Phased Array Feed development for FAST Project

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FAST (Five-hundred-meter Aperture Spherical Telescope) is one of the mega-science project in China (R. Nan et al., IJMPD, Volume 20, Issue 06, 989-1024, 2011). FAST can be seen as a prime focus radio telescope with a zenith angle range of 0 ~ 40 degrees. The neutral shape of the main reflector is spherical, with a radius of 300m and an aperture with a diameter of 500m. When observing a certain direction on the sky, the corresponding part of the main reflector will be deformed into a paraboloid. The aperture of this paraboloid has a diameter of 300m. The focus cabin is driven on a spherical cap by cables run from 6 towers surrounding the main reflector. Stewart stabilization is adopted to accurately control the position of the feeds.

FAST may become the most sensitive single dish radio telescope in the world upon completion of construction. FAST will cover frequency range of 70-3000MHz, with possibility to extend the higher end up to 8GHz or even higher. Single pixel feed is planned for most of the band, and a 19-horn multi-beam at L band will be adopted for HI and pulsar survey. Multi-horn system has inherent defects, such as relative narrow bandwidth and gain degradation for off-axis beams. PAF (Phase Array Feed) might become the next generation receiver for FAST. By conjugate-matching the focal field of a radio telescope using PAF, higher gain may be obtained as compared with traditional corrugated horn. And by re-using the overlapping feeding element, continuous sky coverage may also be obtained. The flexibility of setting the field distribution at the aperture provides the possibility for more versatile use of PAF. E.g. electrical pointing by forming tens or hundred closely spaced beams, correcting the feed position error by dynamically matching the off-focus field distribution and compensating large scale errors in the shape of the main reflector, etc.

In this presentation, we will give an update of the construction of the FAST telescpe. Studies on the PAF feeding element selection, array configuration, receiver noise analysis and digital beam forming will also be addressed.