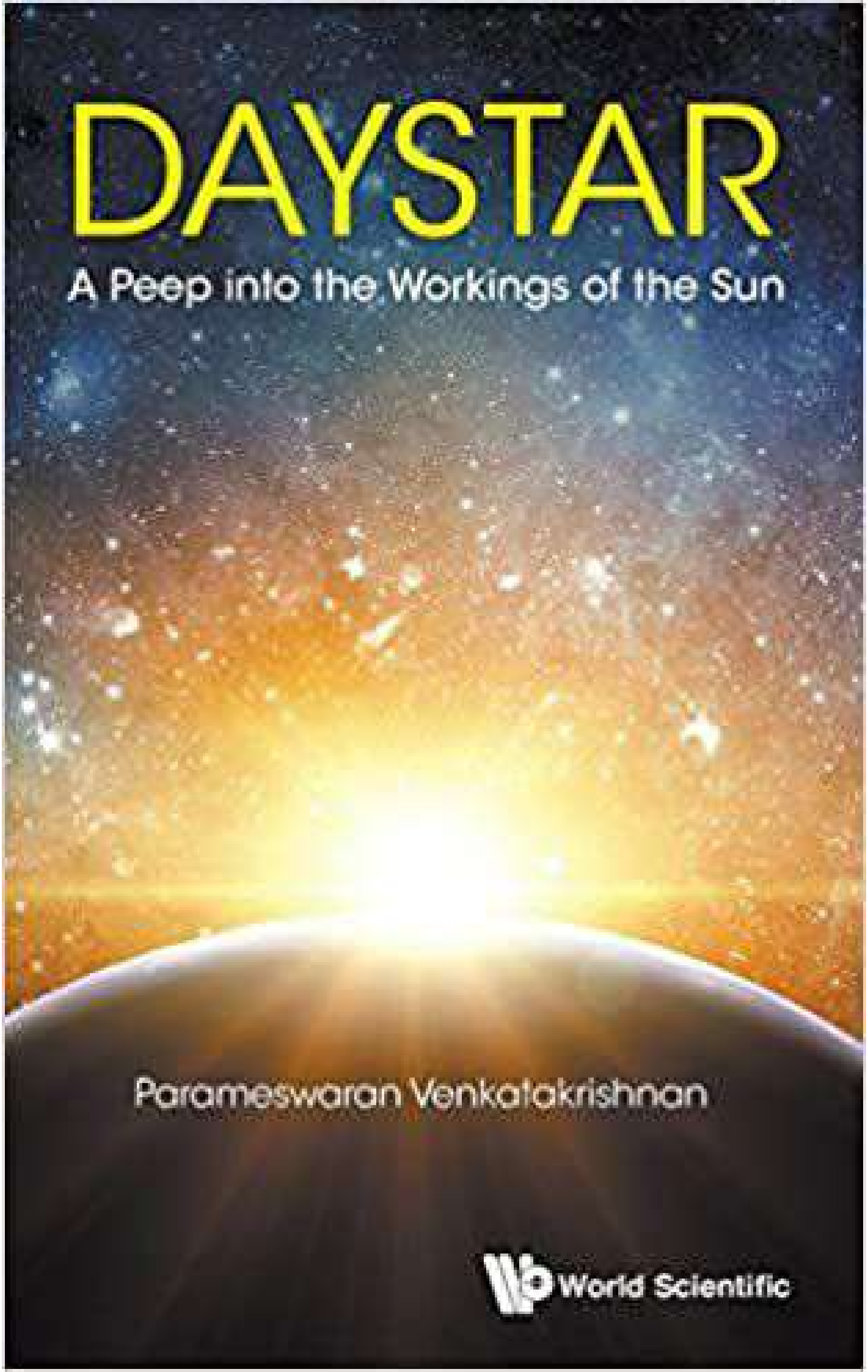
DAYSTAR

A Peep into the Workings of the Sun



Parameswaran Venkatakrishnan

World Scientific

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Dedicated to the memory of

my parents:

R. Parameswara Iyer (1919–1965)
&
Meenakshi Parameswaran (1929–2016)

and also to my mentor:

Professor U.R. Rao (1932–2017)

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May 17, 2017

FOREWORD

From the very beginning of human civilization, we have looked at the Sun with great awe and reverence for its ability to bring light into our life, and enable humanity as a whole to survive and thrive. Yet, the Sun, in spite of its pivotal role in life, continues remaining a mystery yet to be fully uncovered. For example, some of the problems, like that of the million-degree corona, have remained unsolved to this day in spite of many space missions from many different countries. The Indian Space Research Organisation has also joined in this global effort by approving its space mission Aditya-L1 to put an observatory class satellite at the L1 Lagrangian point to continuously watch the solar corona. In this context, there is a great need for the influx of the brightest young minds to use the results of this mission and help solve the problem of coronal heating. In spite

of familiarizing ourselves with the Sun, a detailed understanding of it and a complete understanding of its effect on the Earth and our life are still elusive.

Dr. Venkatakrishnan, who was the Director of the Udaipur Solar Observatory for over 15 years, is a well-known astronomer. Having carried out original, significant work and investigations on the Sun, he is considered an expert on solar physics. In writing this book he has taken all care to explain our accumulated knowledge of the Sun and has beautifully summarized what we still do not know. The book also covers some very important information on the solar atmosphere and clearly discusses the role of solar activity in climate change.

The entire physics of the Sun is described in six chapters, starting from how the vital statistics of the Sun are measured. Dr. Venkatakrishnan then goes on to explain how the scientists used measurements of the Sun's light to understand what the Sun is made of, how it is put together, how this great mass of mainly hydrogen plasma produces the sunlight which we see, what are the nature and cause of the blemishes which we see on the Sun's face, what eruptions come out of such blemishes, and how these eruptions affect the Earth. Finally, the last chapter describes the different kinds of solar telescopes operating at different bands of the electromagnetic spectrum, including even the latest discoveries about solar neutrinos.

This book on the Sun is indeed a great pleasure to read and provides up-to-date information on the solar interior, atmosphere, magnetic fields, and the effects of solar activity on the Earth, in a very fluent style. This will enable students of solar physics, in the initial stages of their carrier, to easily understand the physics of solar phenomena. I am extremely happy to note that Dr. Venkatakrishnan has brought out not only all the known facts about the Sun in a simple and beautiful style, but also the important unexplained aspects of solar activity. I have no doubt that this book will please a large number of people who are interested in solar physics.

U. R. Rao

PREFACE

While delivering talks about the Sun to schoolchildren, I always found that they would start getting more interested (in the talk) and pay a lot more attention if I appealed to their own knowledge of high school physics. What is really fascinating is to sense their awe when they realize that all the laws of physics applicable to processes in the laboratory on the Earth are applicable anywhere in the Universe. This is not a trivial matter. There is a famous episode in scientific history where Sir Arthur Eddington refused to accept the finding of the young Subrahmanyan Chandrasekhar that some stars can collapse into nothing. This is an important example where people refuse to believe that the laws of physics are rigorously applicable to any situation, no matter where. It is for this reason that I have attempted to demystify the activities of a celestial object such as the Sun in terms of high school physics. To further demystify the methods of obtaining all the facts about the Sun, I have included a chapter on the different kinds of solar telescopes operating at different wavelengths and also at different locations ranging from outer space to deep underground. Happy reading!

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Bengaluru, India
May 2017

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