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The LOFAR Decameter Sky Survey: status and lessons for SKA-Low

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The largely unexplored decameter radio band (10-30 MHz) provides a unique window for studying a range of astronomical topics, such as auroral emission from exoplanets, low-energy cosmic ray electrons, and the physics of free-free absorption. The scarcity of low-frequency studies is mainly due to the severe perturbing effects of the ionosphere. Correcting for the ionosphere is challenging as it changes rapidly in time and across the sky at these extremely low frequencies. Building upon previous successes at higher frequencies, we present a calibration strategy that can correct for the ionosphere in the decameter band. We apply this to a night-time observation from the Low Frequency Array (LOFAR) between 16–30 MHz, to evade the majority of radio frequency interference. This allows us to survey a 305 square degrees region of sky at a resolution of 45 arcsec, achieving a sensitivity of 12 mJy/beam. This represents over an order of magnitude improvement in terms of sensitivity and resolution compared to previous decameter band observations, emphasising the large discovery potential of our data. As LOFAR is a direct SKA-Low telescope pathfinder, the development of a pipeline at such low frequencies is critical for calibration of future SKA-Low observations, especially near the lower end of its frequency coverage (~50 MHz).

Topics

Technology & IT

Author: GROENEVELD, Christian (Istituto Nazionale di Astrofisica (INAF))

Presenter: GROENEVELD, Christian (Istituto Nazionale di Astrofisica (INAF))

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