Aperture Array Developments at ASTRON

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The radio astronomical community is currently making detailed plans for the Square Kilometre Array (SKA) [2]. This instrument should provide an order of magnitude higher sensitivity than current instruments as well as a much larger field-of-view. In view of the large frequency coverage, different instrument designs are required for distinct frequency ranges. Up to 1.2 GHz aperture arrays are the most attractive technology in terms of cost and performance. ASTRON is currently building and testing two aperture array instruments, the Low Frequency Array (LOFAR) and the Electronic Multi-Beam Radio Astronomy Concept (EMBRACE). These instruments will demonstrate the maturity of aperture arrays for the radio astronomical application.

LOFAR [3] covers the 10 – 240 MHz frequency range. It will ultimately consist of at least 36 stations within the Netherlands and 10 stations throughout Europe. Each Dutch station consists of 96 low band antennas (LBA) covering the 10 – 90 MHz range and 48 high band antenna (HBA) tiles covering the 110 – 240 MHz range. Each high band antenna tiles consists of a 4×4-array of high band antennas with an analog beam former. The European stations consist of 96 LBAs and 96 HBA tiles each. This telescope will officially start operations on June 12, 2010. Several data reduction pipelines are currently being tested and prepared for production. This has led to a number of impressive results that provide a sneak preview on LOFAR's capabilities. Several milestones are highlighted in this presentation.

EMBRACE [1] is the first full-scale prototype of an SKA phased array station. It is a single polarization demonstrator operating between 500 and 1500 MHz. The station that is currently being built at the site of the Westerbork Synthesis Radio Telescope in the Netherlands will ultimately consist of 144 tiles with 72 receive channels each, giving a total of $\sim 10^4$ active elements. A similar 80-tile station will be constructed at the site of the Nançay radio astronomy facility. In this presentation I give an overview of the performance measurements and the first successful measurements on astronomical sources such as the Sun and Cas A.

References

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[3] Marco de Vos, Andre W. Gunst, and Ronald Nijboer. The LOFAR Telescope: System Architecture and Signal Processing. *Proceedings of the IEEE*, 97(8):1431–1437, August 2009.