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# THE FUTURE OF SMALL TELESCOPES IN THE NEW MILLENNIUM

Volume III – Science in the Shadows of Giants

TERRY D. OSWALT  
Editor



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# Future Of Small Telescopes In The New Millennium

**Terry D. Oswalt**



## **Future Of Small Telescopes In The New Millennium:**

**The Future of Small Telescopes in the New Millennium** Terry D. Oswalt, 2012-12-06 The motivation for these volumes is to provide a vision for the future of small telescopes While this is an admirable task ultimately I believe that as happens all the time in science the prognostications will be overtaken by a rapidly changing scientific reality As Virginia Trimble points out in chapter 1 the kinds of big questions that face us as astronomers today are rather different than the ones that drove the construction of astronomical facilities through much of the twentieth century Right now it appears that small telescopes will not have a lot of influence in answering those questions though they will of course contribute enormously to the many issues discussed throughout the three volumes We are on the verge of opening a whole new parameter space that may revolutionize the way we think of small telescopes and their role in astronomy the domain of the rapidly variable sky While the LSST is the most prominent example it is a long way in the future Nemiroff Rafert chapter 2 consider the value of monitoring large parts of the sky on a continuous basis using technology similar to a webcam They have installed their CONCAM2 at four locations including Kitt Peak A related project built and operated by the Harvard graduate student Gaspar Bakos HAT-1 Hungarian Automated Telescope also is in operation at Kitt Peak *The Future of Small Telescopes in the New Millennium: Science in the shadows of giants* Terry D. Oswalt, 2003 [The Future of Small Telescopes in the New Millennium: The telescopes we use](#) Terry D. Oswalt, 2003 This title details the essential roles that small telescopes should play in 21st century science and how their future productivity can be maximized Over 70 experts from all corners of the international astronomical community have created a reference on the future of big science with small telescopes at national facilities and their omission from national science priority studies the oft lamented demise of the small telescope has been greatly exaggerated In fact the future of these workhorses of astronomy will be brighter than ever if creative steps are taken now This three volume set defines essential roles that small telescopes should play in 21st century science and the ways in which a productive future for them can be realized A wide cross section of the astronomical community has contributed to a definitive assessment of the present and a vision for the future radio and space based facilities face problems in scientific prioritization and funding It highlights how current small facilities are evolving to meet the scientific priorities and economical realities of the 21st century through standardization of instrumentation use of off the shelf technology specialization optical improvements new modes of scheduling automation and internet access *The Future of Small Telescopes in the New Millennium* Terry D. Oswalt, 2003-02-15 This title details the essential roles that small telescopes should play in 21st century science and how their future productivity can be maximized Over 70 experts from all corners of the international astronomical community have created a reference on the future of big science with small telescopes at national facilities and their omission from national science priority studies the oft lamented demise of the small telescope has been greatly exaggerated In fact the future of these workhorses of astronomy will be brighter than ever if

creative steps are taken now This three volume set defines essential roles that small telescopes should play in 21st century science and the ways in which a productive future for them can be realized A wide cross section of the astronomical community has contributed to a definitive assessment of the present and a vision for the future volume one of this three volume set examines the public's and the astronomical communities own perceptions and misconceptions of small telescope productivity These shape the future scientific research that will be done with telescopes smaller than 4 m in aperture and the number of astronomers that will have access to them

### **Cosmic Gamma-Ray Sources** K.S. Cheng, Gustavo E.

Romero, 2012-11-03 Gamma ray astronomy has undergone an enormous progress in the last 15 years The success of satellite experiments like NASA's Compton Gamma Ray Observatory and ESA's INTEGRAL mission as well as of ground based instruments have opened new views into the high energy Universe Different classes of cosmic gamma ray sources have been now detected at different energies in addition to young radio pulsars and gamma ray bursts the classical ones The new sources include radio quiet pulsars microquasars supernova remnants starburst galaxies radio galaxies flat spectrum radio quasars and BL Lacertae objects A large number of unidentified sources strongly suggests that this brief enumeration is far from complete Gamma ray bursts are now established as extragalactic sources with tremendous energy output There is accumulating evidence supporting the idea that massive stars and star forming regions can accelerate charged particles up to relativistic energies making them gamma ray sources Gamma ray astronomy has also proved to be a powerful tool for cosmology imposing constraints to the background photon fields that can absorb the gamma ray flux from distant sources All this has profound implications for our current ideas about how particles are accelerated and transported in both the local and distant Universe The evolution of our knowledge on the gamma ray sky has been so fast that it is not easy for the non specialist scientist and the graduate student to be aware of the full potential of this field or to grasp the fundamentals of a given topic in order to attempt some original contribution

### Adventures in Order and Chaos George

Contopoulos, 2007-09-21 For many years I was organizing a weekly seminar on dynamical astronomy and I used to make some historical remarks on every subject including some anecdotes from my contacts with many leading scientists over the years I described also the development of various subjects and the emergence of new ideas in dynamical astronomy Then several people prompted me to write down these remarks which cannot be found in papers or books Thus I decided to write this book which contains my experiences over the years I hope that this book may be helpful to astronomy students all over the world During my many years of teaching as a visiting professor in American Universities 1962 1994 Yale Harvard MIT Cornell Chicago Maryland and Florida I was impressed by the quality of my graduate students Most of them were very bright asking penetrating questions and preparing their homework in a perfect way In a few cases instead of a final examination I assigned to them some small research projects and they presented their results at the end of the course They were excellent in preparing the appropriate slides and in presenting their results in a concise and clear way

### **High-Velocity Clouds**

Hugo van Woerden, Bart Wakker, Ulrich Schwarz, Klaas de Boer, 2006-01-28 On the occasion of the retirement of Ulrich Schwarz a symposium was held in Groningen in May of 1996 celebrating his contributions to the study of the interstellar medium including his work on the high velocity clouds The coming together of many specialists in the latter field prompted the idea of compiling a book containing their contributions and summarizing the status of our understanding of the high velocity cloud phenomenon This seemed especially worthwhile at the time since many exciting developments were taking place After the discovery of some H I clouds with high velocities about 40 years ago the subject had been dominated by 21 cm observations of H I emission Starting in the mid 1980s much progress was being made because of the availability of new instruments such as large ground based optical telescopes and UV observatories in space The connections between the work on high velocity clouds and other studies of the properties of the hot interstellar medium also became clearer Solar Magnetic Phenomena A. Hanslmeier, A. Veronig, M. Messerotti, 2006-03-30 The concept of summerschools and workshops at the Kanzelhöhe Solar Observatory Karnten Austria devoted to topics in solar physics has been proven to be extremely successful and thus in August-September 2003 the third combined summerschool and workshop was held there This book contains the proceedings of the Summerschool and Workshop Solar Magnetic Phenomena held from 25 August to 5 September 2003 at the Solar Observatory Kanzelhöhe which belongs to the Institute for Geophysics Astrophysics and Meteorology of the University of Graz Austria The book contains the contributions from six invited lecturers They give an overview on the following topics observations of the photosphere and chromosphere solar flares observations and theory coronal mass ejections and the relevance of magnetic helicity high energy radiation from the Sun the physics of solar prominences and highlights from the SOHO mission The lectures contain about 25 to 30 pages each and provide a valuable introduction to the topics mentioned above The comprehensive lists of references at the end of each contribution enable the interested reader to go into more detail The second part of the book contains contributed papers These papers were presented and discussed in the workshop sessions during the afternoons The sessions stimulated intensive discussions between the participants and lecturers Physics of the Solar System B. Bertotti, Paolo Farinella, David Vokrouhlický, 2003 This volume covers most areas in the physics of the solar system with special emphasis on gravitational dynamics its gist is the rational in particular mathematical understanding of the main processes at work Special stress is given to the variety of objects in the planetary system and their long term evolution The unique character of this book is its breadth and depth which aims at bringing the reader to the threshold of original research however special chapters and introductory sections are included for the benefit of the beginner The volume is generally suitable for post graduate students and researchers in physics especially in the field related to the solar system A large amount of figures and diagrams is included often compiled with real data **Radiation Hazard in Space** L.I. Miroshnichenko, 2013-04-17 The monograph contains 8 chapters and their contents cover all principal aspects of the problem 1 Introduction and brief history of the radiation problem and background information of radiation

hazard in the near Earth and interplanetary space 2 General description of radiation conditions and main sources of charged particles in the Earth's environment and interplanetary space effects of space environment on spacecraft 3 Basic information about physical conditions in space and main sources of charged particles in the Earth's environment and interplanetary space in the context of Space Weather monitoring and prediction 4 Trapped radiation belts of the Earth ERB theory of their origin spatial and temporal dynamics and experimental and statistical models 5 Galactic cosmic rays GCR variations of energetic temporal and spatial characteristics long term modulation and anomalous cosmic ray ACR component modeling of their dynamics 6 Production of energetic particles SEPs at near the Sun available databases acceleration propagation and prediction of individual SEP event statistical models of solar cosmic rays SCR 7 Existing empirical techniques of estimating prediction and modeling of radiation hazard methodical approaches and constraints some questions of changes in the Earth's radiation environment due to changes of the solar activity level 8 Unresolved problems of radiation hazard prediction and spacecraft protection radiation experiments on board the spacecraft estimating of radiation conditions during interplanetary missions Space does not allow us to explain every time the solar terrestrial and radiation physics nomenclature used in current English language literature *The Sun and the Heliosphere as an Integrated System* Giannina Poletto, Steve T. Suess, 2013-06-05 9 MHD Turbulence in the Heliosphere Evolution and Intermittency 253 Bruno Bavassano Roberto Bruno and Vincenzo Carbone 1 Introduction 254 2 MHD Turbulence Evolution 255 2 1 Ecliptic Turbulence 256 2 2 Polar Turbulence 258 2 3 Conclusions on Turbulence Evolution 263 3 Intermittency 264 3 1 Probability Distribution Functions of Fluctuations and Self similarity 269 3 2 Radial Evolution of Intermittency 271 3 3 Identifying Intermittent Events 273 3 4 Conclusions on Intermittency 277 10 283 Waves and Turbulence in the Solar Corona Eckart Marsch 1 Introduction 284 2 Coronal Magnetic Field Structures 284 3 Magnetic Network Activity and Coronal Heating 287 4 Waves and Flows in Loops and Funnels 290 5 Magnetohydrodynamic Waves and Flux Tube Oscillations 293 5 1 Observation and Theory 293 5 2 Oscillations of Thin Flux Tubes 295 5 3 Wave Amplitudes Versus Height from Numerical Mod 2 5 4 A Standing Slow Magnetoacoustic Wave 299 6 Plasma Waves and Heating of Particles 301 7 Generation Transfer and Dissipation of Coronal Turbulence 303 7 1 Generation of Magnetohydrodynamic Waves 303 7 2 Wave Energy Transfer and Turbulent Cascade 304 7 3 Wave Dissipation in the Kinetic Domain 307 7 4 Origin and Generation of Coronal High Frequency Waves 308 7 **Soft X-Ray Emission from Clusters of Galaxies and Related Phenomena** R. Lieu, Jonathan Mittaz, 2013-11-09 Since the discovery of the cluster soft excess CSE over eight years ago its properties and origin have been the subject of debate With the recent launch of new missions such as XMM Newton and FUSE we are beginning to answer some of the complex issues regarding the phenomenon This conference proceedings is an attempt to bring together the latest research results and covers both observational and theoretical work on the CSE and related topics One of the main topics is the possible relationship between the CSE and the warm hot intergalactic medium WHIM which is believed to harbor 50% of the baryons in the near Universe New data from

both XMM Newton and FUSE have indicated a possible causal link between the WHIM and CSE Evidence is based on the apparent detection of O VII emission lines in the soft excess spectrum of the outskirts of several clusters as well as reports of absorption lines at local and higher redshifts seen in the spectra of distant sources as signature of the WHIM However while there has been considerable optimism in attributing a substantial fraction of the cluster soft excess flux to WHIM emission other work shows that for example the amount of WHIM material predicted by theoretical simulations falls way short of that necessary to account for the CSE Other work indicates that at the cores of some cluster this excess emission is so strong it is impossible to invoke the thermal model without at the same time enlisting radically new physics Thus alternative interpretations involving non thermal processes are also reported and being pursued in earnest Whatever the origin of CSE may turn out to be results in this book show that it has become beyond reasonable doubt that the phenomenon itself is observationally established This book reports the scientific progress made by bringing together scientists from a wide range of disciplines It clearly demonstrates the importance of such meetings and participants if we are to solve this puzzle This volume is aimed at scientists and graduate students in astronomy who want to learn about the latest results on cluster soft excess observations and theoretical implications

**Polarization in Spectral Lines** M. Landi Degl'Innocenti, M.

Landolfi, 2006-05-17 The scientific research based on spectropolarimetric techniques is undergoing a phase of rapid growth Instruments of unprecedented sensitivity are nowadays available particularly for solar observations To fully exploit the rich diagnostic content of such observations it is necessary to understand the physical mechanisms involved in the generation and transfer of polarized radiation in astrophysical or laboratory plasmas After an introductory part based on classical physics this book tackles the subject by a rigorous quantum mechanical approach The transfer equations for polarized radiation and the statistical equilibrium equations for the atomic density matrix are derived directly from the principles of Quantum Electrodynamics The two sets of equations are then used to present a number of applications mainly concerning the diagnostics of solar magnetic fields This book is primarily addressed to scientists working in the field of spectropolarimetry It may also serve as a textbook for a course at the graduate or advanced undergraduate level

**Civic Astronomy** George Wise, 2012-11-07 The founding of the Dudley Observatory at Albany N Y in 1852 was a milestone in humanity's age old quest to understand the heavens As the best equipped astronomical observatory in the U S led by the first American to hold a Ph D in astronomy Benjamin Apthorp Gould Jr the observatory helped pioneer world class astronomy in America It also proclaimed Albany's status as a major national center of culture knowledge and affluence This book explores the story of the Dudley Observatory as a 150 year long episode in civic astronomy The story ranges from a bitter civic controversy to a venture into space from the banks of the Hudson River to the highlands of Argentina It is a unique glimpse at a path not taken a way of doing science once promising now vanished As discoveries by the Dudley Observatory's astronomers especially its second director Lewis Boss made significant contributions to the modern vision of our Milky Way galaxy as a rotating spiral of more

than a million stars the advance of astronomy left that little observatory behind

Solar Journey: The Significance of Our Galactic Environment for the Heliosphere and Earth P.C. Frisch, 2006-09-12 Written by experts who created the field this volume explores uncharted scientific territory with articles discussing the effect of our galactic environment on the heliosphere planetary system and Earth Leading experts in diverse fields discuss the physical changes expected as the heliosphere adjusts to its galactic environment Topics include the interaction between solar wind and interstellar dust and gas cosmic ray modulation magnetospheres variations in the solar environment and the cosmic ray isotope record preserved in paleoclimate data

Supermassive Black Holes in the Distant Universe A.J. Barger, 2013-11-09 Quasars and the menagerie of other galaxies with unusual nuclei now collectively known as Active Galactic Nuclei or AGN have in one form or another sparked the interest of astronomers for over 60 years The only known mechanism that can explain the staggering amounts of energy emitted by the innermost regions of these systems is gravitational energy release by matter falling towards a supermassive black hole a black hole whose mass is millions to billions of times the mass of our Sun AGN emit radiation at all wavelengths X rays originating at a distance of a few times the event horizon of the black hole are the emissions closest to the black hole that we can detect thus X rays directly reveal the presence of active supermassive black holes Oftentimes however the supermassive black holes that lie at the centers of AGN are cocooned in gas and dust that absorb the emitted low energy X rays and the optical and ultraviolet light hiding the black hole from view at these wavelengths Until recently this low energy absorption presented a major obstacle in observational efforts to map the accretion history of the universe In 1999 and 2000 the launches of the Chandra and XMM Newton X ray Observatories finally broke the impasse The impact of these observatories on X ray astronomy is similar to the impact that the Hubble Space Telescope had on optical astronomy The astounding new data from these observatories have enabled astronomers to make enormous advances in their understanding of when accretion occurs

**How does the Galaxy work?** Emilio Javier Alfaro, Enrique Perez, José Franco, 2006-03-30 The international conference How does the Galaxy work Agalactictertulia rd th with Don Cox and Ron Reynolds was held during the week of 23 to 27 of June 2003 in the marvelous city of Granada Spain This week marked the beginning of one of the hottest summers that we have ever lived but in contrast the meeting was one of the coolest events that we can remember First it certainly was a rstclass scientific reunion with an excellent program talented speakers and alive discussions in a friendly atmosphere Second the whole event was embedded in the passionate Andalusian way of life a true tertulia well seasoned with tasty tapas and perfectly marinated in cool and dry sherry wine Third the celebration was framed by some of the most beautiful settings that one can imagine we enjoyed the magnificent splendor of the Alhambra the unique Muslim Jewish Christian flavor of the Albaicin and the magical gypsy heartbeat of Sacromonte Last but not least all discussions whether they were during the sessions or at a table were sprinkled with the charm and wit of the two guests of honor Don Cox and Ron Reynolds The idea of having a scientific feast to celebrate their 60th birthday in Granada was actually conceived



at a bar table in Seville with plenty of manzanilla at hand a couple of summers ago That perhaps was the difficult part of the project The rest was relatively easy to achieve because Don and Ron are not only remarkable astronomers but they are also great human beings Indeed we had a very positive response from all parties involved every person we talked to was enthusiastic about the celebration and wanted to give their own point of view in this tertulia

**Open Issues in Local Star Formation** Jacques Lépine, Jane Gregorio-Hetem, 2006-04-18 The international colloquium Open Issues in Local Star Formation and Early Stellar Evolution was focused on the physics of young stellar objects which are observed with increasing angular resolution by the new generation of telescopes and the processes that triggered large scale star formation in the solar neighbourhood The scientific presentations were not limited to these two main topics as many new and interesting results related to star formation have been obtained The participants presented new findings in the fields of stellar groups and associations young stellar objects disks outflows and jets the ISM conditions for star formation and early stages of star formation The discussions on open issues representing problems and unanswered questions should make this book particularly useful for researchers and PhD students

**The Sun and Space Weather** Arnold Hanslmeier, 2007-06-19 The field of solar physics and solar terrestrial relation now called space weather is evolving rapidly As in the first edition it is assumed that it is inevitable for the reader to get some basic knowledge in solar physics since the Sun is the main driver for space weather The term space weather itself has been gaining more and more attention during the past years as our society becomes more and more dependent on satellites which are vulnerable to varying conditions in space Space weather efforts and investigations are being made all over the world and more and more is known about the complex relations of processes on the Sun and the Earth and its space environment The term space climate nowadays includes the long term variations caused mainly by the Sun on the Earth and the interplanetary space As in the first edition of the book this edition also covers these topics but new chapters have been introduced e g a chapter on real time space weather forecasts and some main space weather data sources All the chapters have updated information taking into account the results of new satellite missions and telescopes The book also includes a great amount of new literature more than 340 original citations so that the reader is able to go into more details if required in the respective chapters

**Multiwavelength Cosmology** Manolis Plionis, 2006-04-18 The recent scientific efforts in Astrophysics Cosmology have brought a revolution to our understanding of the Cosmos Amazing results is the outcome of amazing experiments The huge scientific technological financial effort that has gone into building the 10 m class telescopes as well as many space and balloon observatories essential to observe the multitude of cosmic phenomena in their manifestations at different wavelengths from gamma rays to the millimetre and the radio has given and is still giving its fruits of knowledge These recent scientific achievements in Observational and Theoretical Cosmology were presented in the Multiwavelength Cosmology conference that took place on beautiful Mykonos island in the Aegean between 17 and 20 June 2003 More than 180 Cosmologists from all over the world gathered for a four day intense

meeting in which recent results from large ground based surveys AAT 2 df SLOAN and space missions WMAP Chandra XMM ISO HST were presented and debated providing a huge impetus to our knowledge of the Cosmos The future of the subject experiments and directions of research was also discussed The conference was devoted mostly on the constraints on Cosmological models and galaxy formation theories that arise from the study of the high redshift Universe from clusters of galaxies and their evolution from the cosmic microwave background the large scale structure and star formation history

## Decoding **Future Of Small Telescopes In The New Millennium**: Revealing the Captivating Potential of Verbal Expression

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