Status Update on the System Verification of APERTIF, the Phased Array Feed system for the Westerbork Synthesis Radio Telescope

B. Hut* [(1)], P. Prasad[(1)], M. Ruiter[(1)], E. van der Wal[(1)], W. A. van Cappellen[(1)]
(1) ASTRON, P.O. Box 2, 7990 AA, Dwingeloo, The Netherlands, hut@astron.nl

The APERTIF (APERture Tile In Focus) project aims to install Phased Array Feeds (PAFs) in the 25m diameter reflector antennas of the Westerbork Synthesis Radio Telescope (WSRT). These PAF systems can simultaneously form 37 compound beams on the sky and will replace the current single beam horn feeds. The survey speed of the WSRT will be improved significantly, bringing down the time to execute a deep wide-field astronomical survey by a few orders of magnitude. The detailed design phase is completed and samples of final hardware have been tested (W.A. van Cappellen and J.G. Bij de Vaate, XXXIth URSI GASS, 2014, pp. 1-4). Three WSRT dishes are equipped with this hardware, with the aim to reconfirm system performance, before starting full production.

In this paper, we report on the results of system performance tests. Both single dish and interferometric experiments are presented to assess primarily temporal and spectral stability, sensitivity and RFI immunity of compound beams. Figure 1(left) shows the result of a temporal beam pattern stability experiment for two compound beams without active compensation for gain variations of the PAF elements. Both compound beams do not vary more than a percent from their mean (μ) over 11 hours. Figure 1(right) shows the measured field of view at 1.5 GHz, with the 3dB contour encircling an area of ~11 deg^2. This is an increase of a factor ~40 over the horn feed. Figure 2 shows the spectral sensitivity of four compound beams. It demonstrates that the hardware is able to simultaneously form multiple beams with an instantaneous bandwidth of 300 MHz and with expected sensitivity. The figure also shows the smooth behaviour over frequency. It is concluded that APERTIF meets the system specifications.

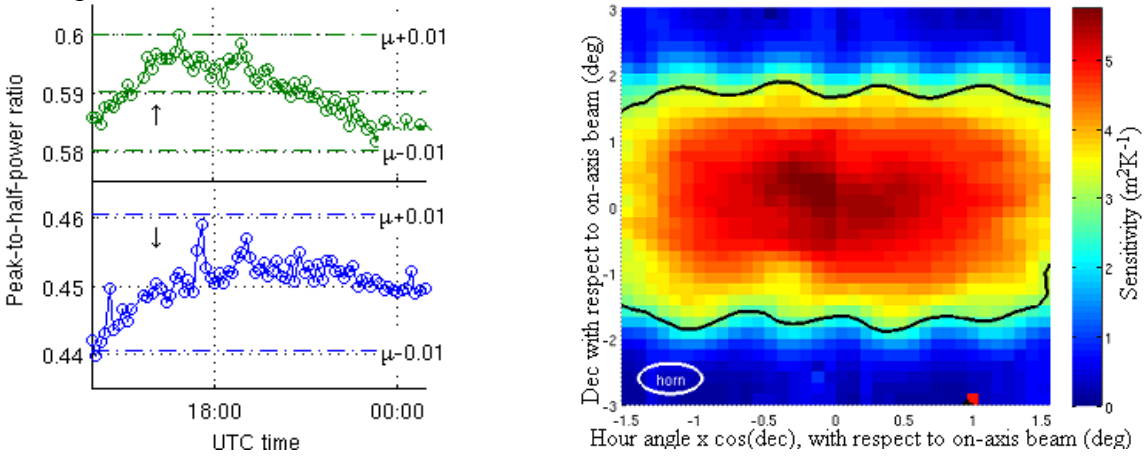

Figure 1: (left) Temporal beam pattern stability for an on-axis and an off-axis compound beam at an offset of 1 degree in hour angle and declination. (right) Compound beam sensitivity over field of view.

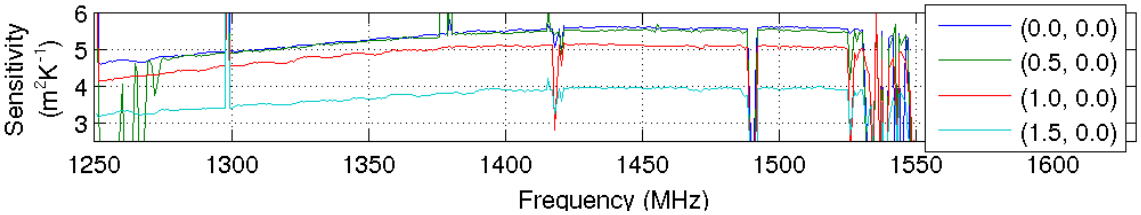

Figure 2: Measured sensitivity over frequency, for four compound beams at an offset (ΔHA,Δdec) in degree with respect to the on-axis beam.