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Proposed FAST Extended Array

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The 500-meter Aperture Spherical radio Telescope (FAST) has passed the national review and will be operated formally in 2020 [1]. The scientific goals of FAST include neutral hydrogen survey, pulsar research, Very Long Baseline Interferometry (VLBI), molecular spectral line etc. Till now, more than 100 new pulsars have been discovered, and several significant outputs of FAST early science have been achieved.

During FAST construction stage, several hot astronomical fields have been developed, such as the electromagnetic counterpart of gravitational wave, Fast Radio Burst (FRB) and exoplanet [2] [3] [4]. According to its high sensitivity, FAST might achieve crucial discoveries for these science cases. However, since the resolution of FAST at L band is about 3 arcmin, it is hard to locate the counterpart of FRB. Moreover, due to the confusion effect, it might be difficult for FAST to detect weak point sources with the flux density below 1 mJy, since we couldn't integrate the data with the observation time above 1 second if there is no proper filtering. Based on the above scientific requirements, a new project called FAST extended array has been proposed.

The preliminary design of this array is to construct some small telescopes around FAST and the longest baseline is about 30 km. Due to the maintenance of FAST Radio Quiet Zone (RQZ) with the radius of 30 km, the local radio environment is relatively quiet and stable. These small telescopes will be connected to FAST by optical fibers. Till now, several candidate plans have been discussed. One plan is to use 36 antennas with the diameter about 5 m covering the frequency bands between 300 MHz and 3 GHz. Different from traditional VLBI, no hydrogen clock will be installed at each small telescope. By using the synchronization technique of frequency and time, the analog signal of each telescope will be transmitted to FAST and the power will be overlaid. The system temperature at L band of this array will be around 40 K by using room temperature LNA. Based on this plan, the equivalent receiving area of these 36 small telescopes is about a telescope with the diameter of 30 m, and the resolution of the array is around 1.8 arcsec, which will meet the technical requirements of these three scientific cases with low cost. In additional, the other plans to build at least three telescopes with the diameter of 15 m, or 100 m around FAST have also been considered. Furthermore, the studies on the main scientific goals, the key technical specification of the array and the cost effectiveness for different designs are ongoing.

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