## ASTROPHYSICS AND SPACE SCIENCE LIBRARY

## Edited by

- J. E. Blamont, R. L. F. Boyd, L. Goldberg, C. de Jager, Z. Kopal, G. H. Ludwig, R. Lüst, B. M. McCormac, H. E. Newell, L. I. Sedov, Z. Švestka, and W. de Graaff
- C. de Jager (ed.), The Solar Spectrum, Proceedings of the Symposium held at the University of Utrecht, 26-31 August, 1963. 1965, XIV + 417 pp.
- 2. J. Orthner and H. Maseland (eds.), Introduction to Solar Terrestrial Relations, Proceedings of the Summer School in Space Physics held in Alphach, Austria, July 15-August 10, 1963 and Organized by the European Preparatory Commission for Space Research. 1965, IX + 506 pp.
- 3. C. C. Chang and S. S. Huang (eds.), Proceedings of the Plasma Space Science Symposium, held at the Catholic University of America, Washington, D.C., June 11-14, 1963. 1965, IX + 377 pp.
- 4. Zdeněk Kopal, An Introduction to the Study of the Moon. 1966, XII + 464 pp.
- B. M. McCormac (ed.), Radiation Trapped in the Earth's Magnetic Field. Proceedings of the Advanced Study Institute, held at the Chr. Michelsen Institute, Bergen, Norway, August 16— September 3, 1965. 1966, XII + 901 pp.
- 6. A. B. Underhill, The Early Type Stars. 1966, XII + 282 pp.
- 7. Jean Kovalevsky, Introduction to Celestial Mechanics. 1967, VIII + 427 pp.
- 8. Zdeněk Kopal and Constantine L. Goudas (eds.), Measure of the Moon. Proceedings of the 2nd International Conference on Selenodesy and Lunar Topography, held in the University of Manchester, England, May 30-June 4, 1966. 1967, XVIII + 479 pp.
- J. G. Emming (ed.), Electromagnetic Radiation in Space. Proceedings of the 3rd ESRO Summer School in Space Physics, held in Alpbach, Austria, from 19 July to 13 August, 1965. 1968, VIII + 307 pp.
- R. L. Carovillano, John F. McClay, and Henry R. Radoski (eds.), Physics of the Magnetosphere, Based upon the Proceedings of the Conference held at Boston College, June 19-28, 1967. 1968, X + 686 pp.
- 11. Syun-Ichi Akasofu, Polar and Magnetospheric Substorms, 1968, XVIII + 280 pp.
- 12. Peter M. Millman (ed.), Meteorite Research. Proceedings of a Symposium on Meteorite Research, held in Vienna, Austria, 7-13 August, 1968. 1969, XV + 941 pp.
- 13. Margherita Hack (ed.), Mass Loss from Stars. Proceedings of the 2nd Trieste Colloquium on Astrophysics, 12-17 September, 1968. 1969, XII + 345 pp.
- 14. N. D'Angelo (ed.), Low-Frequency Waves and Irregularities in the Ionosphere. Proceedings of the 2nd ESRIN-ESLAB Symposium, held in Frascati, Italy, 23-27 September, 1968. 1969, VII + 218 pp.
- 15. G. A. Partel (ed.), Space Engineering. Proceedings of the 2nd International Conference on Space Engineering, held at the Fondazione Giorgio Cini, Isola di San Giorgio, Venice, Italy, May 7-10, 1969. 1970, XI + 728 pp.
- S. Fred Singer (ed.), Manned Laboratories in Space. Second International Orbital Laboratory Symposium. 1969, XIII + 133 pp.
- 17. B. M. McCormac (ed.), Particles and Fields in the Magnetosphere. Symposium Organized by the Summer Advanced Study Institute, held at the University of California, Santa Barbara, Calif., August 4-15, 1969. 1970, XI + 450 pp.
- 18. Jean-Claude Pecker, Experimental Astronomy. 1970, X + 105 pp.
- 19. V. Manno and D. E. Page (eds.), Intercorrelated Satellite Observations related to Solar Events. Proceedings of the 3rd ESLAB/ESRIN Symposium held in Noordwijk, The Netherlands, September 16-19, 1969. 1970, XVI + 627 pp.
- 20. L. Mansinha, D. E. Smylie, and A. E. Beck, Earthquake Displacement Fields and the Rotation of the Earth, A NATO Advanced Study Institute Conference Organized by the Department of Geophysics, University of Western Ontario, London, Canada, June 22-28, 1969, 1970, XI + 308 pp.
- 21. Jean-Claude Pecker, Space Observatories. 1970, XI + 120 pp.
- 22. L. N. Mavridis (ed.), Structure and Evolution of the Galaxy. Proceedings of the NATO Advanced Study Institute, held in Athens, September 8-19, 1969. 1971, VII + 312 pp.

- 23. A. Mullet (ed.), The Magellanic Clouds, A European Southern Observatory Presentation: Principal Prospects, Current Observational and Theoretical Approaches, and Prospects for Future Research, Based on the Symposium on the Magellanic Clouds, held in Santiago de Chile, March 1969, on the Occasion of the Dedication of the European Southern Observatory. 1971, XII + 189 pp.
- 24. B. M. McCormac (ed.), The Radiating Atmosphere. Proceedings of a Symposium Organized by the Summer Advanced Study Institute, held at Queen's University, Kingston, Ontario, August 3 14, 1970. 1971, XI + 455 pp.
- 25. G. Fiocco (ed.), Mesospheric Models and Related Experiments. Proceedings of the 4th ESRIN-ESLAB Symposium, held at Frascati, Italy, July 6-10, 1970, 1971, VIII + 298 pp.
- 26. I. Atanasijević, Selected Exercises in Galactic Astronomy. 1971, XII + 144 pp.
- C. J. Macris (ed.), Physics of the Solar Corona, Proceedings of the NATO Advanced Study Institute on Physics of the Solar Corona, held at Cavouri-Vouliagmeni, Athens, Greece, 6-17 September 1970, 1971, XII + 345 pp.
- 28. F. Delobeau, The Environment of the Earth. 1971, IX + 113 pp.
- E. R. Dyer (general ed.), Solar-Terrestrial Physics/1970. Proceedings of the International Symposium on Solar-Terrestrial Physics, held in Leningrad, U.S.S.R., 12 19 May 1970, 1972, VIII + 938 pp.
- 30. V. Manno and J. Ring (eds.), Infrared Detection Techniques for Space Research, Proceedings of the 5th ESLAB-ESRIN Symposium, held in Noordwijk, The Netherlands, June 8-11, 1971. 1972, XII + 344 pp.
- 31. M. Lecar (ed.), Gravitational N-Body Problem. Proceedings of IAU Colloquium No. 10, held in Cambridge, England, August 12–15, 1970. 1972, X1 + 441 pp.
- 32. B. M. McCormac (ed.), Earth's Magnetospheric Processes. Proceedings of a Symposium Organized by the Summer Advanced Study Institute and Ninth ESRO Summer School, held in Cortina, Italy, August 30 September 10, 1971. 1972, VIII + 417 pp.
- 33. Antonin Rükl, Maps of Lunar Hemispheres. 1972, V + 24 pp.
- 34. V. Kourganoff, Introduction to the Physics of Stellar Interiors. 1973, XI + 115 pp.
- 35. B. M. McCormac (ed.), Physics and Chemistry of Upper Atmospheres. Proceedings of a Symposium Organized by the Summer Advanced Study Institute, held at the University of Orléans, France, July 31 August 11, 1972, 1973, VIII + 389 pp.
- J. D. Fernie (ed.), Variable Stars in Globular Clusters and in Related Systems. Proceedings of the IAU Colloquium No. 21, held at the University of Toronto, Toronto, Canada, August 29–31, 1972. 1973, IX + 234 pp.
- 37. R. J. L. Grard (ed.), Photon and Particle Interaction with Surfaces in Space, Proceedings of the 6th ESLAB Symposium, held at Noordwijk, The Netherlands, 26–29 September, 1972, 1973, XV + 577 pp.
- Weiner Israel (ed.), Relativity, Astrophysics and Cosmology. Proceedings of the Summer School, held 14 26 August, 1972, at the BANFF Centre, BANFF, Alberta, Canada. 1973, IX + 323 pp.
- B. D. Tapley and V. Szchehely (eds.), Recent Advances in Dynamical Astronomy, Proceedings of the NATO Advanced Study Institute in Dynamical Astronomy, held in Cortina d'Ampezzo, Italy, August 9 12, 1972, 1973, XIII + 468 pp.
- A. G. W. Cameron (ed.), Cosmochemistry, Proceedings of the Symposium on Cosmochemistry, held at the Smithsonian Astrophysical Observatory, Cambridge, Mass., August 14–16, 1972. 1973, X + 173 pp.
- 41. M. Golay, Introduction to Astronomical Photometry. 1974, IX + 364 pp.
- 42. D. F. Page (ed.), Correlated Interplanetary and Magnetospheric Observations, Proceedings of the 7th ESLAB Symposium, held at Saulgau, W. Germany, 22 25 May, 1973, 1974, XIV + 662 pp.
- 43. Riccardo Giacconi and Herbert Gursky (eds.), X-Ray Astronomy. 1974, X + 450 pp.
- 44. B. M. McCormac (ed.), Magnetospheric Physics, Proceedings of the Advanced Summer Institute, held in Sheffield, U.K., August 1973, 1974, VII + 399 pp.
- 45. C. B. Cosmovici (ed.), Supernovae and Supernova Remnants. Proceedings of the International Conference on Supernovae, held in Lecce, Italy, May 7—11, 1973. 1974, XVII + 387 pp.
- 46. A. P. Mitra, Ionospheric Effects of Solar Flares. 1974, XI + 294 pp.
- 47. S.-I. Akasofu, *Physics of Magnetospheric Substorms*. 1977, XVIII + 599 pp.

- 48. H. Gursky and R. Ruffini (eds.), Neutron Stars, Black Holes and Binary X-Ray Sources. 1975, XII + 441 pp.
- 49. Z. Švestka and P. Simon (eds.), Catalog of Solar Particle Events 1955-1969. Prepared under the Auspices of Working Group 2 of the Inter-Union Commission on Solar-Terrestrial Physics. 1975, 1X + 428 pp.
- 50. Zdeněk Kopal and Robert W. Carder, Mapping of the Moon. 1974, VIII + 237 pp.
- 51. B. M. McComac (ed.), Atmospheres of Earth and the Planets. Proceedings of the Summer Advanced Study Institute, held at the University of Liège, Belgium, July 29-August 8, 1974. 1975, VII + 454 pp.
- 52. V. Formisano (ed.), The Magnetospheres of the Earth and Jupiter. Proceedings of the Neil Brice Memorial Symposium, held in Frascati, May 28-June 1, 1974, 1975, XI + 485 pp.
- 53. R. Grant Athay, The Solar Chromosphere and Corona: Quiet Sun. 1976, XI + 504 pp.
- 54. C. de Jager and H. Nieuwenhuijzen (eds.), Image Processing Techniques in Astronomy. Proceedings of a Conference, held in Utrecht on March 25-27, 1975. XI + 418 pp.
- N. C. Wickramasinghe and D. J. Morgan (eds.), Solid State Astrophysics. Proceedings of a Symposium, held at the University College, Cardiff, Wales, 9-12 July 1974. 1976, XII + 314 pp.
- 56. John Meaburn, Detection and Spectrometry of Faint Light. 1976, IX + 270 pp.
- 57. K. Knott and B. Battrick (eds.), The Scientific Satellite Programme during the International Magnetospheric Study, Proceedings of the 10th ESLAB Symposium, held at Vienna, Austria, 10-13 June 1975. 1976, XV + 464 pp.
- 58. B. M. McCormac (ed.), Magnetospheric Particles and Fields. Proceedings of the Summer Advanced Study School, held in Graz, Austria, August 4-15, 1975, 1976, VII + 331 pp.
- B. S. P. Shen and M. Merker (eds.), Spallation Nuclear Reactions and Their Applications. 1976, VIII + 235 pp.
- 60. Walter S. Fitch (ed.), Multiple Periodic Variable Stars. Proceedings of the International Astronomical Union Colloquium No. 29, held at Budapest, Hungary, 1-5 September 1976. 1976, XIV + 348 pp.
- 61. J. J. Burger, A. Pedersen, and B. Battrick (eds.), Atmospheric Physics from Spacelab. Proceedings of the 11th ESLAB Symposium, Organized by the Space Science Department of the European Space Agency, held at Frascati, Italy, 11-14 May 1976. 1976, XX + 409 pp.
- 62. J. Derral Mulholland (ed.), Scientific Applications of Lunar Laser Ranging. Proceedings of a Symposium held in Austin, Tex., U.S.A., 8-10 June, 1976, 1977, XVII + 302 pp.
- 63. Giovanni G. Fazio (ed.), Infrared and Submillimeter Astronomy. Proceedings of a Symposium held in Philadelphia, Penn., U.S.A., 8-10 June, 1976. 1977, X + 226 pp.
- 64. C. Jaschek and G. A. Wilkins (eds.), Compilation, Critical Evaluation and Distribution of Stellar Data. Proceedings of the International Astronomical Union Colloquium No. 35, held at Strasbourg, France, 19-21 August, 1976. 1977, XIV + 316 pp.
- 65. M. Friedjung (ed.), Novae and Related Stars. Proceedings of an International Conference held by the Institut d'Astrophysique, Paris, France, 7-9 September, 1976. 1977, XIV + 228 pp.
- 66. David N. Schramm (ed.), Supernovae. Proceedings of a Special IAU-Session on Supernovae held in Grenoble, France, 1 September, 1976, 1977, X + 192 pp.
- 67. Jean Audouze (ed.), CNO Isotopes in Astrophysics. Proceedings of a Special IAU Session held in Grenoble, France, 30 August, 1976. 1977, XIII + 195 pp.
- 68. Z. Kopal, Dynamics of Close Binary Systems, XIII + 510 pp.
- 69. A. Bruzek and C. J. Durrant (eds.), *Illustrated Glossary for Solar and Solar-Terrestrial Physics*. 1977, XVIII + 204 pp.
- 70. H. van Woerden (ed.), Topics in Interstellar Matter. 1977, VIII + 295 pp.
- 71. M. A. Shea, D. F. Smart, and T. S. Wu (eds.), Study of Travelling Interplanetary Phenomena. 1977, XII + 439 pp.
- 72. V. Szebehely (ed.), Dynamics of Planets and Satellites and Theories of Their Motion, Proceedings of IAU Colloquium No. 41, held in Cambridge, England, 17-19 August 1976. 1978, XII + 375 pp.
- 73. James R. Wertz (ed.), Spacecraft Attitude Determination and Control. 1978, XVI + 858 pp.

- 74. Peter J. Palmadesso and K. Papadopoulos (eds.), Wave Instabilities in Space Plasmas. Proceedings of a Symposium Organized Within the XIX URSI General Assembly held in Helsinki, Finland, July 31-August 8, 1978. 1979, VII + 309 pp.
- 75. Bengt E. Westerlund (ed.), Stars and Star Systems. Proceedings of the Fourth European Regional Meeting in Astronomy held in Uppsala, Sweden, 7-12 August, 1978, 1979, XVIII + 264 pp.
- 76. Cornelis van Schooneveld (ed.), Image Formation from Coherence Functions in Astronomy. Proceedings of IAU Colloquium No. 49 on the Formation of Images from Spatial Coherence Functions in Astronomy, held at Groningen, The Netherlands, 10-12 August 1978. 1979, XII + 338 pp.
- 77. Zdenek Kopal, Language of the Stars. A Discourse on the Theory of the Light Changes of Eclipsing Variables. 1979, VIII + 280 pp.
- 78. S.-I. Akasofu (ed.), Dynamics of the Magnetosphere. Proceedings of the A.G.U. Chapman Conference 'Magnetospheric Substorms and Related Plasma Processes' held at Los Alamos Scientific Laboratory, N.M., U.S.A., October 9-13, 1978. 1980, XII + 658 pp.
- 79. Paul S. Wesson, Gravity, Particles, and Astrophysics. A Review of Modern Theories of Gravity and G-variability, and their Relation to Elementary Particle Physics and Astrophysics. 1980, VIII + 188 pp.
- 80. Peter A. Shaver (ed.), Radio Recombination Lines. Proceedings of a Workshop held in Ottawa, Ontario, Canada, August 24-25, 1979. 1980, X + 284 pp.
- 81. Pier Luigi Bernacca and Remo Ruffini (eds.), Astrophysics from Spacelab, 1980, XI + 664 pp.
- 82. Hannes Alfvén, Cosmic Plasma, 1981, X + 160 pp.
- 83. Michael D. Papagiannis (ed.), Strategies for the Search for Life in the Universe, 1980, XVI + 254 pp.
- 84. H. Kikuchi (ed.), Relation between Laboratory and Space Plasmas, 1981, XII + 386 pp.
- 85. Peter van der Kamp, Stellar Paths, 1981, xxii + 155 pp.
- 86. E. M. Gaposchkin and B. Kołaczek (eds.), Reference Coordinate Systems for Earth Dynamics, 1981, XIV + 396 pp.
- 87. R. Giacconi (ed.), X-Ray Astronomy with the Einstein Satellite. Proceedings of the High Energy Astrophysics Division of the American Astronomical Society Meeting on X-Ray Astronomy held at the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass., U.S.A., January 28-30, 1980. 1981, VII + 330 pp.
- 88. Icko Iben Jr. and Alvio Renzini (eds.), Physical Processes in Red Giants. Proceedings of the Second Workshop, held at the Ettore Majorana Centre for Scientific Culture, Advanced School of Agronomy, in Erice, Sicily, Italy, September 3-13, 1980. 1981, XV + 488 pp.
- 89. C. Chiosi and R. Stalio (eds.), Effect of Mass Loss on Stellar Evolution. IAU Colloquium No. 59 held in Miramare, Trieste, Italy, September 15-19, 1980. 1981, XXII + 532 pp.
- 90. C. Goudis, The Orion Complex: A Case Study of Interstellar Matter, 1982 (forthcoming).
- 91. F. D. Kahn (ed.), Investigating the Universe. Papers Presented to Zdeněk Kopal on the Occasion of his retirement, September 1981. 1981, X + 458 pp.
- 92. C. M. Humphries (ed.), Instrumentation for Astronomy with Large Optical Telescopes, Proceedings of IAU Colloquium No. 67, 1982, xvii + 321 pp.
- 93. R. S. Roger and P. E. Dewdney (eds.), Regions of Recent Star Formation, Proceedings of the Symposium on "Neutral Clouds Near HII Regions Dynamics and Photochemistry", held in Penticton. B.C., June 24-26, 1981. 1982, XVI + 496 pp.
- 94. O. Calame (ed.), High-Precision Earth Rotation and Earth-Moon Dynamics. Lunar Distances and Related Observations. 1982, xx + 354 pp.
- 95. M. Friedjung and R. Viotti (eds.), The Nature of Symbiotic Stars, 1982, xx + 310 pp.
- 96. W. Fricke and G. Teleki (eds.), Sun and Planetary System, 1982, xiv + 538 pp.
- 97. C. Jaschek and W. Heintz (eds.), Automated Data Retrieval in Astronomy, 1982, xx + 324 pp.
- 98. Z. Kopal and J. Rahe (eds.), Binary and Multiple Stars as Tracers of Stellar Evolution, 1982, xxx + 498 pp. + index.
- 99. A. W. Wolfendale (ed.), Progress in Cosmology, 1982, viii + 356 pp. + index.

## INSTRUMENTATION FOR ASTRONOMY WITH LARGE OPTICAL TELESCOPES

Proceedings of IAU Colloquium No. 67, held at Zelenchukskaya, U.S.S.R. September 8–10, 1981

edited by

COLIN M. HUMPHRIES
Royal Observatory, Edinburgh, U.K.

At a time when recent advances have produced a dramatic increase in the detection efficiency of astronomical instrumentation (e.g. with the advent of charge coupled detectors and single photon counting systems), it would seem appropriate to review the progress which has been made in the field. To this end, IAU Colloquium No. 67 was recently held in Zelenchuk, U.S.S.R. Topics discussed included spatial and spectral interferometry, conventional and new designs for spectrographs, image intensifiers and solid state detectors, large telescopes, and the efficient matching of telescope images and instrumentation. The spectral region considered included the infrared as well as the visible.

## Audience

The book will be of particular interest to astronomers, physicists, and engineers working in observatories.



D. Reidel Publishing Company

Dordrecht, Holland / Boston, U.S.A. / London, England