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Update on the 100m Effelsberg telescope receiver system

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Extended Abstract

The Max-Planck Institute für Radioastronomie (MPIfR) is operating and permanently enhancing the 100-m single dish Effelsberg telescope. The astronomical receiver suite for the telescope is constantly upgraded, providing state-of-the-art instrumentation to the astronomers. As part of the latest upgrade program, started in 2012, a suite of 7 broadband receivers (covering most of the frequencies from 0.8 GHz up to 50GHz) have been developed and taken into operations. The receivers provide exceptional sensitivity and stability allowing the efficient execution of different astronomical observation modes. This program has been concluded in 2019 and a short overview on the available receiver systems will be given.

Given the already achieved performance of the analogue frontend, further improvements of the classical single pixel receiver performance indicators, e.g. the sensitivity, have only a reduced impact on the overall observing efficiency. In parallel the increasing disturbing effect of Radio Frequency Interference (RFI) on the astronomical measurements will negatively impact the observation, especially at telescope locations such as Effelsberg. Hence hardening the analogue frontends against RFI as well as implementing multi beam systems (e.g. Phased Array Feeds) will be one of the major tasks to maintain and increase the sensitivity of single dish observatories.

An increasing responsibility on developing these systems will fall into the digital data processing either to implement RFI mitigation algorithms in time and/or frequency domain prior to data reduction or to perform real time calibration across multiple beams channels.
To successfully implement such systems, it is required to digitize the RF signal with a high dynamic range, hence avoiding analogue signal processing and sampling as early as possible in the signal chain. Not only the performance and data rate of this approach are challenging, its also crucial to avoid self-induce RFI by integrating high speed digital electronics into the astronomical receiver frontend.

The MPIfR has implemented such systems on several receivers at the 100-m Effelsberg telescope, and commissioning is in progress. At the same time a Generic Backend system is currently being implemented to process the digitized voltage stream in real-time. We will present first results of the astronomical tests and discuss its potential and options for future use.