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Preface: Advanced Space-based Solar Observatory (ASO-S)

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Abstract The Advanced Space-based Solar Observatory (ASO-S) is the first approved solar space mission in China. This special issue includes a total of 13 papers, which were selected from presentations at the First ASO-S International Workshop, held in Nanjing from 2019 January 15 to 18. Taken together, these 13 papers provide a complete description of ASO-S until the end of Phase-B and the beginning of Phase-C.

Key words: space vehicles: instruments — Sun: magnetic fields — Sun: flares — Sun: CMEs — Sun: UV radiation — Sun: X-ray, gamma-rays

The Advanced Space-based Solar Observatory (ASO-S) is a mission proposed for the 25th solar maximum by the Chinese solar physics community. This mission underwent the associated Phase-0/A study (2011–2013) and Phase-A/B study (2014–2016) in succession. At the end of 2017, the ASO-S project was formally accepted by the Chinese Academy of Sciences (CAS). At present, the ASO-S project is undertaking the Phase-C study and is scheduled to be launched at the end of 2021 or early 2022. Being the first approved Chinese solar satellite, ASO-S will focus on observing solar magnetic fields, solar flares and coronal mass ejections (CMEs) simultaneously, in order to study the relationships between the solar magnetic field, solar flares and CMEs, which are the key scientific questions in modern solar physics. Three payloads are therefore deployed on the ASO-S: the Full-disk vector MagnetoGraph (FMG), the Lyman-α Solar Telescope (LST) and the Hard X-ray Imager (HXI).

Space-borne observations targeting the Sun have been carried out for over 50 years since the early 1960s. So far, over 70 solar dedicated/related missions have been launched (Gan et al. 2012). Proposing a new mission which is outstanding in terms of both science and instrumentation and which is technically feasible has become a real challenge for us. Thanks to the series of strategic studies on space sciences organized by CAS via the National Space Science Center, "Prospect for Space Solar Physics in 2016–2030" was accomplished in 2013 (see also Wu 2016; Gan et al. 2019a). The ASO-S is in fact a product of strategic planning by the Chinese solar physics community. In 2014, the International Space Science Institute - Beijing (ISSI-BJ) organized an international forum named "Exploring Solar Eruptions and Their Origins," to focus on evaluating the scientific merits of the ASO-S. The forum concluded that "ASO-S has well defined scientific objectives, and will measure fundamental and important parameters of the solar magnetic field, solar flares and CMEs. The mission is not overloaded but is still ambitious. It has focus and represents a good balance between advanced scientific objectives and resources. Therefore, the mission is very probable to be successful" (Gan & Feng 2015). This conclusion played an important role in leading the ASO-S to progress on track.

By the end of April, 2019, the official Phase-B study ended and the engineering Phase-C study started. Before this important milestone, during 2019 January 15–18, we organized the First ASO-S International Workshop in Nanjing. The main goal of this workshop was to hear opinions on both science and instrumentation from the international community, in order to improve our design, key technique solutions, as well as scientific issues. On the other hand, being a scientific mission, international recognition, connection and cooperation are certainly of great necessity. The workshop was divided into four sessions: ASO-S, other missions available then, synergetic observations, and payload related sciences and technology. In

the ASO-S session, a total of nine talks was presented and discussed intensively. The systematic advisory opinions were summarized after the meeting. In the session on other missions available then, talks on Solar Orbiter, the Parker Solar Probe, Solar-C/EUVST, Aditya-L1, CHASE, Arke and Kortes were presented. The possible collaborations of these missions with ASO-S were emphasized. In the session on synergetic observations, besides the joint observations with other missions available then, ground radio and optical joint observations with ASO-S were also discussed. In addition,16 other talks were delivered during the session on payload related sciences and technology.

We selected 13 talks from the First ASO-S International Workshop to form this ASO-S special issue. It is not just a simple collection of proceedings but also a complete description of the ASO-S up to May 2019, the beginning of the Phase-C study. The whole structure of this special issue is logically arranged as follows: an overview of ASO-S (Gan et al. 2019b), FMG aboard ASO-S (Deng et al. 2019), LST aboard ASO-S (Science, Li et al. 2019a; Instrumentation, Chen et al. 2019), HXI aboard ASO-S (Zhang et al. 2019), Science Operation and Data Center of ASO-S (Huang et al. 2019), Data Issues of FMG aboard ASO-S (Su et al. 2019a), Data Issues of LST aboard ASO-S (Feng et al. 2019) and Data Issues of HXI aboard ASO-S (Su et al. 2019b). Four other papers include: Chinese Hα Solar Explorer (CHASE) – a complementary space mission to the ASO-S (Li et al. 2019b), Joint Hard X-ray Observations with ASO-S/HXI and SO/STIX (Krucker et al. 2019), the synergy between the Payloads on the ASO-S Mission (Vial 2019), and Lyα Science from the LST aboard the ASO-S Mission (Vourdidas 2019), respectively.

We hope that this special issue can help readers understand the ASO-S mission well. Meanwhile, we would like to make use of this opportunity to thank all of participants who contributed lots of helpful suggestions during the First ASO-S International Workshop.

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