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Kneeling down standing waves with APERTIF phased array feeds in the WSRT

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APERTIF is an SKA Pathfinder aiming to increase the survey speed of the Westerbork Synthesis Radio Telescope (WSRT) with a factor 20. With APERTIF, Phased Array Feed (PAF) systems will be installed on most of the WSRT dishes. A commonly observed effect plaguing wideband prime-focus reflector systems is an interaction between the feed and the reflector, commonly referred to as the 'standing wave'phenomenon. For the WSRT, it results in a beam pattern and sensitivity variation as function of observing frequency with a period of ~17 MHz. Consequently, the observed spectra are distorted and because the beam pattern variations are unequal for the X and Y polarized beams, a frequency dependent instrumental polarization is introduced as well. Both effects limit the accuracy of polarimetric measurements and the dynamic range of the resulting images.

Initial measurements of an APERTIF prototype in a WSRT dish hinted that the standing wave effect was reduced significantly compared to the existing horn feeds. This would have a major impact on the offline calibration: In the presence of the 17 MHz ripple the calibration of the beamshape would have to be repeated every ~1 MHz in order to adequately characterize the beam pattern. If the ripple is sufficiently reduced, the beam pattern variation is much smoother and can be described by less parameters. In this case the computational load of the offline calibration can be reduced and its accuracy is increased.

A series of measurements has been performed to confirm the absence of the standing wave effect in the APERTIF prototype. The sensitivity of individual PAF elements, on-axis and scanned compound beams have been measured and the aperture field has been determined using holography. In this contribution we would like to present these recent experimental results which demonstrate that the 17 MHz ripple is largely eliminated in the PAF system.

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