13
Kinetic helicity transfers, 126
Craya–Herring basis, 147
Helical basis, 166
Kolmogorov’s four-fifth law and energy flux, 207
Kolmogorov’s theory of turbulence, 79, 82
Energy flux, 82
Structure function, 201, 209
Kolmogorov’s theory of turbulence: four-fifth law (K41), 203
Laminar flows
   Energy flux, 95
   Energy spectrum, 95
Linear energy transfer, 3
Locality of interactions
Compressible turbulence, 478
Low-dimensional models, 72
Magnetic energy, 312
Magnetic field generation in MHD, 386
Magnetic Reynolds number, 327
Magnetohydrodynamics
   $\nu_k$, 312
   $F_B$, 310
   $F_u$, 309
Alfvén ratio $r_A$, 313
Alfvén wave, 320
Conservation laws, 312
Craya–Herring basis, 321
Cross helicity, 312
Elsässer variables, 312
Energy of $z^\pm$, 312
Enstrophy, 312
Formalism, 308
Governing equations in Fourier space, 316
Governing equations in real space, 308
Helical basis, 325
Magnetic energy, 312
Magnetic helicity, 312
Magnetic Reynolds number, 327
Mean square vector potential, 312
Nondimensionalized equations, 327
Vector potential, 311
Vorticity, 310
With a constant magnetic field, 311
Maximal helical mode, 158
MHD turbulence, 329, 358
$S^{AA}$, 341
$S^{bb}$, 332
$S^{bu}$, 333
$S^{H_K}$, 340
$S^{H_M}$, 339
$S^{ab}$, 331, 333
$S^{z^\pm z^\pm}$, 336
$\Pi^{b<}_b$, $\Pi^{a<}_b$, $\Pi^{b>}_b$, 344
$\Pi^{a<}_u$, $\Pi^{b<}_u$, $\Pi^{b>}_u$, 343
$\Pi_{tot}$, $\Pi_{He}$, 347
$\Pi_{H_K}$, $\Pi_A$, 346
$\Pi_{z^\pm}$, $\Pi_{H_M}$, 345–346
Alfvén frozen-in theorem, 314
Boldyrev et al.—Dynamic alignment, 364
Combined energy transfer, 329
Conserved flux, 347
Craya–Herring basis, 353
Critical balance, 362
Detailed conservation, 330
Detailed conservation of magnetic helicity, 339
Dobrowonly et al.’s model, 359
Energy flux-based model, 361
Flux, 343
Four-third law, 365
Galtier et al.—Weak turbulence, 364
Goldreich and Sridhar, 362
Helical basis, 354
Kolmogorov-like turbulence phenomenology, 361
Kraichnan and Iroshnikov’s model, 358
Large Pm MHD, 376
Magnetic dissipation wavenumber, 373
Marsch, 361
Modal energies, 318
Mode-to-mode transfer, 331, 336
Models, 358
Normalized cross helicity $\sigma_c$, 313
Numerical simulations, 380
Scaling of cross helicity, 371
Scaling of magnetic helicity, 372
Shell model, 460
Shell-to-shell transfer, 351
Small Pm MHD, 374
Solar wind, 377
Structure functions, 365, 370
Turbulence phenomenology, 358
Turbulent drag reduction, 408
Variable energy flux, 347
Verma—Effective mean magnetic Field, 363
Viscous dissipation wavenumber, 373
With a mean magnetic field, 383
Mode-to-mode transfer, 44
Craya–Herring basis, 144, 226, 301, 353
Enstrophy, 183
Craya–Herring basis, 146
Field theory, 175
Giver or donor, 46
Helical basis, 165, 301, 354
Kinetic energy, 44, 101, 175
Kinetic helicity, 184
Mathematical argument, 220
Mediator, 46
MHD turbulence, 331, 336
Physical argument, 48, 103, 220, 337, 446
Receiver, 46
Scalar energy, 218
Shell model, 455, 459
Stably stratified turbulence, 251
Tensor energy, 445
Thermal convection, 266
Vector turbulence, 298
Navier–Stokes equations, 3, 9
in Fourier space, 27
Nondimensionalized version, 10
Tensorial form, 10
Nearly incompressible flow, 471
Nonlinear energy transfer, 4–5
Hydrodynamic turbulence, $T_u(k)$, 27
Hydrodynamic turbulence, $T_u(l)$, 203
MHD turbulence, 342, 367
Scalar turbulence, 241
Scalar turbulence, $T_\theta(k)$, 221
Nonlinear energy transfers $T_u(k)$, 27
Normalized cross helicity $\sigma_c$, 313
Numerical computation of energy transfers, 75
Numerical simulations, 73
Obukhov–Corrsin constant $K_{OC}$, 231
One-dimensional KE spectrum, 28, 174
Péclet number, 216
Pao’s model
  2D hydrodynamic turbulence, 120
  3D hydrodynamic turbulence, 92
  Burgers turbulence, 465
  Helical turbulence, 131
  MHD turbulence, 371
  Passive scalar turbulence, 233
  Thermal convection, 283
Parseval’s theorem, 25
Passive scalar turbulence, 229
  Batchelor’s formula, 234
  Batchelor’s scaling, 236
  energy spectrum $E_{\phi}(k)$, 233
  energy spectrum for laminar flow, 233
  Field-theoretic treatment, 243
  Four-third law, 239
  Governing equations, 229
  Kraichnan’s scaling, 236
  Laminar regime, 233
  Numerical results, 237
  Numerical results for $Sc \approx 1$, 237
  Numerical results for $Sc \gg 1$, 238
  Numerical results for $Sc \ll 1$, 238
  Obukhov–Corrsin constant $K_{OC}$, 231
  Pao’s model, 233
  Scalar energy flux $\Pi_{\phi}(k)$, 230
  Scalar energy spectrum $E_{\phi}(k)$, 230
  Structure functions, 239
  Turbulence phenomenology, 230
  Turbulent regime, 232, 235
  Various regimes, 231
  Passive tensor turbulence, 447
  Turbulence phenomenology, 447
  Vector energy flux, 447
  Vector energy spectrum, 447
  Passive vector turbulence, 305
  Governing equations, 305
  Turbulence phenomenology, 306
  Various regimes, 307
  Vector energy flux $\Pi_{w}(k)$, 306
  Vector energy spectrum $E_{w}(k)$, 306
  Power law physics, 491
  Prandtl number, 216, 265
  Pressure, 9
    in Fourier space, 24, 27
  Projection tensor, 199
QS MHD turbulence, see Quasi-static MHD turbulence, 410
Quasi-static MHD turbulence, 66, 410
  Energy transfer, 412, 418
  Governing equations, 410
  Interaction parameter, 411
  Joule dissipation, 412
  Pao’s model, 414
  Ring energy spectrum, 417
  Turbulence model, 414, 416
  Rayleigh number, 265
  Renormalization group analysis of hydrodynamic turbulence, 497
  Renormalized viscosity, 501
  Reynolds number, 10
  Reynolds number based on Taylor’s microscale $Re_{\lambda}$, 200
  Ring spectrum, 187, 189
  Roberts dynamo, 391
  Rossby number, 430
  Rotating turbulence, 429
  Energy transfers and fluxes, 437
Subject Index 535

Kuznetsov-Zakharov-Kolmogorov spectrum, 436
Phenomenologies, 434
Smith and Waleffe’s phenomenology, 435
Zeman’s phenomenology, 434
Zhou’s phenomenology, 435

Scalar turbulence, 215
Active, 215
Combined energy transfer, 219
Craya–Herring basis, 225
Detailed energy conservation, 219
Flux $\Pi_\theta(k)$, 222
Governing equations, 215
Mode-to-mode transfer, 218
Nonlinear terms, 217
Péclet number, 216
Passive, 215
Passive scalar, see Passive scalar turbulence, 229
Prandtl number, 216
Schmidt number, 216
Shell-to-shell transfer, 222
Stably stratified turbulence, see Stably stratified turbulence, 245
Thermal convection, see Thermal convection, 262
Variable flux, 223
Schmidt number, 216
Shell model, 452
Combined energy transfer, 455
Detailed energy conservation, 455
Energy flux, 456
MHD turbulence, 460
Mode-to-mode transfer, 455, 459
Polymeric flow, 460
Scalar turbulence, 458
Shell-to-shell transfer, 457
Stably stratified turbulence, 459
Tensor turbulence, 458
Thermal convection, 459
Vector turbulence, 458
Shell-to-shell transfer
2D hydrodynamic turbulence, 124
3D hydrodynamic turbulence, 68
MHD turbulence, 351
Scalar turbulence, 222
Shell model, 457
Thermal convection, 279
Sound wave, 470
Spectral decomposition, 72
Spectral method, 73
Pseudo-spectral simulation, 73
Stably stratified turbulence, 245
Bolgiano wavenumber, 256
Bolgiano–Obukhov Phenomenology, 253
Brunt-Väisälä frequency $N$, 247
Conservation of total energy, 248
Enstrophy, 251
Flux $\Pi_{\rho}$, 251
Governing equations in Fourier space, 249
Governing equations in real space, 245
Internal gravity wave, 247
Kinetic energy flux, 255
Kinetic energy injection rate, 248
Kinetic helicity, 250
Mode-to-mode transfer, 251
Modified Bolgiano-Obukhov Phenomenology, 256
Numerical results, 259
Oberbeck-Boussinesq (OB) approximation, 246
Potential energy flux, 255
Shell model, 460
Various regimes, 252
With moderate buoyancy, 253
Stably-stratified turbulence, 66
Structure functions
Burgers turbulence, 464
Hydrodynamic turbulence, 202, 209
MHD turbulence, 365, 370
Passive scalar turbulence, 239
Thermal convection, 273
Taylor’s microscale, 199, 200
Taylor-Proudman theorem, 431
Tensor turbulence, 443
Active, 443
Combined energy transfer, 445
Conservation laws, 444
Detailed energy conservation, 445
Flux $\Pi_C(k)$, 446
Governing equations, 443
Mode-to-mode transfer, 445
Nonlinear terms, 444
Passive, 443
Shell model, 460
Turbulent drag reduction, 450
Variable flux, 447
Thermal convection, 66, 262
Anisotropy, 281
Conservation law, 264
Energy dissipation, 280
Enstrophy, 268
Entropy, 264
 Fluxes, 266
Four-fifth law, 273
Governing equations, 262
Infinite Prandtl number, 286
Kinetic energy dissipation rate, 271
Kinetic energy flux, 270
Kinetic energy injection rate, 270
Kinetic energy spectrum, 270
Kinetic helicity, 267
Kolmogorov-like turbulence phenomenology, 269
Mode-to-mode transfer, 266
Numerical results on spectra and fluxes, 275
Numerical simulation, 275
Pao’s model, 283
Prandtl number, 265
Rayleigh number, 265
Scalar energy flux, 272
Shell model, 460
Shell-to-shell transfer, 279
Structure functions, 273, 278
Turbulence phenomenology, 269
Turbulent drag reduction, 280
Two-dimensional, 287
Zero Prandtl number, 284
Thermodynamic pressure, 469
Turbulence phenomenology
2D hydrodynamic turbulence, 119
3D hydrodynamic turbulence, 79
Burgers turbulence, 464
FENE-p model, 449
Helical turbulence, 130
MHD turbulence, 358
Passive scalar turbulence, 230
Passive tensor turbulence, 447
Passive vector turbulence, 306
Turbulent flow, 10
Turbulent drag reduction
MHD turbulence, 408
Tensor turbulence, 450
Thermal convection, 280
Variable energy flux, 63
2D hydrodynamic energy, 119
3D hydrodynamic turbulence, 63
Ekman friction, 481
### Subject Index

<table>
<thead>
<tr>
<th>MHD turbulence, 347</th>
<th>Helical basis, 301</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalar turbulence, 223</td>
<td>Mode-to-mode transfer, 298</td>
</tr>
<tr>
<td>Tensor turbulence, 447</td>
<td>Nonlinear terms, 297</td>
</tr>
<tr>
<td>Vector turbulence, 300</td>
<td>Reynolds number based on $w$, 296</td>
</tr>
<tr>
<td>Vector turbulence, 295</td>
<td>Variable energy flux, 300</td>
</tr>
<tr>
<td>Combined energy transfer, 298</td>
<td>Viscous dissipation rate, 28</td>
</tr>
<tr>
<td>Craya–Herring basis, 300–301</td>
<td>Viscous flow, 10</td>
</tr>
<tr>
<td>Detailed energy conservation, 298</td>
<td>Vortex stretching, 14, 106, 111, 408</td>
</tr>
<tr>
<td>Flux, 299</td>
<td>Vorticity, 11, 138</td>
</tr>
<tr>
<td>Governing equations, 295</td>
<td>in Fourier space, 29</td>
</tr>
</tbody>
</table>