Effelsberg Radio Observatory 2013 Annual Report

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Abstract The 100-m radio telescope of the Max-Planck-Institut für Radioastronomie (MPIfR) is one of the two largest fully steerable single-dish radio telescopes in the world and a unique high-frequency radio telescope in Europe. The telescope can be used to observe radio emission from celestial objects in a wavelength range from 90 cm (∼300 MHz) down to 3.5 mm (∼90 GHz).

1 General Information

The Effelsberg radio telescope was inaugurated in 1971 and was (for almost 30 years) the largest fully steerable single-dish radio telescope in the world. It is situated in a protected valley near Bad Münstereifel (about 40 km southwest of Bonn) and operated by the Max-Planck-Institut für Radioastronomie (MPIfR) on behalf of the Max-Planck-Society (MPG). To this day, it is the largest radio telescope in Europe and is mostly used for astronomical observations.

The extremely versatile and flexible instrument can be used to observe radio emission from celestial objects in a wavelength range from about 1 m (corresponding to a frequency of ∼300 MHz) down to 3.5 mm (86 GHz). The combination of the high surface accuracy of the reflector (the mean deviation from the ideal parabolic form is ∼0.5 mm RMS) and the construction principle of 'homologous distortion' (i.e., the reflector in any tilted position has a parabolic shape with a well-defined, but shifted, focal point) enables very sensitive observations at high frequencies (i.e., $\nu > 10$ GHz).

The wide variety of observations with the 100-m radio telescope is made possible by the good angular resolution, the high sensitivity, and a large number of receivers which are located either in the primary or in the secondary focus. Together with a number of distinguished backends dedicated to different observing modes, this provides excellent observing conditions for spectroscopic observations (atomic and molecular transitions in a wide frequency range), and also for high time-resolution (pulsar observations), mapping of extended areas of the sky and participation in a number of interferometric networks (mm-VLBI, EVN, and Global VLBI etc.).

Table 1 Telescope properties.

Name	Effelsberg
Coordinates	6:53:01.0 E,+50:31:29.4 N
Mount	azimuthal
Telescope type	Gregorian (receivers in prime and secondary focus)
Diameter of main reflector	100 m
Focal length of prime focus	30 m
Focal length of secondary focus	387.7 m
surface accuracy	0.55 mm RMS
Slew rates	Azi: 25 deg/min, Elv: 16 deg/min
Receivers for Geodetic observations	3.6 cm/13 cm secondary-focus (coaxial)
T_sys (3.6 cm/13 cm)	25 K, 200 K
Sensitivity (3.6 cm/13 cm)	1.4 K/Jy, 0.5 K/Jy
HPBW (3.6 cm/13 cm)	81 arcsec, 350 arcsec

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Effelsberg Network Station

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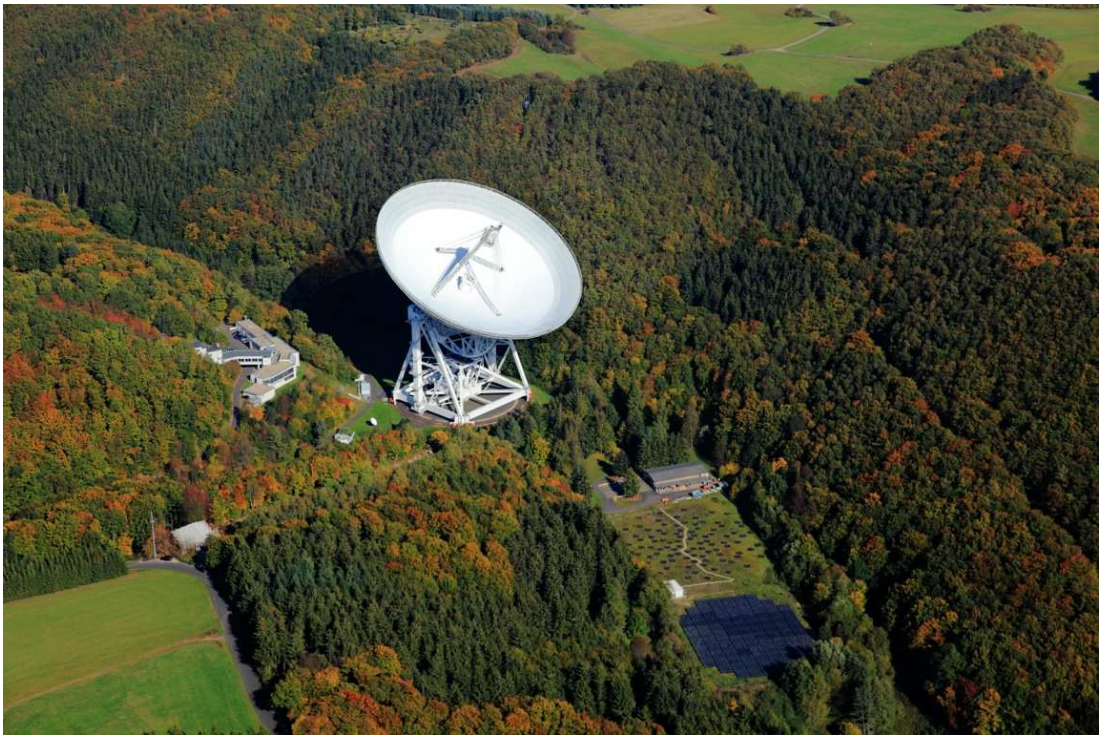

Fig. 1 Aerial image of the Effelsberg radio observatory. Shown are the 100-m Effelsberg antenna and the institute building. Effelsberg hosts also a station of the European Low Frequency Array (LOFAR), seen in the lower part of the picture.

2 Activities during the Past Year

About 30% of the observing time of the Effelsberg antenna is used for VLBI observations. Most of them are astronomical observations for the European VLBI Network (EVN), High Sensitivity Array (HSA), Global MM VLBI Array (GMVA) or other global networks, but also geodetic VLBI observations are performed. Effelsberg has regularly participated in the EUROPE IVS sessions since 1991. In autumn 2013, the slew rates of the antenna had to be reduced because of work at the main power supply of the station. Therefore the schedule for EUR126 had to be adapted to the slower speeds.

3 Current Status

Effelsberg is using the DBBC2 and a Mark 5B+ recorder for all EVN, global, and geodetic VLBI observations. In addition, there are two NRAO RDBEs and a Mark 5C recorder that are used for observations with the VLBA and HSA. The observatory is connected via a 10 GE optical fiber to the e-VLBI network and can do real time e-VLBI observations and e-transfer of data to Bonn and JIVE.

4 Future Plans

Upgrades for several receiving systems are planned for 2014. In January, a new K-band receiver (18 to 26 GHz) was installed into the secondary focus and is just being commissioned. The construction of a new C-band system (4-8/9.3 GHz) for wide band observations and the installation of a new Q-band receiver (38 to 50 GHz) are planned for 2014 as well. The new receivers will provide wide band IF signals of 2.5 GHz band width which can be used with the next generation of digital VLBI backends and recorders, like the DBBC3 and Mark 6, to record data at recording rates of up to 16 Gbps.