

Index

- Ablation front, 8, 9, 15, 23, 40, 41, 43, 324–338, 506, 507, 509–523, 525, 646, 648
- Ablation wave in ICF, 324–338
 - ablation velocity, 328
 - absorption layer, 325
 - comparison with flames, 330–333
 - density and temperature profiles, 326
 - linear growth rate, 329
 - quasi-isobaric model, 327–329
- Ablative Rayleigh–Taylor instability, 329–338
 - anti-Darrieus–Landau relaxation, 334
 - dispersion relation, 330, 333–335
 - nonlinear dynamics, 336
- Accretion
 - shock, 39, 361
 - surface, 39
- Acoustic (or sound) wave, 5, 266, 538, 559–561
- Acoustic instability, *see* Thermo-acoustic instability
- Acoustic restabilisation, 116
- Activation energy, 20
- Admittance function, 106
- d’Alembert’s equation, 106, 208, 244, 530, 673
- Arrhenius law, 20–21, 23, 52, 110, 213, 225, 240, 283, 288–290, 381, 382, 441, 452, 545, 547, 624, 625
- Autocatalytic, *see* Chain branching
- Avogadro number, 313, 609

- Barrère–Borghi diagram, 180
- Bernoulli equation, 656
- Beta decay, 364
- Bifurcation, 479, 480, 554
 - analysis, 544
 - Hopf, *see* Poincaré–Andronov bifurcation
 - parameter, 80, 549
 - secondary, 294, 544
 - subcritical, 176
- Binding energy, 18, 30, 364, 608, 624
- Blast, 41
 - energy, 38
 - explosion, 235, 237, 680
 - furnace, 2, 628
 - wave, 33, 233, 236, 241–243, 682, 684
- Bohr radius, 589
- Boltzmann, 573, 592
 - collision operator, 594
 - constant, 573, 609
 - counting, 579
 - entropy, 594, 595, 600, 601
 - equation, 19, 24, 218, 219, 222, 300, 302, 345, 350, 363, 592–601, 640, 648, 652
 - gas, 343, 348, 349, 363, 581–583, 586, 589
 - H theorem, 302, 591, 594, 595
 - linear equation, 598
 - statistic, 342
- Bose–Einstein distribution, 583
- de Broglie, 586, 589
- Brownian
 - motion, 178, 601, 603, 604
 - particle, 603
- Bunsen flame, 16, 17, 58, 64, 96, 120, 181, 184, 201, 202
 - open tip, 76, 92, 98, 100, 101, 184
- Burgers’ equation, 139, 172, 273, 274, 670
- Burke–Schumann diffusion flame, 26

- Candle, 3, 5, 17, 33, 91
 - candles of the universe, 8
- Carnot, 4, 570, 572, 652
- Cellular detonation, *see* Detonation, cellular
- Cellular flame, 5, 78–81, 90, 101, 103, 104, 107, 110–121, 134, 135, 140–151, 176, 190, 380, 477–480
- Chain branching, 52, 308–309, 312–318
- Chain breaking, 306–309, 313–315, 318, 409–410
- Chandrasekhar mass, 34, 35, 37, 352, 355, 357
- Chapman–Enskog method, 596, 597, 599, 640
- Chapman–Jouguet, *see under* Detonation
- Chemical kinetic scheme, 15, 51, 55, 243, 283, 291, 292, 306, 307, 311, 315, 319–321, 425, 562, 621, 626, 627, 630, *see also* Four-step reaction model; Three-step reaction model; Two-step reaction model
 - global, 618, 621
 - reduced, 307

- Chemical kinetics, 8, 19–21, 50, 62, 63, 73, 231, 232, 237, 238, 248, 290, 295, 306–322, 379, 381, 387, 425
- Chemical potential, 570, 571, 582, 585–587, 590, 622, 623, 650
- Clausius, 4, 573, 591, 651
- Cold boundary difficulty, 383
- Combustion modes, 15–18
- Combustion noise, 197–203, 659, 660
- blowtorch, 201–203
 - intensity, 198–200
 - origin, 197
 - power spectrum, 200–201
- Combustion temperature, 18–19, 21, 25, 79, 310, 409, 628–633
- Conical flame in acoustic field, 120
- Cool flames, 21–22
- Core collapse, 35–39, 363
- Correlation, 207
- dynamics of, 595
 - function, 178, 179, 200, 203, 603–605, 659
 - length, 190
 - long range, 342
 - time, 604
- Corrugated flamelet regime, 183, 190–196
- Countergradient diffusion, 179
- Cross section, 20, 41, 101, 103, 181, 251, 593, 598, 634, 636
- Crossover temperature, 51, 82, 85, 88, 231, 259, 290, 309, 310, 314, 315, 317, 319, 320, 404, 426, 432, 434, 435, 440, 441, 448, 456
- Curvature, 17, 61–64, 69–77, 93–101, 131–133, 156–157, 181–184, 233–243, 337–338
- quenching by, *see* Quenching
- Curved flame front, 124–135, 485
- approximate solution, 129
 - stability, 131
 - stretching, 132
- Curved fronts, 121–135
- Cusp formation, 63
- Cusped flame regime, 135
- Cutoff temperature, 21, 51
- Damköhler
- number, 414, 415
 - turbulent regime, 180
- Darrieus–Landau instability, 56, 58
- dispersion relation, 60, 149
 - experiments, 67, 146–152
 - integral operator, 136
 - linear analysis, 59
 - marginal wavenumber, 63
 - nonlinear dynamics, 149–152
 - small wavelength stability, 61
 - stability threshold, 66
- DDT, 7, 15, 35, 250–261, *see also* DDT experiments
- by localised thermal explosion, 252–253
 - other acceleration mechanisms, 255–256
 - phenomenology, 250–251
 - runaway mechanism, 253–255
 - turbulence induced, 251
- DDT experiments, 256–261
- in capillary tubes, 258–259
 - in choked tubes, 258
 - in ordinary tubes, 256–257
- Debye, 363
- length, 345
- Deflagration-to-detonation transition, *see* DDT; DDT experiments
- Deflection of streamlines, 58
- Degenerate electron gas, 35, 343, 588
- nonrelativistic, 352, 588
 - relativistic, 590
- Detonability limits, 232, 257
- Detonation, 27–29, 213–300, 543–563, *see also*
- Detonation, cellular; Detonation, galloping
 - burnt gas state, 224–227
 - Chapman–Jouguet, 27–29, 213, 224, 229–231
 - dispersion relation, 296, 551–556, 562–563
 - inner structure of wrinkled detonation, 561
 - instability, *see* Detonation, cellular; Detonation galloping
 - nonlinear equation, 287, 290, 298–300, 546–548, 556–557
 - overdriven, 223, 227, 235, 281, 282, 284–298, 311, 541–543, 557–563
 - propagation speed, 27
 - quenching, *see* Quenching
 - spherical
 - effect of curvature, 238–242
 - inner structure, 236–242
 - self-similar solution, 233–234
 - spinning, 257, 261
 - square-wave model, 239, 283, 288
 - stability analysis, 539–543
 - structure of, *see* ZND structure of detonation
 - temperature, velocity, pressure profiles, 228–229
 - thickness, 29, 35, 233, 238, 239, 242, 246, 292, 296, 298, 545, 550, 554, 557, 559
 - transit time, 246, 247, 249, 298
- Detonation, cellular, 292–300, 550–557
- Chapman–Jouguet regime, 300, 550–557
 - diamond pattern, 279, 281, 292, 299
 - dispersion relation, 296
 - instability threshold, 294–298
 - nonlinear equation, 298–300, 546–557
 - at strong overdrive, 557–563
- Detonation, galloping, 281–292, 539, 546–550
- dispersion relation, 289
 - instability threshold, 290
 - modified Arrhenius model, 288
 - nonlinear dynamics, 287, 290
 - pulsating, 539, 554
- Detonation ignition, *see* Detonation initiation

- Detonation initiation, 231–261
 - critical ignition energy, 242–243
 - direct initiation, 233–243
 - infinitely fast chemistry approximation, 235
 - in parallel flow, 255, 260
 - spontaneous initiation, 243–250, 663
 - in a temperature gradient, 244–250
 - Zeldovich criterion, 236
- Detonation quenching, *see* Quenching
- Deuterium–tritium reaction, 40, 636
- Diamond pattern, *see under* Detonation, cellular
- Diffusion coefficient, 32, 145, 166, 168, 225, 335, 405, 420, 494, 602, 603, 648
 - binary, 642
 - molecular, 25, 26, 78, 85, 118
 - thermal, 22, 62, 118, 328, 419, 420, 599, 652
 - turbulent, 178, 179
 - viscous, 118, 181, 204, 205, 260, 419, 599, 652
- Diffusion flame, 17, 24–26
- Direct drive, 42
- Discontinuity, 39, 107, 401, 405, 525, 664
 - hydrodynamic, 55, 58, 69, 124, 125, 230–239, 262–332, 647–649, 665–678
 - reaction layer, 391, 392
 - supersonic, 533
 - surface of, 181
 - weak, 678–680
- Dispersion relation, 61, 146, 148, 149, 263–265, 270, 294, 296, 298, 330, 331, 334, 470, 477, 480, 493, 511, 514, 518, 533, 534, 539, 542, 551–554, 562
 - ablative Rayleigh–Taylor instability, 330
 - Darrius–Landau instability, 60
 - detonation, 551–556, 562–563
 - shock wave, 263–265, 533–535
- Dissipation, 591
 - fluctuation–dissipation, 601, 603, 604
 - scale, *see under* Kolmogorov
 - viscous, 185, 220, 252, 256, 260, 644–646
- Doring, *see* ZND structure of detonation
- Einstein, 583, 601, 604
 - Brownian motion, 178
 - relation, 601, 604
- Electron, 35–39, 363
- Electron capture, 35–39, 346, 364
- Entropy, 4, 37, 217–222, 230, 302, 343, 348, 350, 355, 364, 655, 663–664, 672–677
 - Boltzmann, 594–595, 600
 - flux, 600–601, 650–654
 - jump, 222, 652, 678
 - at local equilibrium, 599, 600
 - production, 260, 600–601, 650–654, 657, 664
 - spots, 660
 - statistical, 573–577, 586–591, 595
 - thermodynamic function, 570–573, 582, 621–622
 - wave, 262, 282, 283, 286, 292, 295, 300, 530–533, 543–549, 557–560
- Equivalence ratio, 18, 19, 51, 90, 149, 168, 259, 386, 410, 631, 633
- Euler constant, 407
- Euler equations, 126, 127, 230, 233, 262, 271, 294, 303, 421, 464, 499, 519, 530, 532, 543, 598, 652, 664
 - reactive, 543, 557, 558
- Euler–Poisson equation, 342, 344, 357
- Explosion of stars, 8, 9, 15, 39, 339–375
- Extinction, *see* Quenching
- Faraday instability, 103, 117, 470
- Fermi, 342, 343, 349, 363, 582, 583, 586
 - distribution, 583–586
 - energy, 363
 - gas, 582, 586–591
 - statistic, 342
 - temperature, 343, 349, 588
- Fick law, 23, 179, 640–642
- Fisher equation, 397, 398
- Fission, *see under* Nuclear
- Flame, wrinkled, *see* Wrinkled flame
- Flame balls, 77, 83, 85, 88–91, 431–459
- Flame dynamics
 - experiments, nonlinear dynamics, 149–152
 - linear, 55–137, 166–169
 - nonlinear, 137–146
 - sensitivity to noise, 141–146
- Flame initiation, 82, 95–100
- Flame instability
 - cellular, *see* Cellular flame
 - hydrodynamic, 55–69, 135–146, 463–473, 481–503
 - oscillatory, 478–480
 - parametric, 116–120, 148, 164–166, 169
 - pulsating, 77–81, 103, 389, 478–480
 - thermo-acoustic, *see* Thermo-acoustic instability
 - thermo-diffusive, 55, 56, 63, 77–81, 90, 135, 138, 142–144, 425, 463, 473–480
 - vibrating, 103
 - vibratory, 103–105
- Flame kernels, 81, 89–91, 431–459
- Flame quenching, *see* Quenching
- Flame speed, 60, 70, 417
 - at quenching, *see* Quenching
 - critical, 67, 68
 - curved, stretched, 16, 70, 472, 485
 - laminar, *see* Laminar flame speed
 - local, 61, 69–70, 73, 136, 184, 196, 485
 - near flammability limits, 425–428, 437
 - turbulent, *see* Turbulent premixed flames
 - wrinkled flame, 61, 69, 79, 184, 472, 483, 489
- Flame stretch, 69–77, 158–160
 - at Bunsen tip, 76
 - finite thickness effects, 74
 - high-frequency response, 76
 - in spherical flames, 75
 - pure curvature, 73

- pure strain, 72
- quenching by, *see* Quenching
- stretch rate, 70, 158–160
- Flame thickness, 24, 50, 54, 58, 61–64, 77, 80, 84, 88, 93, 94, 99, 124, 166, 179, 180, 331, 386, 389, 390, 420, 423, 431, 436, 448, 457, 463, 475, 483, 485, 488, 490, 497
- Flame transit time, 16, 23, 24, 50, 54, 70, 76, 97, 108, 136, 181, 187, 236, 237, 386, 389, 390, 414, 432, 475, 479, 483, 497, 550
- Flame, weakly wrinkled, *see under* Wrinkled flame
- Flammability limits, 21, 51, 309, 425–428, 437
- Floquet theory, 117
- Fluctuation–dissipation, *see* Dissipation
- Flux, 641–649
 - conductive, 380–393
 - convective, 177, 417, 432, 556
 - diffusive, 17, 24, 66, 79, 81–101, 346, 353
 - dissipative (diffusive), 598, 604, 642–649, 652
 - energy, 107, 108, 113, 205, 209, 325, 327, 328, 380–393
 - entropy, 650, 652
 - heat, 53, 54, 332, 380–393, 406, 596
 - incident, 593
 - mass, 50, 69, 75, 124, 127, 197, 215, 219, 247, 263, 282, 285, 344, 380–393, 406, 412–428, 465–558, 653
 - molecular, 642
 - momentum, 467, 652
 - neutrino, 33, 37, 39, 341, 364–375
 - neutron, 7
 - transverse, 61
- Four-step reaction model, 319
- Fourier
 - coefficient, 171
 - decomposition, 205, 492
 - equation, 645, 652
 - law, 23, 32, 179, 325, 640, 644, 645, 651
 - representation, 106, 538, 559
 - series, 122, 129, 171, 524
 - space, 136, 298
 - transform, 60, 169, 170, 200, 203, 532, 602, 603, 605, 659, 661
- Fractal
 - dimension, 193, 206–207
 - geometry, 191, 206–207
 - structure, 143
- Free energy, 581, 582
 - Gibbs, 622
 - Helmholtz, 579
- Free fall, 122
 - time, 353, 355
 - velocity, 347, 353, 358, 359
- Fronts, 30
- Froude number, 56, 67, 78, 117, 131, 329, 334, 482, 513
- Fusion, *see under* Nuclear
- G equation, 182
- Gamow
 - energy, 30, 634
 - tunnelling, 634
- Gibbs, 573, 576
 - chemical potential, 623
 - distribution, 577, 581
 - Gibbs–Duhem relation, 571
 - relation, 217, 570
- Gibson scale, 191–195, 207, 208
- Gravitational collapse, 8, 15, 34, 37–39, 341, 346, 347, 352–375
- Green
 - function, 92, 398, 448, 602, 671
 - retarded propagator, 659
- Green–Kubo relations, 603
- Helmholtz free energy, 579
- Hopf bifurcation, 288, 296, 298, 300, 478, 549, 555
- Hopf–Cole transformation, 670
- Hugoniot
 - curve, 215–219, 223, 225, 258, 263
 - relation, *see* Rankine–Hugoniot relations
- Huygens’ construction, 15, 64, 181, 182, 266, 274, 665
- Hydrodynamic instability, 43, 55–69, 78, 118, 135, 143, 161, 162, 295, 298, 495, 511
- Hydrogen kinetics, 311–317
 - crossover temperature, 314
 - effect of hydroxyl radical, 315
 - main elementary reactions, 311
 - rich flame model, 317
 - shuffle reactions, 313, 315
 - steady-state approximation for O and OH, 313
 - two-step model, 315–317
- Ignition, 16, 42, 51, 76, 77, 81–99, 142, 188, 425, 437, 454, 662
 - by constant heat source, 86
 - effect of Lewis number, 84
 - energy, 90–91, 242
 - facilitated by turbulence, 85
 - near flammability limit, 88–89
 - quasi-isobaric, 81–88, 436, 449
 - quasi-steady state approximation, 92–97
 - self-ignition, 252
 - spontaneous, *see* Detonation initiation
 - temperature, 31
 - thermonuclear, 8, 34, 40–43
 - time, 260
 - Zeldovich radius, 82
- Implosion, laser-driven, 40
- Induced flow, 59, 189, 251, 257, 260
- Induction delay, 310
 - detonation, 232–244, 249, 252, 282, 288, 295, 562
 - kinetics, 306–321

- Inertial confinement fusion, 8, 9, 15, 23, 30, 40–43, 324
- Initiation, 35
 detonation, *see* Detonation initiation
 of flame, *see* Flame initiation
 process, 459
 reaction, step, 308–312, 318, 321
 spontaneous, *see* Detonation
- Instability threshold, *see* Detonation, cellular;
 Detonation, galloping; Flame instability; Stars;
 Thermo-acoustic instability
- Integral
 equation, 127, 130, 138, 284–291, 300, 525
 integral-differential equation, 298
 length, 179, 193
 method, 124, 337
 operator, 136
 scale, 187, 188, 190, 192–194, 196, 203, 205–208, 279
 spin, 583
 time, 178, 179, 199
 volume, 200, 207, 208
- Irreversibility, 221, 302, 382, 577, 591, 592, 594
- Kapitza pendulum, 117, 161
- Kelvin–Helmholtz instability, 126
- Kolmogorov
 cascade, 176, 178, 180, 190, 192–201, 203–206, 279, 335
 dissipation laws, 192
 dissipation scale, 181, 204, 206
 Kolmogorov–Petrovskii–Piskunov (KPP), 397–403
 Kolmogorov–Obukhov K41, 204
 KPP–ZFK transition, 399–403
 scaling laws, 187, 191–201, 204–206
- Kuramoto–Sivashinsky equation, 80
- Laminar flame speed, 16–17, 23–24, 50–51, 54, 68, 78, 88, 103–105, 120, 126, 420, 467
 chain-branching reactions, 403–410
 methane–air flame, 410
 ZFK analysis, 384–390
- Lane–Emden
 equation, 351, 354, 355
 equilibrium, 350
 solution, 350, 351, 353
 stability of solution, 353, 354
- Langevin equation, 142, 145, 601, 603, 604
- Laser Megajoule, 41, 636
- Law of mass action, 622–624
- Lean mixture, 19, 78, 82, 84, 88, 232, 310, 425, 435, 437, 631
 colour of lean flames, 78
- Lewis number, 53, 54, 62, 63, 76–177, 327, 331, 382–489
- Local equilibrium, 20, 219, 220, 222, 346, 570, 596–601, 608, 640–654
- Mach, 592
 number, 23–29, 49, 107–111, 216–248, 261–302, 328, 360, 380, 410, 463, 464, 515, 532–561, 600, 647, 652, 654–662, 683
 stem, 261–274, 278, 279, 293, 298, 663
- Markstein number, 67, 69–76, 98, 118, 147, 166–168, 182, 184, 306, 416, 424, 489, 494
 in burnt gas, 74
 first Markstein number, 69–70, 118, 489, 500
 measure, 150
 second Markstein number, 73, 481, 500
- Mass-weighted
 average, 179
 coordinate, 304, 354, 405, 557, 561
 distance, 282
 quantities, 349
 variable, 420
- Mathieu’s equation, 117, 118, 160–161, 470
- Maxwell, 591
- Maxwell–Boltzmann distribution, 20, 301, 581, 595, 597, 634
- Maxwell–Boltzmann gas, *see* Boltzmann, gas
- Mean free path, 21–41, 213, 219, 220, 222, 302, 597, 599, 640, 652
 neutrino, 346
- Methane kinetics, 317–322
 induction delay, 321
 main elementary reactions, 317
 three-step scheme, 319
 two-step scheme, 321
- Methane–air
 flame, 19, 24, 50, 51, 90, 261, 317, 320, 410
 mixture, 29, 103, 459
- Michelson–Rayleigh line, 215–219, 223–224, 258
- Mixture fraction, 26
- National Ignition Facility (NIF), 40
- Navier–Stokes equations, 185, 204, 205, 419, 421, 599, 643, 657, 664
- Neumann, 682, *see also* ZND structure of detonation
 boundary conditions, 27, 141
 state, 27, 29, 214, 217, 223, 226, 236, 239, 247, 254, 257–300, 310, 530, 533–563, 683, 684
 temperature, 29, 35, 232, 239, 246, 249, 257–300, 311, 533–563
- Neutrino, 33, 35–39, 364, 365
 outburst, 34
- Neutrino-driven explosion, 39, 372–375
- Neutron, 30, 31, 35–39, 41, 346, 365, 590, 610, 635, 636
- Neutronisation, 35–39
- Non-premixed combustion, 17–18
- Normal burning velocity, *see* Flame speed
- Normal-mode analysis, 263–264, 531–532
 at large Mach number, 541
- Nuclear
 burning, 31–39

- combustion, 31–39, 339–341
- density, 347
- energy, 41, 42, 339–341
- explosion, 8, 40, 41
- fission, 7
- fusion, 7, 15, 40
- matter, 35–39, 339–341
- physics, 8, 15, 34–39, 339–341
- power plant, 6, 7
- reactions, 8, 9, 15, 31–39, 41, 42, 339–341
- weapons, 7, 8, 40
- Nucleon, 30, 31, 39, 346, 361, 590, 609, 610
- Obukhov, *see* Kolmogorov
- Obukhov law, 178, 205
- One-step Arrhenius model, *see* One-step reaction model
- One-step flame model, *see* One-step reaction model
- One-step reaction model, 52, 70, 76, 77, 83, 88, 98, 166, 225, 239, 283, 288, 290, 381, 411, 414, 424, 426, 432, 481, 543, 636
- One-step ZFK model, *see* One-step reaction model
- Oxidation, 21, 629
 - of C, 618
 - of CH₄, 318, 319
 - of CH₄ to CO, 318
 - of CO, 319, 618, 626–628
- Parametric
 - analysis, 39
 - instability, 103, 114, 116–166, 169, 470
 - resonance, 164
 - stabilisation, 120, 161–163, 168
- Pauli exclusion principle, 365, 583, 613
- Perrin experiment, 601, 604
- Phase space, 395–396, 574–586
- Phase trajectory, 398
- Photodisintegration, 346
- Photodissociation, 363
- Photon, 32, 35–39, 78, 325, 635
- Physical kinetics, 591–605
 - kinetic theory of gas, 599
- Piston effect, 57, 296
- Planck's distribution, 345
- Plasma, 30, 32, 40, 41, 325, 327, 341, 569, 589, 609, 635, 636
 - frequency, 325
 - physics, 138, 342
- Poincaré, 592
- Poincaré–Andronov bifurcation, 288, 296, 298, 300, 478, 549, 555
- Poisson, 664, *see also* Euler–Poisson equation
 - equation, 524
 - law, 583, 587, 589
- Pole decomposition, 139, 140, 144, 151, 169–173
- Positron, 35–39
- Premixed combustion, 15, 18, 50–304, 379–503, 543–563
- Prigogine school, 595
- Prompt shock, *see under* Shock
- Proto-neutron star, 39
- Proton, 30, 31, 35–39, 41, 346, 365, 590, 610, 635, 636
- Pulsating
 - cells, 104, 298, 299
 - detonation, 238, 250, 539
 - flame, 77, 79, 81, 235, 389, 479
 - membrane, 197
 - stars, 355
- Quasi-isobaric, 16
 - analyses of the ablation front in ICF, 329–338, 512–526
 - analyses of flames, 379–503
 - approximation, 48, 49, 81, 239, 255, 284, 285, 292, 629, 630, 640, 659
 - combustion, 105, 655
 - equations, 49, 655
 - expansion, 8
 - flame ignition, 41, 81–88, 92
 - heat release, 107
 - instability of detonation, 294–300, 557–563
 - model of ablation front in ICF, 327–329
- Quenching
 - detonation quenching by curvature, 236–242
 - dynamic quenching of detonations, 290
 - flame quenching by curvature, 98
 - flame quenching by heat loss, 85, 411–413, 438
 - flame quenching by stretch, 77, 414–425
 - near flammability limits, 425–428
 - spontaneous quenching of detonations, 246–250
- Radicals, 51, 109, 307–322, 426, 608, 616, 617, 619, 620, 632
 - loss, 232
 - steady-state approximation, 313
- Random walk, 145, 178, 601
- Rankine–Hugoniot relations, 27, 214–217, 220, 221, 233, 254, 260, 263, 269, 270, 283, 285, 287, 294, 301–302, 345, 530
- Rarefaction wave, 218, 221, 229, 325, 675–679
- Rayleigh criterion, 105, 106, 660, 661
- Rayleigh–Taylor bubble, 122–124
 - rising velocity, 123
 - solution at spikes, 124
 - solution at vertex, 123
 - steady-state solution, 123
- Rayleigh–Taylor instability, 32, 35, 43, 60, 65, 324, 326, 329, 330, 332, 333, 337, 472
- Reaction–diffusion
 - problem, 83
 - system, 81
 - turbulent wave, 177

- Reaction–diffusion (cont.)
 - unsteady equations, 441–447, 474–480
 - wave, 21, 22, 54, 186, 379, 381, 393–403
- Rebound, 38, 40, 341
- Reynolds
 - number, 204, 251, 259, 260, 657
 - tensor, 137
- Rich mixture, 19, 56, 68, 78, 82, 84, 88, 92, 100, 101, 103, 232, 259, 307, 310, 311, 317, 425, 426, 435, 437, 478, 500, 628, 631, 632
 - colour of rich flames, 78
- Richardson, 205
 - law, 178
- Richtmyer–Meshkov instability, 152, 255
 - images, 153
- Riemann, 654, 664
 - invariant, 259, 672–675
- Rijke tube, 111
- Saffman–Taylor finger, 135
- Scheme, *see* Chemical kinetic scheme
- Self-extinguishing flame, 90, 431, 448, 459
- Shear
 - Couette, Poiseuille flows, 657
 - flow, propagation in, 183–185, 189
 - flow, vorticity wave, *see* Vorticity wave
 - pure shear flow, 126
 - viscosity, 419, 643
- Shock
 - accretion, *see* Accretion, shock
 - front, *see* Shock wave
 - outburst, 360, 362
 - prompt, 38–40, 361, 362
 - stalled, 39, 362, 363
 - strong shocks, 269–274
- Shock wave, 214–222
 - dispersion relations, 263–265, 533–538
 - inner structure, 219–222
 - irreversibility of, 302
 - isolated, 262
 - linear stability, 261–266
 - linear stability criterion, 538–539
 - neutral modes, 264–265
 - in polytropic gas, 216–217
 - sound radiation condition, 538
 - thickness of, 221–222
 - transit time, 346
 - weakly wrinkled, 265, 271
- Shock–turbulence interaction, 278–279
- Shock–vortex interaction, 274–279
- Shooting method, 399
- Singing flames, *see* Thermo-acoustic instability
- Singular point, 395–402, 483, 496, 682
 - focus, 400
 - node-spiral, 397–402
 - saddle, 395–402
- Singularity, 124, 171, 181, 264, 273, 274, 298, 337, 338, 356, 357, 654
- Sivashinsky equation, 135
 - nonperiodic solutions, 139
 - periodic solutions, 140
 - pole decomposition, *see* Pole decomposition
 - pole dynamics, 139
 - sensitivity to noise, 141
- Smoluchowski, 601
- SOFBALL experiments, 91
- Sound, 103–116
 - emission, 658, 659
 - generation, 274, 640, 660
 - intensity, 278
 - monopolar sound generation, 197–209
 - nonradiating, 538
 - radiation, 278, 538
 - speed of, 20, 22, 23, 29, 33, 41, 49, 59, 213–271, 325, 326, 328, 353, 380, 532, 544, 557, 642, 648, 651, 652, 654, 658, 664–684
 - spontaneous emission, 265, 538–539
 - velocity, *see* speed of
 - wave, *see* Acoustic (or sound) wave
- Spitzer formula, 326
- Spray flames, 114
- Stagnation point flow, 72, 77, 91, 123, 131
 - quenching of flame at, *see* Quenching
 - stability of flame in, 133
 - viscous effect, 418
- Stars, 339–375, 569, 588, 590, 591
 - constitutive equations of, 341–346
 - dying, 8
 - energy, 349, 352
 - explosion, 8, 9, 15, 39, 341–374
 - hydrostatic equilibrium, 346, 350
 - instability, 352
 - lifetime, 347
 - mass, 350–352
 - pulsating, 355
 - in quasi-steady state, 15, 347
 - radius, 347, 349, 350, 352
 - stability analysis, 353–355
 - stable, 347
 - surface, 350
 - theory, 346
 - unstable, 349
- Statistical thermodynamics, 569–591
- Stellar
 - equilibrium, 346
 - evolution, 31
 - pulsation, 355
 - structure, 32
- Stochastic
 - equation, 177, 182, 183, 190, 604
 - field, 145, 177, 183
 - force, 603
 - intrinsic stochasticity, 81

- motion, 178
 - process, 179, 190, 601, 602
 - variable, 576, 579
- Stoichiometric
 - coefficient, 308, 619, 631, 642, 654
 - composition, 19, 25, 29, 232, 386, 631
 - mixture, 19, 23, 24, 90, 103, 255, 256, 259, 291, 316, 632
 - ratio, 631
- Stokes
 - flow, 657
 - force, 115, 603, 657
 - theorem, 656
- Stosszahlansatz, 592, 593
- Strain, 70, 73, 75, 136, 649
 - critical strain rate, 414–425
 - pure, 72
 - rate, 72, 77, 91, 132, 134, 414, 415, 420, 421, 498
- Stretch, *see* Flame stretch
- Stretch, of a passive surface, 71
- Strong shocks, *see* Shock
- Sun, 15, 30, 32, 33, 347, 635
- Supernovae, 8, 31, 33–40

- Takabe formula, 330
- Taylor, *see also* Rayleigh–Taylor instability; Saffman–Taylor finger
 - analysis, 129
 - bubble, 131
 - diffusion coefficient, 178
 - expansion, 71, 217, 449, 450, 498, 572, 578, 602, 671
 - hypothesis, 189
 - instability, 330
 - scale, 178
 - self-similar solution, 243, 682
 - solution, 123
- Test particle, 21, 602, 603
- Thermal quenching, *see* Quenching
- Thermal waves, 30, 40, 42, 648
- Thermo-acoustic instability, 40, 55, 56, 101–121, 291, 296, 355
 - acceleration coupling, 112
 - acceleration transfer function, 113
 - admittance function, 106
 - experiments, 114, 116, 118, 119
 - neutrino-driven, 372–375
 - pressure coupling, 109
 - two-phase (spray) flames, 114
 - velocity coupling, 111
 - velocity transfer function, 111
 - vibrating flat flame, 116–119
- Thermo-diffusive
 - approximation, 79, 177, 414–418, 424, 440
 - effects, 61, 480
 - model, 56, 79, 80, 92–101, 331–336, 420, 424, 441, 448, 463, 474–480, 506–509
 - phenomena, 77–101
- Thermo-diffusive instabilities, *see* Flame instability
- Thermonuclear
 - burning, 31
 - explosion, 34, 35
 - fusion, 30–31
 - ignition, 8, 42
 - reactions, 15, 30–31
- Three-step reaction model, 291, 319, 321
- Transport process
 - coefficient, 596, 603, 604, 640, 651, 652
 - convective, 483, 657
 - dissipative (diffusive), 8, 22, 29, 56, 102, 219, 225, 325, 472, 543, 650, 663, 680
 - equation, 468
 - of heat and mass, 22, 69
 - molecular, 23, 282, 640
 - of neutrino, 39
 - radiative, 326
 - turbulent, 34, 177–179
- Triple flame, 26
- Triple point, 257, 261, 267–269, 279, *see also* Mach, stem
- Tulip flame, 152–156
 - auto acceleration, 154
 - geometrical model, 154
- Turbulent diffusion, 177–179
 - limitations, 179
 - Taylor's diffusion coefficient, 178
- Turbulent premixed flames, 174–209
 - corrugated flamelet regime, 183, 190–196
 - covariant laws, 195
 - flame speed, 181, 187, 189, 195, 196, 251, 484
 - folded flame brush, 255
 - fractal dimension, 193
 - propagation velocity, 184, 187, 189, 193, 195
 - surface area fluctuations, 207
 - thickened flame regime, 183
 - well-stirred regime, 32, 180, 183
 - wrinkled flame regime, *see* Wrinkled flame
- Turning point, 85, 99, 135, 238, 248, 254, 347, 411–424, 439, 447
- Two-step reaction model, 52, 55, 109, 307, 309–311, 313, 315, 317, 320, 321, 403, 405, 410, 425, 500

- Variational
 - principle, 347
 - problem, 349
- Vibrating flat flame, *see* Thermo-acoustic instability
- Virial theorem, 348, 349
- Vortex–flame interaction, 185–188
 - chaotic flow, 187
 - vortex array, 186
 - vortex tube, 185
- Vorticity wave, 262, 267, 268, 270, 271, 468, 530–533, 559–560

712

Water–gas shift reaction, 319–322, 628
Wave equation, 208, 270, 372, 394, 530, 559, 560, 658, 659, 673
Weakly nonlinear analysis, 271, 272, 274, 293, 294, 298, 300, 355, 544
Well-stirred
 reactor, 15, 32, 660
 regime, 32, 180, 183
White dwarfs, 32, 35, 352, 588, 589
Wiener–Kintchin theorem, 605
WKB method, 671
Wrinkled flame, 463–503
 speed, 61

Index

turbulent regime, 180, 183, 185, 188
weakly, 55, 58, 185
weakly wrinkled flame regime, 189–190

Zeldovich, *see also* Detonation initiation; Ignition;
 Zeldovich mechanism; ZND structure of
 detonation
 KPP-ZFK transition, 399–403
 mechanism, 243, 252, 259
Zemerlo, 592
ZFK analysis of flames, 52
ZND structure of detonation, 27, 222–231