The Onsala Twin Telescopes: the Status at the Time for the Inauguration

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Abstract We summarise the activities related to the Onsala Twin Telescopes (OTT), from the time when the decision was taken to fund the proposal, to the inauguration on 18 May 2017.

Keywords VLBI, VGOS, Onsala twin telescopes

1 Introduction

The Onsala Space Observatory is the European site in the International VLBI Service for Geodesy and Astrometry (IVS) that has the longest history in VLBI. First geodetic VLBI measurements were performed already in 1968 with the 25 m radio telescope. Hence Onsala is today one of the sites with the longest time series in the IVS data base. The observatory is one of the unique fundamental space geodetic sites that have a direct access to the coast line operating VLBI, GNSS, gravimetry, and sea-level monitoring. Onsala is thus an important co-location site for the Global Geodetic Observing System (GGOS). Being well aware of the VGOS standard it was clear around 2010 that Onsala needed a telescope with significantly faster slew rates than the existing radome-enclosed 20 m telescope.

A proposal for funding of twin telescopes, including the VGOS standard receiver systems, was submitted in August 2011 to Knut & Alice Wallenberg Foundation by the president of Chalmers. The decision to fund the telescopes was taken on the 26 March 2012.

We summarise the site preparations in Sect. 2, the procurement process in Sect. 3, and the construction in Sect. 4. An update of the "geodetic milestones" of the observatory are finally given in the conclusions.

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2 Site preparation

Obtaining the building permit for the two telescopes was not straight forward. The first application was not approved. The reasons were described by Haas (2013). Finally the permit was obtained 6 February 2014. Figure 1 depicts the area of interest.

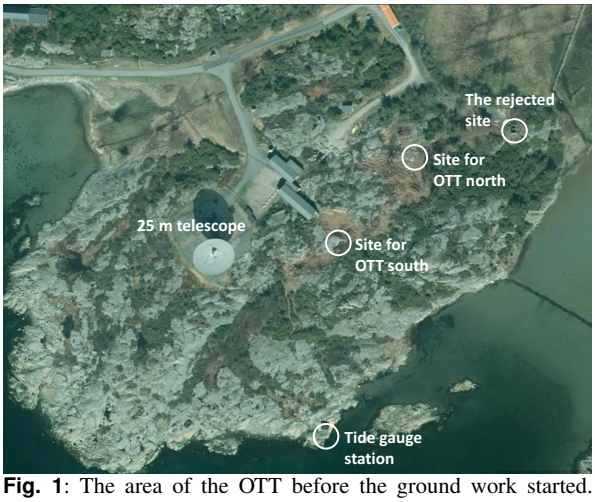

Fig. 1: The area of the OTT before the ground work started. The two sites most to the north were in the first application for the building permit, which was submitted 6 December 2012. The rejected site was in the next application (2 December 2013) replaced with the OTT south telescope. North is up.

The preparation of the grounds, including the construction of new roads, was immediately started. As can be seen in Figure 2 the area has several potential sites where the telescopes can installed directly on the bedrock. The roads were laid out around and connecting the two sites, with almost identical heights, for the telescopes, see Figure 3.

Fig. 2: The area where the OTT south telescope will be built. The photo is from 25 February 2014, credit L. Wennerbäck.

Fig. 3: The preparations of the ground are almost ready. The photo is from 4 June 2015, credit L. Wennerbäck.

3 Procurement phase

The procurement process was prepared to some detail already before the building permit was given, so that it was possible to publish the call for tender on 11 June 2014. At the end of the submission period four different offers were received. For various reasons none of them were fully compliant with our demands given the budget constraints. A period of discussions finally concluded in December 2014 and an order for the two telescopes was placed with MT Mechatronics.

Once the telescope design was specified the procurement of the telescope concrete foundations could start. It was handled separately by Chalmersfastigheter AB and an order was placed with the main contractor Hansson & Söner in August 2015.

Fig. 4: The lower part of the foundation of the northern telescope on the 28th of September 2015, credit L. Wennerbäck.

4 Construction phase

For obvious reasons the concrete foundations were to be built before the scheduled arrival of the telescopes in the spring of 2016. Already in September 2015 the work with the foundations was in progress (see Figure 4) and a couple of months later we could get an impression of the final shape (see Figure 5). In January 2016 the foundations were completed, now waiting for the arrival of the telescopes.

Fig. 5: The concrete foundation of the southern telescope on the 8th of December 2015, credit R. Haas.

There was a delay of a couple of months compared to the original time schedule and the telescope parts arrived in containers to the observatory at the end of May and early June. The installation started by mounting the equipment in the azimuth and the elevation cabins, while they were still located on the ground. Thereafter, during a period of a couple of weeks, the azimuth and elevation cabins were lifted into their final positions, see Figures 6 and 7. Once the reflectors were mounted, adjustments of the reflector panels were made, see Figure 8. The Site Acceptance Test (SAT) of the telescopes

was carried out from 30 November to 2 December 2016. Figure 9 gives an impression of the site just after the SAT.

Fig. 6: Lifting the azimuth cabin of the southern telescope on the 16th of August 2016, credit G. Elgered.

Fig. 7: The reflector on its way to the northern telescope on the 18th of August 2016, credit R. Haas.

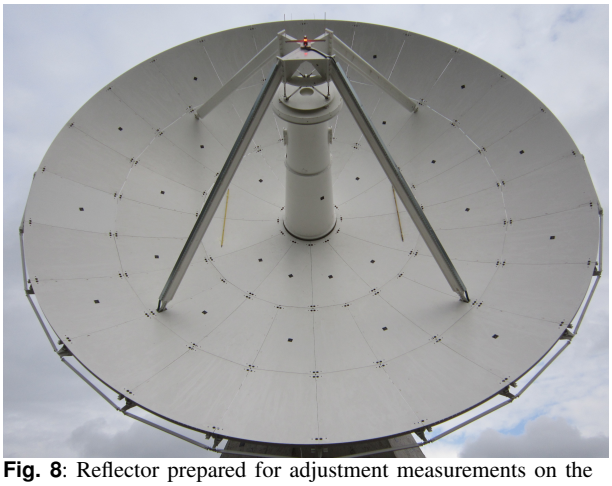

Fig. 8: Reflector prepared for adjustment measurements on the 26th of October 2016, credit R. Haas.

The two VGOS receivers were built in house by the electronics laboratory at Onsala in parallel to the telescope construction during 2016. More details on this subject are found in Pantaleev et al. (2017). The 1st VGOS receiver, with a QRFH feed, was installed in the north telescope in January 2017. In March the digital backend units, two DBBC3, were installed and commissioned, and in April the 2nd VGOS receiver, with an Eleven feed, was installed in the south telescope.

The Cable Delay Measurement Systems (CDMS) were built by MIT-Haystack. They were installed and tested in the telescopes, and on the ground, in the spring of 2017.

Further tests will be carried out for the rest of 2017 making the OTT ready for participation in geodetic VLBI. The horizon masks for the future observations are shown in Figure 10.

Fig. 9: The Onsala Twin Telescopes (OTT) on the 5th of December 2016, credit G. Elgered.

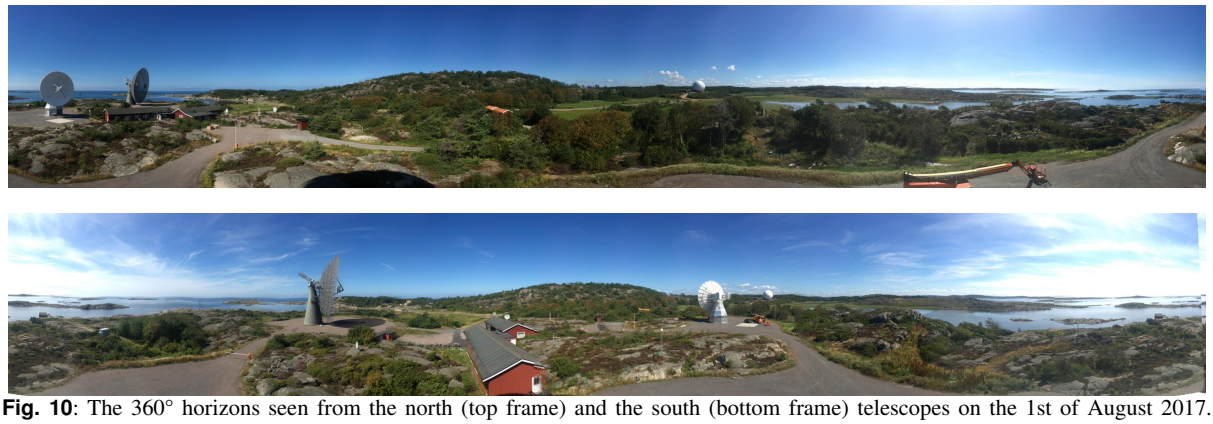

Fig. 10: The 360° horizons seen from the north (top frame) and the south (bottom frame) telescopes on the 1st of August 2017. The north direction is approximately located slightly to the left of the middle of the frames, credit G. Elgered and R. Haas.

5 Conclusions

The inauguration on 18 May 2017 added a milestone to the list of important events of the research infrastructure for geodesy and geodynamics at Onsala:

1968: First intercontinental VLBI for astronomy and geodesy using the 25 m telescope.
1980: First Mk-III experiments, with a supporting Water Vapour Radiometer, using both the 20 m (X-band) and the 25 m (S-band) telescopes.
1987: The ONSA GNSS station was started. Today it has the longest observing history in the world.
2009: Installation and start of operation of the superconducting relative gravimeter.
2012: Installation of the seismometer station, a site in the Swedish national seismic network.
2015: Inauguration of the super tide gauge station, a site in the national sea level observational network.
2017: Inauguration of the Onsala twin telescopes.

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