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Measurement of the cosmic ray mass composition with the LOFAR radio telescope

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LOFAR is a multipurpose radio telescope which can be used for radio detection of cosmic rays while running astronomical observations at the same time. In the dense core individual air showers are detected by hundreds of dipole antennas. The raw electromagnetic waveform as detected by each antenna is stored in a five-second ring buffer, which is read out when a trigger is issued by the LORA particle detector array. Hundreds of showers with energies above 10^17 eV have been measured in two frequency regimes: low band (10-90 MHz) and high band (110-250 MHz).

The complicated radio emission pattern on the ground can be accurately reproduced by modern radio simulation codes and contains information about the longitudinal shower development. With a hybrid reconstruction technique, we can measure the depth of the shower maximum with an accuracy of ~20 g/cm^2 in the energy regime of 10^17 eV to 10^18 eV. Cosmic-ray mass measurements in this range are of particular interest as it may harbor the transition from a Galactic to an extragalactic origin. We present a mass composition analysis based on the first results and discuss their implications for transition models.

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