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Shower $X_{\text{max}}$ determination based on LOFAR radio measurements

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Content:
LOFAR is a multipurpose radio telescope which can be used for radio detection of cosmic rays while running astronomical observations at the same time. The core of LOFAR contains hundreds of antennas within a square kilometer. This high density makes it an ideal location for a detailed study of the radio signal of extensive air showers in the energy range $10^{16}$ - $10^{18}$ eV. The LORA scintillator array is located at the center of LOFAR and provides a trigger for the system and a reconstruction of the shower parameters.

We present an analysis of high quality LOFAR events for which the lateral distribution of the radio signal can be studied in 2D. For each event dedicated simulation sets for proton and iron primaries have been produced. The radio and particle data are fitted simultaneously to the simulation. We show the accuracy with which $X_{\text{max}}$ can be determined with LOFAR data on an event-by-event basis, and present first results of a composition study of cosmic rays above the knee.

On behalf of LOFAR Cosmic Ray Key Science Project

Primary authors: Dr. BUITINK, Stijn (KVI, University of Groningen, Netherlands)

Co-authors: 

Presenter: Dr. BUITINK, Stijn (KVI, University of Groningen, Netherlands)

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