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Preface: Key technologies for enhancing the performance of FAST

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Abstract The Five-hundred-meter Aperture Spherical radio Telescope (FAST) passed its national acceptance inspection on 2020 January 11. This special issue includes a total of 15 papers, which are selected to introduce the status of FAST's performance and demonstrate the key technologies applied to FAST. The presented performance parameters can provide an important reference for scientists to propose observations with FAST. The key technologies presented in these papers include design and implementation in the measurement and control system, electromagnetic compatibility system, and receiver system. Finally, scientific achievements obtained by FAST during the commissioning phase are also reported.

Key words: telescope — techniques: radar astronomy — methods: data analysis — methods: observational — techniques: interferometric

The Five-hundred-meter Aperture Spherical radio Telescope (FAST), the largest single-dish radio telescope in the world, will not only promote scientific discovery and technological development in China but also be beneficial to international radio scientists. On 2020 January 11, FAST successfully passed its national acceptance inspection, marking FAST being a fully operational Chinese national facility. During the commissioning phase, scientific achievements have been made continuously with FAST. These have all benefited from the excellent performance of FAST. This special issue mainly focuses on the key technologies which are crucial to the telescope's performance, covering the measurement and control technology, electromagnetic compatibility (EMC) method, and receiver systems. In addition, several technological tests and scientific results are also provided.

There are 15 papers in total in this special issue of Research in Astronomy and Astrophysics (RAA). The first paper by Jiang et al. (2020) reviews the current key parameters of FAST at L-band, which should be helpful for proposing science observations with FAST. The performance of FAST allows observing pulsars and galaxies with the greatest sensitivities. Considering the special design of FAST, several new methods are proposed and implemented for the active reflector and the feed support system to realize high accuracy and safety. These include the open-loop control algorithm of the active reflector system (Li & Jiang 2020), installation and maintenance of the active reflector (Song et al. 2020), the prognostics and health management of the cable-net structure (Li et al. 2020b), and a motion planning algorithm of the feed support system (Yao et al. 2020b). Based on the feed accuracy, FAST's electromagnetic (EM) performance for both the axial and lateral feed defocusing is simulated by Gan et al. (2020). This special issue also introduces the feed and receiver technologies of FAST, including the research and design of a cross bow-tie dipole feed with cavity (Yu et al. 2020), development of wideband orthomode transducers for cryogenic receiver system (Fan et al. 2020), and the time frequency standard system of FAST (Zhu et al. 2020). For adapting various astronomical observations of FAST, the China Reconfigurable ANalog-digital backEnd (CRANE) is developed with a set of hardware, software and firmware platforms by Zhang et al. (2020b). In order to mitigate radio frequency interference (RFI), various EMC methods have been implemented by Zhang et al. (2020a). On this basis, FAST has completed various tests and observations. The viability of FAST as a very long baseline interfer-

ometry (VLBI) station has been established with the first VLBI fringes detected between FAST and the Shanghai 65-m Tianma telescope (Chen et al. 2020). Through pulsar observations, Yao et al. (2020a) present detailed measurements and analysis of scintillation arcs and demonstrate FAST's advanced capability in studying pulsars and the interstellar medium through scintillation observations. A pilot HI survey of 17 Planck Galactic Cold Clumps (PGCCs) was carried out with FAST by Tang et al. (2020). At last, a highlight of some unique features that will allow for novel search for extraterrestrial intelligence (SETI) observations with FAST is presented by Li et al. (2020a).

We hope we can help our readers to better understand the capabilities of FAST by this special issue. Meanwhile, we would like to express our sincere gratitude to all the authors and our appreciation to the referees who conducted an extensive review of the submissions.

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