

INDEX

- abundances, elemental (see also chemical composition) 98, 99, 102-104, 109-128,
 142, 148, 197, 322, 392, 393, 402
 accretion 371
 acoustic waves 263, 309-311, 317
 Am stars, possible relation to Barium stars 60
 AGB (see asymptotic giant branch)
 angular diameter 82-87
 asymptotic giant branch (AGB) evolution, termination of 349-351
 asymptotic giant branch (AGB) stars (see also individual topics and star types)
 classification of 4-11
 CSE's of 349-357, 359-364, 367, 369, 370, 373, 383
 evolution of 58, 104-112, 161-173, 208-213, 225, 236, 284-290, 341, 342,
 349-351, 412, 414
 in external galaxies 37-49, 104-106
 galactic distribution and space density of 15-24, 340, 348-351
 IRAS observations of 58, 306
 kinematics of 26-33
 luminosities of 37-49, 340, 341
 mass-loss rates from 229-231, 342-346, 349-354, 387, 424, 425
 photometry of 13-24, 35-41, 305-311, 367
 atmospheric models (see model atmospheres)
 Balmer lines 257, 262, 371, 369
 barium stars 4-6, 31-33, 59, 60, 108-110, 139, 145, 150, 196-203, 223, 224,
 317, 408
 bifurcation in atmospheres (see inhomogenities)
 binary stars 31-33, 108-110, 138, 139, 156, 196-203, 222, 232, 234, 303, 304,
 362, 371, 375, 378
 bipolar nebulae 325, 326
 born-again AGB stars (see post-AGB stars)
 brightness distribution (stellar surface) 81-84
 C IV line 312, 371
¹³C pocket (see mixing)
¹³C/¹²C ratio 111, 112-115, 140, 150, 331, 375, 407
 carbon enhancement 112-117
 carbon grains (see grains)
 carbon monoxide (see CO)
 carbon recombination opacity 164, 169-172, 180
 carbon stars (see also AGB stars and individual topics)
 chemical composition of 112-117, 122, 136
 ¹³C rich (J stars) 53, 140, 407-411, 416, 417
 CSE's of 278-284, 297, 303, 316, 359-364, 367
 in external galaxies 42-44, 414-417
 as extragalactic distance indicators 48, 49
 IRAS observations of 15, 16, 23, 24, 306, 402
 luminosities and space densities of 15-17, 21, 63, 340-342
 mass loss from 22, 367, 374, 375
 molecules in 52, 113, 116, 245, 246
 photometry of (see also IRAS) 37-44, 53, 244, 366
 production of 36, 44, 51, 104-106, 169-173, 224, 229-231, 284-287
 variability of 245, 246, 424
 violet and ultraviolet observations of 307, 313, 314, 366
 Cepheids 242
 CH 5, 7, 151
 CH stars 31-33, 196-200, 202, 203

- chemical composition 3, 109–128, 146–148, 211–213, 228, 304–318, 331, 332, 410, 411
- chromospheres 252, 263, 303–318, 351, 366, 381, 401, 385
- chromospheric heating and cooling 309–311, 315–317, 366, 381
- circumstellar chemistry 359, 382
- circumstellar (CS) dust 54, 55, 86, 248–250, 284, 287, 290, 292, 313, 351–355, 359–364, 367, 372, 377, 378, 408, 411
- circumstellar envelopes (CSE)
 models of 327–331, 367, 369, 381, 422–423
 observations of 321–324, 370, 385–388, 404
- circumstellar (CS) gas 232, 251, 304, 317, 321–324, 372
- classification of PRG stars 4–11, 38–40, 54, 62, 63, 99, 104
- CN 52, 63, 75, 113, 116, 152, 146, 402
- C/N ratio 228
- CNO 103, 104, 109–123, 152, 182, 183
- CO
 photospheric (visual, infrared) 90–95, 102–104, 113, 146, 244, 282 302
 circumstellar (radio) 226, 232, 233, 302, 322–325, 333–335, 368, 370, 373, 410, 411
 cooling by 93–95, 316, 381
- C/O ratio 61, 102–104, 247, 284, 366, 375, 379
- colors 73, 74, 87–89
- common envelope evolution 232, 234
- condensation (see dust)
- convection 93–97, 150, 152, 164, 169–172, 227, 233, 236, 416, 417
- convective overshooting (see also convection) 164, 169–172
- core breathing pulses 163, 164
- core helium burning 162, 163, 416
- core mass 158, 206, 211, 235, 349–351, 413–416
- coronae, stellar 401
- diamonds (see meteorites)
- distances, stellar 37, 48, 49, 331, 332
- double shell sources 152
- dredge-up (third, on AGB) 110, 119–128, 134–135, 137, 161–173, 206, 227, 229–231, 245, 251, 413
- dust (see also CS dust) 229–231, 272–279, 284, 290, 359–363, 367, 373–377, 379, 381
- dust shell (see CS dust)
- equilibrium 371, 381
- evolution of PRG stars (see stellar evolution)
- excitation, radiative 368, 372, 402
- expansion velocity 369
- fluorescence 372
- Four color IR Sky Survey (AFGL) 16
- galactic center (see nuclear bulge)
- galactic evolution and PRG stars 36, 37
- galaxies, PRG's in external 36–49, 46, 47
- globular clusters 6, 7, 16, 242, 243, 322
- grains (see also CS dust; dust)
 carbon 54, 355–357, 367
 silicates 284, 288–290
 silicon carbide 54, 367, 375
- H₂ 90, 327, 328
- H₂O 68, 72–78, 153, 298, 404
- HCN 65, 68, 155
- helium core ignition (see core helium burning)

- helium lines 378, 401
- helium shell flash (see also thermal pulse) 349–352, 412, 413
- hot bottom burning (envelope burning) 111, 112, 117, 152, 236, 356
- H–R diagram 58, 266
- Hubble constant 48, 49
- hydrogen burning (see also thermal pulses) 213–220, 349–352, 356, 357
- hydrogen-deficient stars 151, 353–357, 433, 434
- hydrogen, neutral (H I) 151, 251, 262, 369
- ice 370
- incredibly thin hydrogen envelope scenario (see also post-AGB stars) 218–220
- infrared excesses 288, 306, 307, 313, 316, 340, 345, 351, 385, 402, 423
- infrared spectroscopy 54, 284
- inhomogeneities, atmospheric 93–97, 316, 381
- initial mass 390
- initial mass function (see luminosity function)
- interstellar extinction 15
- IRAS observations 14, 24, 54, 234, 294, 305–307, 340, 351, 352, 359–361, 380, 384, 391–400, 428, 405, 409
- IRAS color-color diagram 17, 54, 58, 233, 249, 250, 285–289, 299, 305–305, 363, 369, 395
- IRAS low resolution spectra (LRS) 16, 24, 54, 292, 294, 359–361, 367, 394, 402, 429
- IRAS sources (see individual stellar types)
- isotopic ratios 117–122, 332, 333, 374, 375, 408
- IUE observations 55, 262, 298, 299, 305–307, 371, 386
- joy of stars 399–402
- KAO observations 370
- K giant stars 136, 145, 150, 198–202, 228, 234
- kinematics
 - of stars 5, 26–34, 56, 60, 240, 245
 - of CSE (see also mass loss) 326, 327
- line blanketing 68, 71–73, 87–89, 153, 157
- lithium 150
- Large Magellanic Cloud 10, 33, 45, 46, 51, 57, 238
- long-period variables (see Mira variables)
- LTE and departures from LTE 69, 89, 154, 372, 381, 401, 418
- luminosities 28–30, 32, 46–49, 295, 331, 332
- luminosity function, of PRG stars in external galaxies 44–49
- Lyman α 315, 316
- magnesium (Mg II) lines 234, 262, 307, 308, 313–315, 366
- M–MS–S–SC–C sequence 14, 102, 107, 112–117, 134, 140, 197, 304, 407–411
- M giant stars 17–24, 26–31, 84, 85, 111–114, 136, 141, 145, 147, 153, 288, 305–311, 323, 324
- M supergiants (see also individual stars) 85–87, 136, 154, 242, 248, 260, 299, 323, 324
- Magellanic Clouds (see also Large Magellanic cloud) 10, 15, 19, 29, 45, 46, 75, 104–107, 152, 197, 247, 248, 413–417, 426
- main sequence stars 206, 223
- masers 245, 251, 298, 326, 332, 333, 369, 380, 404
- masses 27, 138, 353, 409
- mass loss
 - evolutionary effects of 169–172, 211–213, 224, 225, 226, 228, 229–231, 284, 349–351, 382, 390, 391, 403, 424
 - mechanisms of 233, 234, 269–282, 317, 342, 382, 412
 - observations of 14, 58, 226, 319, 323, 324, 352, 353, 421, 422
 - rates of 14, 51, 211–213, 224, 233, 281, 275, 327–335, 342–346, 355–357, 368, 382, 384, 421, 422, 424, 425–430

- mass transfer 60, 122, 139, 140, 199-203, 222, 223, 224, 234, 304
- meteorites, origin of grains in 374, 375
- microturbulence 91-93
- microwave observations 321-324, 332-335
- Mira variables (see also AGB stars and individual star types)
 - infrared observations of 391-398, 402
 - kinematics of 26-31, 50
 - masers associated with 380, 404
 - models of 72-78, 269-282, 297
 - periods of 244-248, 409-412
 - photometry of 244-248, 292, 298
 - radio observations of 321-324, 383, 404
 - space distribution and luminosities of 17-24, 340-342
 - spectra and chemical composition of 61, 138-140
- mixing 105, 114-120, 133, 134, 169-172, 190, 191, 409
- mixing length 160, 395
- model atmospheres:
 - chromospheres 314, 366
 - comparison with observations 73, 75-78, 81-97, 375, 377, 149, 151, 314, 366 399-402
 - extended atmospheres 68-73, 157, 269-282
 - photospheres 67-79, 141, 153, 236, 375, 399-402, 417-421
 - with shocks 72-79, 269-282
- molecules (see also individual molecules)
 - molecular bands in infrared 113, 155, 284, 381
 - in radio 284, 322-324, 373
 - in visible 52, 61, 72-78, 90, 91, 95, 102-104, 113, 114, 284, 403
- momentum loss 425-430, 432, 433
- MS stars 133, 306-312
- nova 218
- nebula, reflection 55
- neutron exposure 133, 176-179, 227
- neutron source 109, 110, 127, 128, 133, 134, 176, 180-188, 227, 237
- NGC 7027 410, 428
- N/O ratio 235
- nuclear bulge, red giants in, 10, 42, 246, 247
- nucleosynthesis 227
- number of PRG stars 27, 42-44, 49, 51, 377, 423
- objective prism survey 63
- OH 95, 322-324, 332, 333, 380, 428, 429
- OH/IR stars 30, 352, 368, 409, 415
- opacities 68, 153, 155, 157, 180, 236, 351, 366
- oxygen stars (see K giants, M giants)
- oxygen 102-104, 113-123, 229-231, 408
- PAH molecules 233, 294
- period-luminosity relation
 - of Mira variables 28-31, 138, 241, 289
 - of RV Tauri stars 295
- photodissociation (see excitation)
- photometry 35-41, 53, 57, 59, 73-77, 244, 259, 260, 298, 366, 367, 391-393
- photospheres (see model atmospheres)
- planetary nebula 113, 114, 208, 209, 226, 232, 233, 235, 314, 315, 388, 389, 425-427, 433
- planetary nebula nuclei 211-220, 235, 351, 352, 425-427, 432
- polarization 296
- population II stars 141, 154

- post-AGB stars 55, 146-148, 196, 211-220, 228, 330, 331, 348-353, 356, 357, 384-389, 425-430
 pre-planetary nebulae (PPN) 207-210, 228, 232, 233, 290, 323, 324, 351-352, 354-357, 380, 384-389
 proto-planetary nebulae (see pre-planetary nebulae)
 pulsation 228, 269-282, 293, 353-356, 369, 383, 424
 radiative excitation (see excitation; fluorescence)
 radial velocities 56, 60, 139, 144, 219, 299
 radio observations 284, 288, 311, 313, 321-324, 373, 383
 R Cor Bor (R CrB) stars 57, 215, 293, 348, 353-357, 387, 403, 416, 423, 433
 red-giant branch 206, 223, 228, 237
 Roche lobe 222, 234
 r-process 183-185, 190
 R stars 10, 53, 197, 203, 407-410
 semiconvection (see convection)
 shell flashes (see thermal pulses)
 shocks, effect on atmosphere 297, 381
 shocks, models of 263, 269-282, 316, 317
 shocks, observations of 251, 263, 269-282, 297, 316
 silicate grains (see also dust; circumstellar (CS) dust) 284, 288-290
 silicon carbide (SiC) 54, 284-286, 290, 367, 375
 spectral classification (see classification)
 spectral energy distribution 74-79, 82-84, 151, 153, 155
 spectral lines (see also individual atoms and molecules)
 in infrared 61, 261, 378, 401
 in radio 321-327, 369
 in ultraviolet 55, 305-317, 366, 369, 372
 in visible 4, 5, 8, 55, 89, 107, 261, 296, 369
 spectral type 4-11
 spectrophotometry 54
 spectroscopic binaries 222, 223
 s-process elements 60, 108, 109, 111, 127, 128, 131-141, 169, 170, 187, 190, 191, 237
 s-process enhancement 104, 110, 111, 123-128, 131-141, 154, 156, 176, 183-188, 190, 191, 206
 S stars 16-19, 26-31, 104, 108, 109, 114, 117, 124-126, 136, 197, 245, 288, 306-313, 317, 371, 378
 spectroscopy 53, 261, 262
 star formation 36, 47
 stars, groups of
 ζ Aur 234
 barium (see barium stars)
 carbon (see carbon stars)
 ZZ Ceti 218-220
 CH (see CH stars)
 CH-weak (weak G-band stars) 7, 9
 Eta carinae 30
 globular cluster (see globular clusters)
 M31 46
 M giants (see M giants)
 M supergiants (see M supergiants)
 N55 46
 stars, individual
 α Tau 84, 85
 Arcturus 82, 83, 94, 144, 306, 307, 311
 Betelgeuse 85-87, 261, 262, 264, 299
 N300 46
 NGC 2403 47
 nuclear bulge (see nuclear bulge)
 Omega centauri 30
 R stars (see R stars)
 S (see S stars)
 SC stars 27, 245
 strong CN stars 4
 R CrB stars (see R Cor Bor stars)
 subgiant CH stars 196, 197
 RV Tau 154, 242, 294-296
 47 Tuc 242, 243, 411, 412

- μ Cep 264
- μ Gem 85
- μ Leo 2
- BD -21.3873 156
- HD 35155 156
- HD 36598 33
- HD 39853 150
- HD 49500 7
- HD 130255 4-6
- HD 182040 151
- NT Tel 30, 243
- HR 1105 378
- HR 3126 55
- IRC+10216 15, 326, 328
- FG Sge 146-148
- SN 1987A 238
- TX Psc 155, 306, 307, 314
- stars, joy of research on 399-402
- stellar evolution
 - descriptions of 36, 37, 55, 58, 160, 104-106, 124, 125, 131, 152, 169-172, 221, 234, 290-292, 308, 339, 349-354, 356, 357, 412
 - with mass loss 225, 349-351, 362
 - modeling of 169-172, 211-220, 225, 238, 394-396; 413, 414
 - observational tests of 104-106, 110-128, 164, 290, 317, 318, 397, 404, 407-410
- stellar wind (see also mass loss; mass transfer) 222, 378
- subdwarfs 431
- supergiants (see also M supergiants 242, 314, 315, 348, 353-357, 430, 431)
 - supergiants of spectral types F, G as post-AGB stars (see also post-AGB stars) 146-148, 348, 351, 384-388
- superwind (see also mass loss) 211-213, 217, 228, 384, 421, 422, 424, 425
- surface brightness distribution 84-87
- symbiotic stars 156, 371, 378, 391-400
- technetium (Tc) 29, 102, 107-109, 128, 131-141, 197, 227, 251, 304
- temperatures, effective 70, 73, 83, 86, 349-352, 366, 418
- thermal pulses 30, 105-107, 109-128, 130, 161, 164, 182, 183, 206-208, 213-218, 225, 236, 349-352, 415, 422, 423
- TiO 56, 68-78, 73, 103, 104, 146, 284
- Two Micron Sky Survey (TMSS) 13, 14, 15-24, 24, 340
- variable stars
 - irregular 136, 241, 258-266;
 - mira (see also Mira stars) 19, 20, 136, 241-252, 258, 292, 298, 424
 - models of 263-276, 291, 297
 - periods of 260, 261, 264, 293
 - semi-regular 19, 20, 136, 241-252, 258, 261, 262
 - types and light curves 254, 260, 298
- velocity dispersion, RG stars 26-29, 32
- VLA observations 298, 302
- water vapor (see H₂O)
- white dwarfs 208-220, 223, 356, 357, 431
- x-rays 401
- 5 Cet 234
- IRAS 212824+5050
- TW Hor 256
- o Cet 111, 257
- R CrB (see R Cor Bor stars)
- 30 g Her 91-93
- AC Her 290
- UV Her 290
- ER Del 156, 371
- V CrB 32
- χ Cyg 61, 111, 251, 261
- RV Tau 288-290, 294, 295