Shanghai Station Report for 2017–2018

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Abstract This report summarizes the observing activities at the Sheshan station (SESHAN25) and the Tianma station (TIANMA65) in 2017 and 2018. It includes the international VLBI observations for astrometry, geodesy, and astrophysics and domestic observations for satellite tracking. We also report on updates and development of the facilities at the two stations.

1 General Information

The Sheshan station ('SESHAN25') is located at Sheshan, 30 km west of Shanghai. It is hosted by the Shanghai Astronomical Observatory (SHAO), at the Chinese Academy of Sciences (CAS). A 25-meter radio telescope is in operation at 3.6/13, 5, 6, and 18-cm wavelengths. The Sheshan VLBI station is a member of the IVS and EVN.

The Tianma station ('TIANMA65') is located in the western suburbs of Shanghai, Sheshan town, Songjiang district. It is jointly funded by the Chinese Academy of Sciences (CAS), the Shanghai Municipality, and the Chinese Lunar Exploration Program. The telescope construction started in early 2009, and the majority of the mechanical system was completed in October 2012. On December 2, 2013, the Tianma 65 telescope passed the acceptance evaluation. By design, the Tianma telescope with a diameter of 65 meters, one of the largest steerable radio telescopes in the world, is a multifunction facility, conducting astrophysics, geodesy, and astrometry, as well as space science. By the end of 2018, ten cryogenic receiver systems (L, C, S/X, Ku, K, Ka, X/Ka, and Q), of which K-band, Ka-band, and Q-band all have two beams, had been installed on the Tianma telescope. In the future, a K-band seven-beam cryogenic receiver will be installed on the Tianma telescope, in 2020. The CDAS and DBBC2 were installed at the Tianma VLBI 65-m telescope terminal.

The SESHAN25 and TIANMA65 telescopes take part in international VLBI experiments on astrometric, geodetic, and astrophysics research. Apart from its international VLBI activities, the telescope spent a large amount of time on the Chinese Lunar Project, including the testing before the launch of the Chang'E test satellite and the tracking campaign after the launch and other single dish observing.

2 Component Description

In 2017, SESHAN25 participated in 39 IVS sessions (including ten INT3 Intensive sessions) while TIANMA65 participated in five IVS sessions. In 2018, SESHAN25 participated in 36 IVS sessions (including 11 INT3 Intensive sessions and six INT2 Intensive sessions) while TIANMA65 participated in four IVS sessions.

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Table 1 Statistics of experiments observed.

Session Name	2017 (SH)	2018 (SH)	2017 (T6)	2018 (T6)
AOV	4	4	2	3
APSG	2	2	0	0
AUS-AST	1	1	0	0
IVS-R1	19	8	0	0
IVS-T2	2	1	0	0
IVS-R&D	1	1	3	1
IVS-INT2	0	6	0	0
IVS-INT3	10	11	0	0

3 Current Status

3.1 Antenna Maintenance with SESHAN25

The Sheshan station encountered an antenna azimuth towing chain fault and suspended observations in early September 2018. Repairs were carried out. From September to December in 2018, we did some maintenance work with the antenna chain, etc.

3.2 Antenna Maintenance with TIANMA65

The Tianma radio telescope conducted mechanism maintenance in March 2018, including the greasing of the driving mechanism of azimuth and elevation, elevation bearing, the adjusting mechanism of the sub-reflector, and the rotating mechanism of the feed. We also checked the status of the central pivot. Apart from the above annual maintenance, we greased the azimuth track and elevation gear every three months. All the maintenance work assured the antenna to be in a good status. In addition, we updated the wheels of the protection cover of the azimuth track, which shows a good running state at present.

The primary reflector of the Tianma Radio Telescope (TMRT) distorts due to gravity, which dramatically reduces the aperture efficiency of high-frequency observations. In 2017–2018, we have acquired a model for the compensation of the gravitational deformation of the TMRT. After applying the model, there is a 150%–400% improvement in the aperture efficiency at low and high elevations. The model flattens the gain curve between 15%–80% elevations with an aperture efficiency of approximately 50%. The final weighted root-mean-square (RMS) error is approximately 270 m.

We also measured the thermal deformations when the back and front structures, respectively, were heated by the sun, and we then used the active surface system to correct the thermal deformations immediately to confirm the measurements. The thermal deformations when the back structure is heated are larger than those when the front structure is heated. The values of half power beam width (HPBW) are related to the illumination weighted surface RMS and can be used to check the thermal deformations. When the back structure is heated, the aperture efficiencies can remain above 90% of the maximum efficiency at 40 GHz for approximately two hours after one adjustment. While the front structure is heated, the aperture efficiencies can remain above 90% of the maximum efficiency at 40 GHz and above 95% after one adjustment in approximately three hours.

3.3 Other Upgrades

A new Fluxbuff has been installed at the Tianma 65 m in June 2018. The total capacity is 240 TB. We can work up to 2 Gbps using fila10g of the DBBC with flexbuff. At the same time, we also upgraded the FS from fs-9.11.8 to fs-9.11.19 for supporting the new devices.

4 The Staff of the Shanghai VLBI Station

Table 2 lists the group members at the Shanghai VLBI Station. The staff is involved in the VLBI program at the station with various responsibilities.

5 Future Plans

In 2019, the Sheshan radio telescope will take part in 30 IVS sessions. The Tianma radio telescope will take part in five IVS sessions. The telescopes will regularly track the Chang’E-4 satellite in its lunar orbit.

Fig. 1 The antenna chain removal, completed.

Fig. 2 The antenna maintenance of the SHESHAN 25-m telescope.

Fig. 3 The new Flexbuff hardware system at Tianma station.