

Index

- accretion disc, 2, 4, 6, 14, 55, 62, 69, 71, 72, 74, 83, 85, 86, 88, 93, 104, 107–109, 113, 115, 118–122, 144, 150, 160, 162, 180, 182, 186, 189, 193, 195, 196, 212, 220, 255, 256, 259, 261, 263–267, 272, 278, 282, 283, 291, 292
- accretion efficiency, 4, 5, 70, 102, 123, 124, 136, 182, 188, 192, 251, 276, 283, 296
- accretion luminosity, 3, 5, 189, 196, 237, 248, 249, 252, 282, 283
- accretion rate, 6, 77, 88, 89, 93, 95, 98, 99, 101, 102, 114–116, 129, 131, 132, 137, 152, 176, 184, 192, 193, 211, 251, 264, 275, 281, 282, 292
- ADAF (advection-dominated accretion flows), 97, 98, 100
- adiabatic, 42–44, 46, 48–50, 89, 98, 114, 184, 198–200, 207, 208, 243, 255, 290
- AGN (active galactic nuclei), 14, 15, 17, 80, 82, 88, 93, 94, 98, 101, 112, 113, 115, 120–122, 135, 152, 180, 189–193, 195–197, 199–201, 204–207, 209, 211, 213, 214, 216–220, 222, 224, 226–228, 237–243, 245, 246, 248, 249, 251–257, 265, 266, 269, 273–275, 277, 278, 280–282, 294
- AGN flickering, 135
- AGN luminosity function, 274, 276, 277
- AGN torus, 14, 17, 120–122, 135, 274
- AGN, flickering, 136
- Alfvén, 58, 60, 61, 264, 266
- assembly picture of scaling relations, 233, 234, 237, 239
- asymptotically flat, 36
- BAL QSO, 198
- beaming, 197, 293
- bending wave, 154
- Bernoulli integral, 44, 45, 57, 60
- binding energy, 2, 69, 72, 78–80, 116, 188, 189, 198, 208, 264
- black hole area theorem, 32, 33
- black hole–bulge mass relation, 231
- black hole charge, 28, 258
- black hole foraging, 116, 121, 273
- black hole merger, 8, 33, 36, 134, 135, 156, 164, 172, 178, 233, 234, 279, 280, 282, 295
- black hole scaling relations, 17, 18, 112, 187–189, 198, 209, 231, 233–235, 238, 239, 243, 245, 248, 277, 283
- black hole wind, 248
- Blandford–Payne (BP) effect, 105
- Blandford–Znajek (BZ) effect, 102, 106
- blast wave, 290
- blue nuggets, 285
- Bondi accretion, 114, 115, 273
- Boyer–Lindquist coordinates, 28, 29, 35, 289
- brightness temperature, 83, 265
- causal structure, 21, 24, 26, 36
- chaotic accretion, 121, 122, 131, 136, 274, 280
- charge separation, 65
- charge-separated plasma, 256, 257, 259, 261
- circumbinary disc, 295
- collisionless plasma, 58
- contact discontinuity, 51, 198, 206, 209, 212–214, 216–220, 223, 225
- continuity equation, 41, 44, 46, 52, 57
- Coulomb logarithm, 8
- covariant derivative, 21, 22, 34
- cusplike, stellar, 13
- dark matter cusp, 246
- Debye length, 53
- decretion disc, 162
- diffusivity, 63, 64, 104, 106, 109
- dipole emission, 31, 264–266
- disc breaking, 109, 137, 143, 144, 147–150, 155, 171
- disc self-gravity, 93, 134
- disc tearing, 137, 150, 155, 171
- disc tilt, 142
- disc twist, 142
- double pulsar, 38

- dynamical friction, 8, 9, 11, 155, 156, 161, 162
 dynamical infall rate, 218
- Eddington–Finkelstein coordinates, 24, 29
 Eddington limit, 3–5, 7, 124, 132, 134, 226, 280
 Eddington luminosity, 5, 6, 131, 134, 192, 196, 218, 242, 253, 281
 Eddington wind, 189, 196, 199–201
 Einstein field equations, 20, 21
 Einstein–Maxwell equations, 257, 259
 Einstein precession, 10, 37, 185
 elliptical galaxy, 11, 12, 225, 226, 230
 EMRIs (extreme mass-ratio inspirals), 288
 energy-driven outflow, 207, 208, 211–213, 215–217, 220, 222, 224–226, 229, 234, 237, 238, 241, 243, 245, 246, 248, 250, 251, 285, 296
 equivalence principle, 19
 ergosphere, 29–31, 258, 259
 Euler equation, 41, 43–46, 52, 61, 84
 Eulerian, 107–110
 event horizon, 26, 27, 68, 95, 96, 110, 257, 259, 260
- feedback, 188, 189, 198, 201, 206, 209, 211, 212, 222, 224, 229, 231–234, 236–241, 245, 247, 248, 253, 255, 273, 278, 282, 283, 285–288
 Fermi bubbles, 10, 11, 17
 FFE, *see* force-free electrodynamics
 final parsec problem, 171
 flat space, 19, 20
 flickering, AGN, 136
 force-free electrodynamics, 65, 110
 force-free MHD, 62, 65
 frequency, 29, 265
- Galactic Centre, 10, 13, 17, 98, 112, 274
 galaxy merger, 8, 9, 12, 113, 116, 134, 155, 156, 160, 161, 167, 172, 233–235, 248, 249, 251, 253, 273, 282, 285–288
 gamma-ray burst, 2, 6, 289
 general relativity, 1, 2, 10, 19
 geodesic, 20, 21, 68
 geometrized units, 21–23, 28, 258
 Goldreich–Julian charge density, 63
- Hawking radiation, 32
 Hills mechanism, 13, 14
 Hot DOGs, 280
 Hubble time, 233, 276
 Hulse–Taylor pulsar, 37
 hypervelocity star, 13, 17, 121
- ideal MHD, 109
 incompressible fluid, 44, 45, 57
 inverse Compton cooling, 199–203, 208, 209, 241, 282
 ionization front, 290
- iron emission lines, 81
 irradiated disc, 83, 292
 irreducible mass of black hole, 33
 ISCO (innermost stable circular orbit), 68, 70–72, 78–80, 82, 91, 92, 95, 96, 98, 123
 isothermal, 12, 42–44, 50, 51, 61, 119, 146, 147, 202, 204, 207–209, 211, 213, 223–225, 230, 235, 237, 241, 243, 249, 251, 290
- jet, 14–17, 51, 101–103, 109, 112, 121, 122, 135, 189, 229, 255–257, 260–263, 265–272, 274, 280, 297
- Kepler, 10, 70, 73, 76, 78, 84, 89, 93, 172, 175, 225, 291, 295
 Kerr solution, 22, 28, 30, 32, 34, 35, 68, 70, 71, 160, 257, 259, 289
 Kerr–Schild coordinates, 29, 110
 Killing tensor, 68
 Killing vector, 30, 34, 68
- Lagrangian, 107, 108, 110, 140, 151
 last parsec problem, 160
 Lense–Thirring effect, 29, 72, 122, 123, 137, 144, 146, 150, 157, 263, 265, 269, 270
 light cone, 20, 26
 Lightman–Eardley instability, 86, 148–150
- M– σ relation, 199
 M– σ relation, 119, 188, 208, 218, 224, 229, 282, 296
 Mach number, 44, 48–50, 61
 MAD, *see* magnetically arrested disc
 magnetic diffusivity, 64, 102, 104, 105, 110, 259, 260
 magnetic field, 15, 40, 41, 45, 51, 54–63
 magnetically arrested disc, 102, 104, 107, 109
 magnetorotational instability, 100, 101, 107, 154, 155
 mass-loading, 217, 218, 222
 maximum black hole mass, 278–283, 294, 298
 metal enrichment (super-solar abundance), AGN, 17, 248
 metals in the circumgalactic medium, 246
 MHD (magnetohydrodynamic), 45, 53–65, 108, 109, 259, 261
 Minkowski metric, 19, 23, 33
 momentum-driven outflow, 207–209, 211, 213, 214, 217, 233, 240–242, 246, 254, 255, 282
 monsters, 283
 MRI, *see* magnetorotational instability
- no-hair theorems, 23
 non-thermal emission, 83
 null surface, 26, 31, 33, 35, 259, 289
 numerical diffusivity, 109
 numerical viscosity, 108, 109
- P Cygni profile, 189, 190, 195, 196, 205
 Paczyński–Wiita potential, 69

- Particle in Cell, 110
 Penrose process, 30, 256
 plasma frequency, 52, 53, 265
 polar alignment, 171
 Prandtl number, 64
 pseudoblazar, 294
- quasi-periodic eruption (QPE), 14, 180
 quasi-star, 137
- radiation driving, 248, 254
 Rayleigh–Taylor instability, 219, 220, 253
 red and dead, 188, 226
 Reissner–Nordström solution, 36, 38
 resonances, 111, 160, 162, 167
 Riemann curvature tensor, 24
- Salpeter timescale, 6, 115
 scaleheight, 73, 84, 89, 138, 165, 184, 264, 280
 Schwarzschild metric, 23, 26–29, 34, 36, 37, 39, 70, 71
 Schwarzschild radius, 252, 275, 293
 self-gravity, 12, 13, 92, 115, 133, 160, 161, 174, 179, 278, 281
 Schwarzschild ‘singularity’, 24
 self-gravity, disc, 92–94, 134
 Seyfert I galaxy, 14
 Sgr A*, 10
 shearing-box simulation, 281
 shock wave, 46–51, 85, 117, 118, 161, 195, 198–204, 206–209, 212, 213, 215, 217, 220, 221, 225, 237, 239, 242, 245, 252, 255, 261, 290, 292, 296, 297
 Silk–Rees mass, 245
 similarity solution, 290
 slim disc, 95–97, 99, 100
 smoothed particle hydrodynamics (SPH), 107–109
 Soltan relation, 6, 13, 98, 112, 113, 135, 188, 278
 sound speed, 43, 44, 46, 49, 50, 57, 60, 61, 64, 84, 114, 137, 147, 198, 212, 225, 264, 266, 290
 spacelike, 259
 spacetime metric, 19, 21–24, 28, 259, 289
 sphere of influence, 12, 66, 115, 187
 spheroid, 12, 18, 113, 115, 116, 211, 222, 224, 225, 231, 233, 239, 245, 249
 spin alignment, 121, 124–130, 133, 135, 136, 148, 150, 158
 spin energy extraction, 30
 starburst, 225–228, 237, 274, 275
 stellar cusp, 12, 13
 super-Eddington mass supply, 95, 96, 98, 189, 197
 super-solar element abundances, *see* metal enrichment (super-solar abundance), AGN
 synchrotron emission, 83
- TDE, *see* tidal disruption event
 thin accretion disc, 71, 264
 thin disc, 84–86, 89, 95, 96, 100, 101, 106, 108, 109, 138
 tidal disruption event, 13, 17, 173, 179, 183, 185
- UFO (ultrafast outflow), 190–193, 197–201, 203, 205–208, 211, 223, 224, 237, 240, 241, 245, 252–254
 ULX (ultraluminous X-ray source), 5, 193, 197, 293, 297
 ULX nebulae, 297
- velocity dispersion, 12, 17, 18, 114, 115, 187, 192, 209, 233
 viscosity, 46, 64, 66, 71, 73, 75, 77, 79–81, 85–90, 94, 95, 97–102, 104, 107, 109, 115, 116, 120, 123, 124, 138, 275
 vorticity, 45, 57
- warm absorber, 253
 warp, 72, 123, 137, 142, 145, 153, 271
- X-ray irradiation, 82