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PHAROS2: A C-Band Cryogenic Phased Array Feed

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High-sensitivity large-scale surveys are an essential tool for new discoveries in radio astronomy. A Phased Array Feed (PAF) placed at the focal plane of an antenna can increase the Field-of-View (FoV) and the mapping efficiency by fully sampling the sky. Multiple beams can be formed by adding signals from electrically small focal plane radiating elements of the array using different sets of complex weights.

Following an overview of PAF technologies, we will describe the design and architecture of PHAROS2, a cryogenically cooled 4-8 GHz PAF demonstrator with digital beamformer for radio astronomy application. The instrument is under development in the framework of the SKA (Square Kilometer Array) PAF Advanced Instrumentation Program as an international collaboration of the National Institute for Astrophysics (INAF, Italy), the Jodrell Bank Observatory (University of Manchester, UK), the Netherlands Institute for Radio Astronomy (ASTRON, the Netherlands), the Onsala Space Observatory (OSO, Sweden) and the University of Malta (Malta).

PHAROS2 will be capable of synthesising four independent single-polarization beams by combining 24 active elements of an array of Vivaldi antennas. The instrument features: a) commercial cryogenic Low Noise Amplifiers with state-of-the-art performance, b) a “Warm Section” for signal filtering, conditioning and single downconversion to select a ≈ 275 MHz Intermediate Frequency (IF) bandwidth within the 4-8 GHz Radio Frequency (RF) band, c) an IF signal transportation by analog WDM (Wavelength Division Multiplexing) fiber-optic link, and d) a FPGA-based Italian Tile Processing Module (iTPM) digital backend.

PHAROS2 will be mounted at the primary focus of the 76-m diameter Lovell radio telescope (Jodrell Bank Observatory, UK) for technical and scientific validation.

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