

Preface

Regarding the publication of this book, I should mention Qian Jun, a sunny boy, and the editor of Science Press for my first book in 2009, "Plasma kinetic theory and application in solar physics", he visited my institute in 2013, and suggested me to consider a new publication. In the first book, the plasma theories (70%) are well combined with observations (30%), and of course, I want to keep this characteristic, but to increase the proportion of observations properly to attract much attention of astronomers. Thus, I should thank my coauthor, Victor F. Melnikov (in Central Astronomical Observatory at Pulkovo of Russian Academy of Sciences, Saint-Petersburg, Russia), to contribute greatly to the second book, "Physics in flaring loops", especially in the theoretical development of gyrosynchrotron radiation and particle propagation, and distinctive studies on observations. The main topic of this book that is different from the other numerous solar monographs is concentrated in the microwave theories and observations of flaring loops, which is expected to be attractive for the studies of solar physics. And I also would like to thank the other two coauthors, Dr. Ji Hai-sheng and Dr. Ning Zong-jun (my colleague in Purple Mountain Observatory (PMO) of Chinese Academy of Sciences, Nanjing, China) to extend this book from microwave and X-ray to optical and EUV bands. Another characteristic of the second book is that it covers all representative studies of the authors in recent years, even the most papers that have been published in English, but the authors have reorganized the material and deepened it to be a systematical monograph (including theories and observations, case study and statistics, forward and backward diagnostics, and micro and global processes), and helpful particularly for the Chinese solar people and graduate students to understand this book.

After the second book was published by Science Press in 2015, it was a bit surprising that the editor of Springer, Li Jian suggested me to publish an English version of this book, and which is actually cooperated with Science Press, and the editor Qian Jun as well. Probably a specific monograph in the field of solar microwave theories and observations was rare in recent years, and definitely, it is a great honor for Chinese scientists to publish a book by a famous publisher in the world. In this case, I don't want to simply translate the Chinese version to English,

but keep about 80% of the original material, and increase some new contents in the recent 2 years given by all of the authors, and here I should thank Prof. Mingde Ding of Nanjing University, Nanjing, China and Dr. Zhang Qing-min of PMO (jointed by Dr. Ning Zong-jun) to add the recent theoretical and observational studies on chromospheric evaporation to this book, which make it to face more solar physicists of the world, and Prof. Mingde Ding has also kindly provided a graceful foreword for this book as given before. The other authors have also added their new results published in 2015–2016 to the English version, to make an update rate over 20% in comparison with the Chinese version.

The feature of English version is somehow similar to the Chinese one, both focused in the microwave and relevant X-ray emissions in flaring loops. The English version is composed of seven chapters. A general review is given in Chap. 1 to summarize the main contents and new results of this book. Chapters 2 and 4 respectively introduce the radiation mechanisms in microwave (gyrosynchrotron) and X-ray bands (bremsstrahlung), as the theoretical basis of this book, while Chaps. 3 and 5 respectively show the observational studies in these two bands, including intensity, time profiles, spectral evolution, polarization, etc., and theoretical explanations for these observations. Chapter 6 pays particular attention to the radio and X-ray diagnostics for flaring parameters from the observations and theories, especially for coronal magnetic field and energetic electrons. At last, some large-scaled or global variations of flaring loops based on the microwave and X-ray data and relevant theories are discussed in Chap. 7.

Moreover, an important motivation of this book is based on the newly developed radio heliographs in China (Inner Mongolia, MUSER), Russia (Irkutsk, SSRT), and USA (Owens-Valley, FASR), etc., from which we can expect a 3-D radio image of solar corona, as well as coronal magnetic field and energetic particles with high spatial, temporal, and spectral resolutions, to open a new window to explore and answer the key mysteries of solar physics, as well as to develop and protect our Earth. The content of this book is closely associated with the scientific objective of the instruments as mentioned above, and it is expected to play a definite role to analyze the released data from these instruments in near future. This is my dream and expectation to the young generation of solar physicists as a retired person.

Finally, I also would like to thank my colleagues of PMO, Dr. Li Jian-ping and Dr. Song Qi-wu, for supporting the publication of this book effectively. Furthermore, I should thank all of the coauthors who participated in the main references of the authors for their contribution to this book, especially, Dr. Hiroshi Nakajima (Nobeyama Radio Observatory, NAOJ, Minamimaki, Minamisaku, Nagano 384-1305, Japan), Dr. Gregory Fleishman (Center For Solar-Terrestrial Research, New Jersey Institute of Technology, Newark, NJ 07102, USA), etc. I'd like to share all my happiness and hardship about this book with my wife Gu Li-min, as well as my Ph.D. supervisor Wang De-yu in PMO.

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