Absorption of cluster light by dust 288 Adiabatic invariants 164,235 AC-211 63 Action integrals 239,350 (see also Adiabatic invariant, Integral of motion) Active galactic nuclei (see Galactic nuclei) Ages of globular clusters 285 Ages of open clusters 427,442,444, 449,450ff,461,471 (see also Lifetimes) Age-velocity relation for disk stars 451 Alpha Persei 438 Angular-momentum transport 152, 293ff Angular resolution 5,14,383ff,428 Anisotropy in velocity distribution 2,22,24ff,28,65,78,96,113,116,120, 152,153,157,161,170ff,178,182,192 219ff,285,288ff,294,296,297ff, 301ff,386ff,395,439ff,444,502,515 AXAF 46,519 Binary stars General 109,110,189,231ff,254,275, 381,422,433,471,502 Binary-binary encounters 128ff, 176, 237ff, 253, 256, 272, 276, 321, 333, 335ff, 347, 349ff, 362, 364, Binary-single-star encounters 126ff, 176, 232ff, 253, 321, 347, 350ff, 358, 362ff, 365ff, 367ff, 370 (see also Escape...binaries, Binary stars...as Energy source) Close (Hard) binaries 126ff,131ff, 201,238,249,253,255ff,263,264, 279ff, 321, 335ff, 363, 374, 416 (see also Binary stars -- Spectroscopic)

Distribution of binding energies 145,240ff,306 Disruption of 100,461 as Energy source or sink 1,15, 17,44,89,126ff,131,133ff,137, 141,144ff,151,155,157ff,161, 166,172ff,212,214,221,225, 229,231ff,251,255ff,268, 271ff,284,305ff,321,332ff, 347ff, 361ff, 365ff, 367ff, 374, 413, 416, 419, 428, 442, 474, 504, 508,512 Formation by three-body encounters 128,131ff,133,137, 172ff, 176, 203, 238, 244ff, 347, 348ff, 354, 361, 363, 366, 419, 499,504,514,515 Formation by tidal capture 9, 47ff,52,60,133ff,137,152,176, 245,347ff,354,359,361,362, 363ff,365ff,419ff,499,504, 507,514,515 Hardening rate of 126,133,235, 264 Observations of in globular clusters 21,83,93,99ff,103ff, 358,360,507 (see also X-ray sources) Observations of in open clusters 43ff,442ff Permanent binary 244 Primordial 100,128ff,442,515 Radial distribution in open clusters 433 (see also Mass stratification) Spectroscopic 21,99ff,435 Wide (Soft) binaries 126,238, 248,436,439,452,454,461 (see also X-ray sources) Binding energy of a star cluster 2,282,305ff,332,368ff Black holes

in Gaseous spheres 149ff,211,302 in Galactic halo 449,451,455ff, 459,462 in Star clusters 17,52,89,109, 132,137,144,149ff,158,162, 166ff, 171ff,174,179,184ff,202, 227,373ff,413,415ff,421ff, 487ff,498,499,507,512ff Blue stragglers 359 Boltzmann equation 162,180,217, 301,374ff,502 Cataclysmic variables 103ff, 248, 356,360,514 (see also X-ray sources) Central angular velocity 25ff,28 Central density 9,115,139,143ff, 150,192,208,214,222ff,254,268, 270,278ff,332,350ff,365ff,401 (see also Cusps) Central potential 24,28,122ff,192, 356 (see also Escape velocity) Central relaxation times 33ff,139, 154,155ff,267,347ff,415ff,511 Central singularity (see Cusps) Central velocity dispersion 19,23, 24ff,28,113,118ff,141,142,146, 147,155,192ff,270,378 Chang-Cooper differencing scheme 170 Chemical gradients in globular clusters 33ff,499 Chemical inhomogeneities in globular clusters 34ff, 40, 42, 105 Close two-body encounters 120ff, 161,179ff,187,251,253,263,290, 462,471,514, (see also Escape of stars -- by Close...encounters) CN stars 33ff,107 Collapse time 267,269,333 (see also Core collapse -- rate of) Collisionless systems 217,324,373, 379,407ff (see also Vlasov equation) Color gradients in globular clusters 33ff,42,98 Color-magnitude diagrams 6,34,81ff, 285

- Coma Berenices 438
- Compact objects 132,133 (see also Black holes, White dwarfs, Neu-

tron stars)

- Concentration parameter 85,144, 218,290,293
- Conductive flux ll5ff (see also Flux of energy)
- Core 43,89ff,137,150,155,190ff, 211,307,331ff,362,367ff,370, 421ff,468 Definition of 143 (see also
 - Central...,Core collapse, Core radius, Cusp)
- Core collapse lff, 12ff, 17, 43, 113ff, 120, 123ff, 128ff, 134, 137 139, 142, 147, 150, 151, 152, 153, 154, 155, 156, 161, 166ff, 183ff, 207, 212, 251, 253ff, 261ff, 267ff, 272, 278ff, 284, 294, 366, 368, 391ff, 401, 415ff, 421, 443, 468, 474, 499ff, 506ff, 517 rate of 120, 125, 129ff, 178, 183, 190ff, 195, 197, 200 (see also Collapse time, Evaporative models, Gravothermal instability, Stability)
- Core radius 24ff,28,89ff,98,115, 143ff,157,171ff,255,268,270,307
- Crossing time 455
- Cross sections 231ff,335ff
- Crowding 483ff
- Cusps in central surface brightness or density 1ff,17,60,61, 89ff,132,140,150,166,169,184, 219,230,255,360,377,378,383ff, 413,416,487ff
- Dark Matter in Globular clusters 169,507, 508,518ff (see also Black holes, Neutron stars, White Dwarfs)
 - in Open clusters 437ff
 - in Galactic halo 451,508
- Deflection time 25,28,289 (see also Relaxation time)
- Density contrast 111ff,121,191,209, 218,222,266
- Density profiles 1ff,9,12ff,42, 89ff,117,120,139,140ff,142,145ff, 147ff,149,150,153,155ff,157, 167ff,173ff,178,192,212,267,271, 272,381,382ff,400,404ff,416,421,

498,504 (see also Surface Photometry) Diffusion coefficients 164,264,289ff, 314ff Disruption of globular clusters 44, 56ff,110,155,368ff,392,423ff,461, 499,506ff Disruption of open clusters 449, 452ff 461 Disruption of stars by a black hole (see Tidal disruption... Dissipative effects 152 (see also Binary stars -- Formation by tidal capture, Binary stars -- as Energy...sink) Distant (Weak) two-body encounters 179,187,313,381,462 (see also Relaxation) Distances of globular clusters 19,22, 26 Distribution function 2,19,22ff,27, 111,113,122,140,154,178,179,180, 182ff, 196, 259, 313, 317, 323ff, 327ff, 379,382,427,435ff,440ff,506,510ff (see also Anisotropy, Lowered maxwellian, Wilson model) Distribution of globular clusters in galaxy, 90,309ff (see also Orbits of globular clusters) 30 Doradus 467ff Draco dwarf spheroidal galaxy 345 Dynamical evolution of Open clusters 449ff,463ff of Globular clusters (see Precollapse evolution, Post-collapse evolution) Dynamical models of globular clusters 2ff,19ff,65ff, 97,202ff,327ff of open clusters 429ff,437ff Dwarf spheroidal galaxies 21,77ff, 345ff Eccentricities of globular cluster orbits 309ff,343 Elliptical galaxies 490ff Ellipticities of star clusters (see

- Flattening of star clusters) Encounters between stars 109,161,192
- (see also Binary stars, Close twobody encounters, Distant two-body

encounters, Relaxation)

- Energy flux (see Conductive flux, Flux of energy)
- Energy sources in star clusters 140,144,146,148ff,152,153, 157ff,166,219,221,223,229ff, 261,361ff,367ff,382,391,512ff (see also Binary stars, Black holes, Mass loss, Stochastic energy sources, Tidal heating)
- Entropy 111,113,209ff,220,223ff, 302,325,341,502
- Equilibria of stellar and gaseous systems 111ff,210,212, 219ff,240,301,313,382
- Equipartition of energy 23,27, 121ff,123,152,189,193ff,197ff, 205,221,279,317ff,421,428ff, 441,442ff,447
- Escape energy 423ff (see also Escape velocity)
- Escape of stars from clusters General 189,220,282,503 by Close two-body encounters 60,121,179,182,184ff,368, 369ff,462
 - by Distant two-body encounters 110,162,182,291,369ff,511
 - by Interaction with binaries 60,100,129,141ff,158,241, 256ff,333,347,349ff,354, 366ff,370 (see also Tidal stripping)
- Escape velocity from cluster 2, 61,113,182,317,511 (see also Escape energy)
- Evaporation of stars 391ff
- Evaporative models cluster evolution 2,113,116,118,125,139, 144ff,149ff,292ff,499 (see also Escape of stars) Exchange reaction 235,238
- Field star 394ff
- Flattening of star clusters 23, 39,77ff,85ff,96,285ff,327ff, 434,438,474ff
- Fluid models (see Gaseous models, Moment equations, Thermal conductivity)
- Flux of energy 140,143,150,157,

301 (see also Conductive flux, Thermal conductivity) Fokker Planck Equation 110,113,118ff, 132,139,140,142,148ff,150,152,154, 161,179,180,183ff,192,195ff,217, 219,229,251,261ff,275,283,305, 313,324ff,341,358,373ff,389ff, 416,506,514,517 Integration by finite difference methods 161,163ff (see also Chang-Cooper differencing) Integration by Monte-Carlo methods 373ff One-dimensional E-space form of 165ff,170 Formation of globular clusters 35, 40ff,105ff,346,500,501,503ff,507, 509,517ff Formation of open clusters 428,463ff, 500,503ff Functional integral 313ff Galactic halo (see Halo of the galaxy) Galactic nuclei 171,373ff,403ff,419ff, 512, 515, 518 Gaseous models 110,123,132,139,141ff, 146ff,151ff,166,169,192,207ff,219ff, 231ff,275,301ff,502,506,517 (see also Moment equations, Thermal conductivity) General-relativistic instability of star clusters 323ff,407ff General relativity 323ff,373ff (see also General-relativistic instability, Gravitational radiation) Giant molecular clouds 43,56ff,61, 449,451,454ff,461,471,508 (see also Interstellar clouds) Gravitational radiation 133,248ff, 323,353,359,419ff Gravothermal instability 2,109,111, 123,133,170,190,191,196,207ff, 219ff,229ff,302,361,379,401,511 Gravothermal oscillations (see Oscillations) Half-mass relaxation time 137,174, 401,468,511 (see also Relaxation time) Half-mass radius 286,290,347,351ff

Halo of the galaxy 43,44ff,309,449,

451,455ff Halo of star cluster 116,190ff, 211,278,303,434,518 Heat conduction (see Thermal conductivity) Heating (see Energy sources) Hertzsprung-Russel diagrams (see Color-magnitude diagrams) Hierarchical multiple-star systems 53ff,233,237,257,271ff, 335ff HII regions 467ff Homologous evolution (see Selfsimilar evolution) Horizontal branch 33 Hyades 433,437,442ff,447,448 Hybrid programs 110,132,150, 153,219,261ff,283,331ff,362, 363, 417, 502 Impulsive approximation 235,451 Initial mass function 43,60, 71ff,74,422,447,467,507 Integral of motion General 23 Non-classical 293,327ff,343 (see also Action integral) Interstellar clouds Effects on dynamics of open clusters 449ff,471ff as Open-cluster progenitors 463ff (see also Giant molecular clouds) Isothermal 8,10,15,17,49,111, 113,115,118,121,123,140,143, 144,148,150,154ff,158,191, 196,207,210,212,219ff,222, 223, 229, 255, 267, 272, 325, 333, 350ff, 356, 382, 389, 421, 440, 504,510ff Jeans length 464 Jeans mass 459,501 Jeans; theorem 381 King models 22ff,65ff,74,77,89, 97ff,122,174,346,399,468

Kustaanheimo-Stiefel regularization (see Regularization)

Lagrangian points 343,345 (see

also Tidal radius) Large Magellanic Cloud 85,205,285ff, 346 Lifetimes of open clusters 456ff, 471ff (see also Ages of open clusters) Linear series method 112ff, 123, 218 Loss cone 303,386ff,416ff Lowered-Maxwellian 139,154ff,429ff, 443 Luminosity function of Population II 483ff of stars in globular clusters 34, 81ff,422 of stars in open clusters 447 of globular clusters 489ff,498 of X-ray sources in globulars 46ff,60,514,519 M2 (see NGC 7089) M3 (see NGC 5272) M5 (see NGC 5904) M11 (see NGC 6705) M13 (see NGC 6205) M15 (see NGC 7078) M22 (see NGC 6656) M30 (see NGC 7099) M35 (see NGC 2168) M53 (see NGC 5024) M67 (see NGC 2682) M92 (see NGC 6341) Mass function (see Mass spectrum, Initial mass function) Masses of globular clusters 28 Mass-to-light ratios of star clusters) 28,69ff,85,93 Mass loss 100,148,189,471ff as Energy source 141ff,158,205, 284,361,368ff,420,512ff by Escape of stars (see Escape of stars) by Stellar Evolution 44ff, 125, 153, 175,244,248,361,362,363,368ff, 427,447,449,499,515,519 by Physical Collisions 245,358,420 Mass segregation (see Mass stratification) Mass spectrum General 25,165,196ff,365,427,439, 441

Dynamical effects of 69ff,121, 129,131,152,153,161,170, 189ff,248,251,294,335,337ff, 417,448ff,449,463ff,471ff, 501,502,507ff (see also Binary stars, Mass loss, Mass stratification, Multicomponent systems) Observations of 155,167,268, 427ff,477 Modification by cluster evolution (see Mass loss, Escape of stars, Tidal stripping) Mass stratification 2,14,17,110, 121ff,123ff,129,133,169,192ff, 202,256,278ff,317ff,365,429ff, 433,447,499,505 Master equation 180ff,183 Mean free path 112,113,115,506, 508 Median radius (see Half-mass radius) Membership of stars in clusters 428ff,433ff,477ff Metallicity of globular clusters 85,90 Moment equations 115,123,132,162, 217,251,301 Monte-Carlo simulations of cluster evolution 110,113ff,118ff, 123ff,139,147,148,150,162,196, 251,283,319,361ff,373ff,393ff, 416,432,502 Moving groups 459,506 Multicomponent models 69ff,121ff, 123ff,131,140,161,165,167ff, 189ff,278ff,317ff,365ff,515, (see also Dynamical models, Mass spectrum) N-body simulations 110,129,132, 137, 139, 141, 150, 151, 153, 189, 202,214,219,229,237,251ff,261ff, 275ff,297ff,305ff,321,331,339, 344,345,415ff,423ff,433,440, 442,449ff,456ff,463ff,471ff,502

Neutron stars 44,46ff,52,60,132, 137,155,169,255,319,359,407ff, 422,499,507,514,518

NGC 104 (47 Tucanae) 3,7,20,33ff, 36ff,46,49ff,69ff,81ff,93ff,101,

287,288,296,422,498,519 NGC 188 438 NGC 362 287 NGC 1851 7,50 NGC 1904 (M79) 75 NGC 2168 (M35) 432ff,443 NGC 2244 461 NGC 2264 461 NGC 2506 435ff NGC 2682 (M67) 432ff, 435ff, 439, 447 NGC 3532 438 NGC 3603 467ff NGC 5024 (M53) 63 NGC 5139 (Omega Centauri) 33ff, 36ff, 45ff,93ff,287,288,296,344,346,422, 519 NGC 5272 (M3) 4,6,21ff,63,69ff,99ff, 103ff,288,358,422,501 NGC 5824 6ff NGC 5904 (M5) 22,63,104 NGC 6093 7ff NGC 6205 (M13) 19ff,22ff,63,65,288, 328,346 NGC 6273 (M19) 287,288 NGC 6284 75 NGC 6341 (M92) 19,22ff,63,288,328 NGC 6342 74 NGC 6397 63,74 NGC 6440 7 NGC 6441 7 NGC 6494 439 NGC 6624 6ff, 10ff, 17, 51, 54, 74, 155, 170,226,359 NGC 6642 74ff NGC 6656 (M22) 46,287,519 NGC 6681 6ff,10,74 NGC 6705 (M11) 429ff, 435ff, 439, 441 447 NGC 6712 218 NGC 6717 74 NGC 6752 105 NGC 7078 (M15) 1,4,6,9,10ff,15,22, 60,63,74,155,422 NGC 7089 (M2) 63 NGC 7099 (M30) 6ff, 10ff, 17, 63, 74 Orbit average (see Phase-space average) Orbits of globular clusters 44ff, 309ff (see also Eccentricities) Omega Cen (see NGC 5139)

Open clusters 1,85,275,427ff, 449ff,463ff,471ff,510 (see also Ages, Dynamical evolution, Lifetimes) Ophiuchus cloud 464 Oscillations in core radius 132,137,146,150,152,157,207, 212ff,273,333,504,517 Phase-space average 154,163, 179,181ff,187,195ff Physical collisions of stars 134, 185, 245, 354, 358, 359, 364, 374,403,420,499 (see also Binary stars...Formation by tidal capture) Pleiades 262,433ff,437,438, 439,441,442ff,447,477ff,517 Plummer model 146,147,182,192, 198,221,277,343,401,451,455, 463,472 Post-collapse dynamical evolution 12ff, 57ff. 61, 73ff, 89, 139ff,145ff,152,153,161,166, 171ff,189,201ff,203,207,212, 218,219ff,230,253ff,261,273, 280,331ff,347ff,362ff,366ff, 380,415ff,506ff,511ff,517 Praesepe 437, 438, 439, 441, 442 Pre-collapse dynamical evolution 109ff, 189ff, 221, 261, 350, 365ff,517 Proper motions of Globular-cluster stars 19ff,65ff,288 of Open-cluster stars 428, 428ff,439,447,448,477ff, 517 Quasars 404ff Radial action 164 (see also Adiabatic invariants) Radial velocities of globular-cluster stars 19ff,35,38,69ff,93ff,99ff, 288 of open-cluster stars 428, 435ff Red giant stars 33

Reddening of cluster light (see

INDEX OF SUBJECTS

Absorption) Regularization of two-body interactions 237ff,253,275ff,331,471ff Relaxation 152,179,213,232,289ff, 294,302,339ff,345,381,459 (see also Relaxation time) Relaxation time 9,36,85,113,115ff, 125,131,141,162,185,187,192,196, 205,226,230,290,339ff,345,365,374, 381,383,428,432,506 (see also Central relaxation times, Deflection time) Rotation of star clusters 24,25,35, 39ff,42,69ff,86,93ff,152,161,285, 288ff, 327ff, 344, 438, 515 RR Lyrae stars 33 Scaling 153,230 Scattering kernel 180ff Self-similar evolution 115ff,118ff, 132,140ff,142ff,144,145ff,149, 151,152,153,156,166,208,212,219, 267,269ff,272,391,401 Shock heating (see Tidal heating) Similarity solutions (see Selfsimilar evolution) Singularities in cluster evolution 142,148,156 (see also Cusps) Small Magellanic Cloud 85 Small-number statistics in Dynamics of star clusters 261ff,275,305ff,427,450 in Observations of clusters 428 in Surface photometry of globular clusters 4ff,73,97ff,286 Space Telescope 13, 17, 49, 245, 248, 481ff, 503,505,518 Specific heat 111,209ff,220,239 Square-well potential 162,182,241 Stability of star clusters "Thermodynamic" 109,111ff,121ff, 191,301ff Collisionless 297ff (see also General-relativistic instability, Gravothermal instability) Star counts 10ff,72,77ff,98,286,343, 377,432,505 Star formation 444,447 Efficiency of 463ff Statistical equilibrium 109 Statistics of globular clusters 139,

155ff (see also Luminosity function of globular clusters)

- Stochastic energy sources 152, 280 (see also Energy sources)
- Supernovae in globular clusters 105ff,358
- Surface density of globular clusters (see Density profiles, Star counts, Surface photometry, Cusps)
- Surface photometry of globular clusters 1ff,5ff,23,24,29,63, 69ff,73ff,89ff,154,286ff, 421ff,468 (see also Density profiles)
- Tensor virial theorem 288ff,292 Test star 394ff
- Thermal conductivity 112,115,132, 141ff,152,208,212,217,225,232, 301
- Tidal capture (see Binary stars ... Formation by tidal capture)
- Tidal disruption of stars near a black hole 171,302,378ff, 381ff,386ff,390ff,396ff
- Tidal field of the galaxy (dynamical effects on clusters) 2,58,78,98,110,141,152,203, 235,283,343ff,392,428,433,434, 440,449,453ff,459,471ff,502 (see also Tidal heating, Tidal radius, Tidal stripping)
- Tidal heating 91,110,125,153, 225,345,361,362,363,368,369, 423,428,440,471,501,503,515
- Tidal radius 24,28,77ff,85,98, 110,154,343ff,345ff,351,401, 456,490ff,503 (see also Lagrangian points, Tidal stripping)
- Tidal shocks (see Tidal heating, Tidal stripping)

Tidal stripping 110,153,227,344, 423ff,502ff,508,515 (see also Escape of stars)

- Tidal truncation (see Tidal field, Tidal radius, Tidal stripping)
- Triple systems (see Hierarchical systems)

INDEX OF SUBJECTS

```
47 Tucanae (see NGC 104)
Turning point 112,123,218
Two-component systems (see
  Multicomponent systems)
U-band 90ff
V/σ 42,95ff,290ff,296
Velocity dispersion 21ff,25,29,
  35,38ff,42,65ff,69ff,93,95ff,
  140,152,167,202,217ff,232,
  301ff,317ff,352,377,382,386,
  413,422,439ff,479,507,519
  (see also Central velocity dis-
  persion)
Velocity distribution function
  (see Distribution function)
Virial theorem 439
Viscosity (see Angular momen-
  tum transport)
Visual extinction of clusters
  (see Absorption)
Violent relaxation 213
Vlasov equation 324,373ff,407ff
  (see also Collisionless systems)
von Zeipel 164 99ff
von Zeipel 318 101
von Zeipel 490 101
von Zeipel 764 101
von Zeipel 803 101
von Zeipel 807 101
von Zeipel 858 101
von Zeipel 911 101
von Zeipel 1053 101
von Zeipel 1397 101
von Zeipel 1449 101
Watershed 126
White dwarfs 24,44,46ff,60,69,132,
  169,319,358,409,484ff,507,514
Wilson model 122ff,317ff
W Ursa Majoris stars 356
X-ray sources 9,13,17,43ff,63,91,
  103, 133, 356, 359, 377, 425, 503, 518
  (see also Luminosity function of
  X-ray sources)
```

622