

Foreword

Humans have scrutinized and wondered about the Sun since the dawn of civilization. There are many reasons for this intense, continuing interest. The Sun sustains life on Earth; it controls our environment and impacts our technological civilization. Understanding and predicting the influences of the Sun on the Earth's climate and on space weather in the near-Earth environment are major challenges for solar astronomy. Solar and stellar evolution continues to influence the evolution of life on Earth and planetary systems in general. The Sun is the nearest and most readily studied example of many physical processes that form the foundations of our current understanding of the universe. The Sun is a unique, astrophysical-scale plasma physics laboratory. It is close enough for laboratory-accurate measurements to be made. The Sun presents us with many important mysteries and unexplored domains that challenge science. *The Complete Idiot's Guide to the Sun* captures the essence of these phenomena and much more in a manner that is easily understood. It forms a basis from which the reader can easily launch further studies of the Sun and astronomy.

It was not without some angst that I undertook writing a foreword to Jay Pasachoff's book—*The Complete Idiot's Guide to the Sun*. Jay is such a prolific writer of astronomy texts that a foreword almost seems superfluous. Jay is one of the few, or perhaps only, authors who could pen this book, which is certainly in line with his recent Education Prize from the American Astronomical Society, “for his willingness to go into educational nooks where no astronomer has gone before.” He has brought together a wide range of astronomical research and knowledge—using the Sun as a catalyst—showing how we apply physical insight gained from the Sun in our interpretation of the cosmos, and how we use our knowledge gleaned from other parts of the universe to unravel solar mysteries. Jay's many years of teaching all aspects of astronomy give him an in-depth perspective on the Sun's role as a cornerstone of astronomy. He has done a wonderful job using this perspective to produce a very readable and enlightening book.

Very appropriately, the first two figures of the book include a solar eclipse. No one has devoted more effort than Jay to viewing solar eclipses and bringing solar experiments into the path of totality or to expressing enthusiasm to others for these impressive events. I recall reading a tongue-in-cheek article back in my graduate student days that used the existence of total solar eclipses to prove there is a divinity, who by arranging for total solar eclipses revealed to us much of the workings of the universe. Within our solar system, it is only from the Earth's surface, where the relative angular size of a moon and the Sun are nearly identical, that one can stand on a planetary surface and view a perfect blocking of the bright solar disk to see chromosphere and corona.

Jay covers many topics you might find only in advanced college textbooks—such as the reason the Sun apparently has a sharp edge—but explains them in terms of everyday experience. He provides one of the best and easiest-to-follow explanations of opacity I have read. The book often takes you by surprise; you think this is going to be too hard to explain, and suddenly, very clearly, you find yourself in the heart of nucleosynthesis or helioseismology and it all seems easy and logical. A few pages later, you find yourself understanding the solar neutrino puzzle and its solution.

Jay quickly has the reader doing astrophysics in his or her head (no computers), for example computing the wavelength dependence of the Rayleigh scattering of light, leading to an understanding of why the sky is blue and explaining the mystery of the green flash. The book is dotted with interesting historical notes, letting us follow the progress of solar physics and astronomy in general from ancient times, through the Middle Ages, through the Renaissance, and into modern times.

The Complete Idiot's Guide to the Sun is timely. Recent high-energy spectroscopic images of the Sun's outer atmosphere made from satellites and breakthroughs in resolving fundamental physical processes by using adaptive optics at large ground-based telescopes have placed us at the brink of understanding fundamental processes on the Sun. Although there is still a lot we don't know about the Sun, Jay's book does an excellent job of describing what we do know and pointing out where understanding is still lacking.

Even though the book is called an idiot's guide, Jay manages to squeeze in much of astronomy, proving that the Sun not only provides for life on Earth, but it also provides us with a continuing source of knowledge. *The Complete Idiot's Guide to the Sun* is a fun read, which I enjoyed immensely.

—Dr. Stephen L. Keil

Dr. Stephen L. Keil is director of the National Solar Observatory and Principal Investigator for the Advanced Technology Solar Telescope (ATST), a planned 4-meter aperture solar telescope that will revolutionize our understanding of magnetic process on the Sun. Prior to joining the NSO in 1999, Dr. Keil led the Air Force's Solar Environmental Disturbances task and was the program manager for the Solar Mass Ejection Imager, which is now in orbit around the Earth. He is a 1969 graduate of the University of California and earned his doctorate in Physics and Astronomy at Boston University in 1975. He has over 60 publications in scientific literature.

Introduction

Do you enjoy going outside on a sunny day? Do you prefer the Sun to the gloom? I certainly do, for both my personal life and my professional life. And when I am outside, I am confident that I know something about what is going on over my head. The Sun is shining, and I know why.

As you read this book, you will find out why, too. But the Sun is more than just a nuclear furnace safely set 93 million miles away from us. Energy travels from its center to about 70 percent of the way out, in just the way a space heater sends out energy. But then the last 30 percent or so of the energy is carried out by a type of boiling. And how do we know these facts? The ideas came from theory, but the details have been pinned down in recent years by studying ripples and oscillations on the Sun's surface.

I like the Sun's exterior more than its interior. My own work especially studies the normally invisible gas that we can detect only at eclipses or from spacecraft. While we get aesthetic pleasure from admiring the beautiful shapes of the gas, we also get intellectual pleasure by making progress in understanding its temperature and motions. How does it get to be millions of degrees hot, for example? It has been my academic pleasure on more than one occasion to take a dozen students and a ton and a half of equipment, most recently to Australia, to try to find out why and how at a total solar eclipse.

I have observed the Sun in a variety of ways—using telescopes on eclipse expeditions, on mountaintops, and in space. I hope you will enjoy reading about how we study the Sun as much as I enjoy carrying out the studies and writing about my own work and that of others.

In this book, you will see these notes:



The Solar Scoop

Things you should know about the Sun and other objects we discuss.



Sun Safety

Cautionary remarks, given that the Sun is so bright that you shouldn't ever stare at it—except during the seconds or minutes of the total phase of a total solar eclipse.



Solar Scribblings

Anecdotes and longer stories about the Sun and the people who study it.



Sun Words

The terms we use in talking about our nearest star.

Fun Sun Facts

Particular items of interest, often out of the ordinary train of thought.

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The Complete Idiot's Guide to the Sun was reviewed by an expert who double-checked the accuracy of what you'll learn here, to help us ensure that this book gives you everything you need to know about the Sun. Special thanks are extended to Dr. Leon Golub.

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