Geodetic Observatory Wettzell - 20-m Radio Telescope and Twin Telescope

Alexander Neidhardt, Gerhard Kronschnabl, Raimund Schatz

Abstract

In the year 2012, the 20-m radio telescope at the Geodetic Observatory Wettzell, Germany again contributed very successfully to the IVS observing program. Technical changes, developments, improvements, and upgrades were made to increase the reliability of the entire VLBI observing system. In parallel, the new Twin radio telescope Wettzell (TTW) got the first feedhorn, while the construction of the HF-receiving and the controlling system was continued.

1. General Information

The 20-m Radio telescope in Wettzell (RTW) is an essential component of the Geodetic Observatory Wettzell (GOW) and is jointly operated by Bundesamt für Kartographie und Geodäsie (BKG) and Forschungseinrichtung Satellitengeodäsie (FESG) of the Technische Universität München (Technical University Munich). In addition to the RTW, an ILRS laser ranging system, several IGS GPS permanent stations, a large laser gyroscope G (ringlaser), as well as the associated local techniques such as time and frequency, meteorology, and super conducting gravity meter are also operated. Also, the building of the first fully VLBI2012 compliant Twin telescope at the location of the GOW is currently in the final phases. It should extend the observation possibilities according to the new technical suggestions of the IVS Working Group 3 (WG3).

Within the responsibility of the GOW are also the TIGO system in Concepción, Chile, operated mainly together with the Universidad de Concepción (see the separate report about TIGO), and the German Antarctic Receiving Station (GARS) O'Higgins at Antarctica, operated together with the German Space Center (DLR) and the Institute for Antarctic Research Chile (INACH) (see the separate report about O'Higgins).

2. Staff

The staff of the GOW consists of 34 members (excluding students) for operations, maintenance, repair issues, and improvement and development of the systems. The staff operating RTW is summarized in Table 1. One additional engineer is in a position which is funded by the "Novel EXploration Pushing Robust e-VLBI Services" (NEXPReS) project in cooperation with the Max-Planck-Institute for Radioastronomy (MPIfR), Bonn. It was also possible to support the student operators to work within development projects and internships.

3. Observations in 2012

The 20-m RTW has been supporting the geodetic VLBI activities of the IVS, and partly other partners, such as the EVN, for almost 30 years. All successfully observed sessions in the year 2012 are summarized in Table 2. After the repair of the bearings in 2010 the RTW is again completely in all schedules as before, and except for some problems with the gears and the servo system, which are also overaged, the telescope is in a very good and stable state. The main priority in operations

Table 1. Staff members of RTW.

Name	**Affiliation**	**Function**	**Mainly working for**
Ulrich Schreiber	BKG	head of the GOW (until March 2012)	GOW
Reiner Dassing	BKG	interim head of the GOW (from April 2012)	GOW
together with			
Johannes Ihde	BKG	interim head of the GOW (from April 2012)	GOW
Alexander Neidhardt	FESG	head of the RTW group and VLBI station chief	RTW, TTW (partly O'Higgins, laser ranging development)
Erhard Bauernfeind	FESG	mechanical engineer	RTW
Ewald Bielmeier	FESG	technician	RTW
Gerhard Kronschnabl	BKG	electronic engineer	RTW, TTW (partly TIGO and O'Higgins)
Christian Plötz	BKG	electronic engineer	O'Higgins, RTW
Raimund Schatz	FESG	software engineer	RTW
Walter Schwarz	BKG	electronic engineer	RTW (partly O'Higgins and WVR)
Reinhard Zeitlhöfler	FESG	electronic engineer	RTW
Martin Ettl	FESG/MPIfR	IT and computer scientist	NEXPReS (EU FP7)
Jan Kodet	FESG	applied physical engineer	Reference systems (DFG)
Yvonne Klingl	FESG/BKG	student	Operator WLRS/RTW
Gerhard Mühlbauer	FESG/BKG	student (April to December 2012)	Operator WLRS/RTW
Daniel Prexler	FESG/BKG	student	Operator WLRS/RTW
Johannes Vogl	FESG/BKG	student (April to September 2012)	Operator RTW/WLRS, VLBI project work

was participation in all daily one-hour INTENSIVE-sessions (INT) in order to determine UT1-UTC. For these sessions the complete data transfer is done with e-VLBI techniques. RTW now also routinely uses the increased Internet connection capacities of 1 Gbit/sec for the e-transfers to Bonn, Tsukuba, and Haystack for the 24h sessions. Following the implementation of a Field System extension for remote control, weekend INTENSIVEs were partly done in the new observation modes by remote attendance, remote control from students at the laser ranging system (WLRS), or completely unattended.

In addition to the standard sessions RTW was also active for other special observations such as the tracking of the ESA Venus Express spacecraft and RadioAstron satellite for the EVN. Another participation in the EVN network was made with the monitoring of the supernova SN2011dh in M51. These sessions were coordinated by the Joint Institute for VLBI Europe (JIVE).

Table 2. RTW observations in 2012.

program	**number of 24h-sessions**
IVS R1	52
IVS R4	51
IVS T2	7
IVS R&D	10
RDV/VLBA	6
EUROPE	6
total	**132**
total (in hours)	**3168**

special program	**number of 1h-sessions**
1h-INT1(Kokee-RTW)	229
1h-INT2/K(Tsukuba-RTW)	153
1h-INT3/K(Tsukuba-RTW-NyAl)	40
ESA VENUS Express	6
EVN RadioAstron	62
EVN sopernova monitoring	10
total (in hours)	**454**

4. Technical Improvements and Maintenance

Regularly, tasks and maintenance days (obtaining replacements for the hardware, 8-pack repairs, gear maintenance, exchange of motors after they reach their lifetime, NASA Field System updates, cryo-system maintenance, servo replacements, and improvements for e-VLBI issues) were scheduled for the usual maintenance work. The components of the servo system are overage and not available on the market anymore. Therefore it was possible to commission a replacement of the whole system and to upgrade to a similar, modern technique such as is installed in the Twin telescopes. The upgrade will be done in the middle of 2013. Upgrades and repairs were also necessary for the Mark IV data acquisition rack. The revision of the replacement dewar systems for Wettzell and O'Higgins were commissioned to be done by the cooperation partners at the observatory at Yebes in Spain, where specialists update the systems to the state-of-the-art.

The usage of the EVN-PC for e-Transfer was continuously extended. In addition e-Transfer for the 24h sessions to Bonn, Haystack, and Washington was installed and tested at rates up to 600 Mbit per second. A combination of the Mark 5 software "fuseMk5" and the communication protocol "Tsunami" was used on a regular Mark 5B system. Meanwhile all R1 sessions were regularly sent to the Bonn correlator using e-VLBI techniques, which reduced the shipping costs tremendously. In parallel with that, all Mark 5 systems were updated or upgraded.

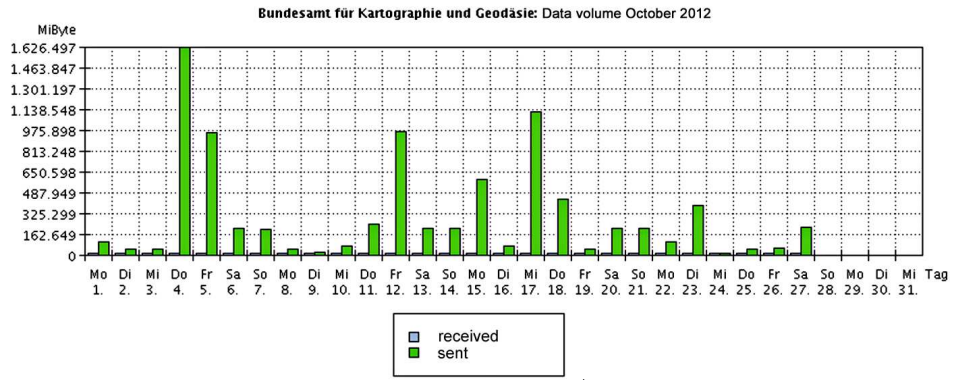

Figure 1. Example of the transfer volume with e-VLBI from the 20-m radio telescope.

The usage of the new Digital Baseband Converters (DBBC) progressed. They were tested, calibrated, and adjusted again. Several test data were correlated at the Bonn correlator to check the functionality and quality. Additionally new CoMo boards were ordered to upgrade to a standard version of the equipment. The development is still in progress.

The remote control software "e-RemoteCtrl" was also extended, mainly by the TUM. In close cooperation with the developers of the NASA Field System and with other test sites at Australia (e.g. Hobart, Katherine, and Yarragadee), new features were established. The deliveries were on time, so the newly implemented authentication and authorization with user roles could be successfully tested. The AuScope network and the Wettzell site already use the software routinely. During the days off around the new year the Wettzell radio telescope was completely remotely controlled including the preparation of the data transfer. Students at the laser ranging system regularly used the software to control the radio telescope in parallel with the laser observation to optimize shift times. The software development is funded in task 3 of work package 5 of the NEXPReS project and is performed in cooperation with the MPIfR.

As a pilot study, ideas for a permanent survey of the telescopes were realized to enable reference movements, which are surveyed with a total station and 20 to 30 reflectors in the back-structure. First software models for the calculation of the positions and the surveying were implemented.

The broadband RFI- and data acquisition for the RFI surveys for a possible new location for the TIGO system in La Plata, Argentina was prepared in Wettzell. Therefore an RFI measuring system was implemented and developed to allow a broadband analysis of dual-polarized RFI signals with an omnidirectional antenna.

Another new field is the preparation of the tracking of global navigation satellites. Therefore new amplifier and receiver boards were implemented, which can be used after the waveguides for S- and X-band to receive the L-band of the satellite. Additionally the software from the laser ranging system was changed to create schedules for the NASA Field System, which can be used to track the satellites with the 20-m radio telescope, using one-second orbit sampling points.

5. The TWIN Radio Telescope Wettzell (TTW)

The Twin Telescope Wettzell project is Wettzell's realization of complete VLBI2010 conformity. While the construction of the buildings and telescopes was the main focus in recent years, the year 2012 was used to install parts of the interior and to commission the final elements for the receiving system. Therefore at the beginning of 2012, the final review of the telescopes was completely possible without any critical issues. Both telescopes are now completely controllable and movable. After that the first installations, such as air conditioning, helium flex-lines, and communication cable to the operator building, were made by the Wettzell team. In the operator building all server racks are now mounted and partly populated with hardware and computers. The network was installed and configured to build up a separate network enclave for VLBI.

A big milestone was the final review of the first three-band feedhorn (triband horn from the company Mirad, Switzerland for S/X/Ka-band). The first test results offered an excellent receiving performance in combination with the ring-focus antennas of Twin. There were some delays with the final review of the dewar, as amplifiers for the S-band, provided by the BKG, became defective during the tests. They had to be shipped back to the vendor.

A final design review for the second horn of the broadband feedhorn was held in June 2012. The second horn is an "Elevenfeed" from Omnisys, Sweden, which allows tunable frequency bands between 2 and 14 GHz. The reviewers were able to decide on the constructive parameters, and construction of the feedhorn started.

A special task was the organization of the IVS VLBI2010 workshop for technical specifications for March 2012. Local organizers were the BKG and the FESG/TUM. Several new technical issues were discussed and presented during this meeting. More than 80 participants from geodetic fields, industry, and science attended the very successful meeting.

6. Plans for 2013

During 2013, dedicated plans are:

- Upgrading the gear, servo, and control system of the 20-m radio telescope,
- Inaugurating the first Twin telescope in April, and
- Finalizing the NEXPReS developments.