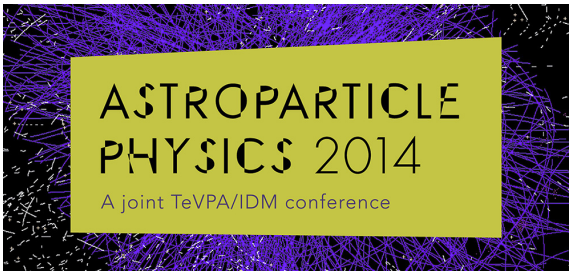

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Cosmic ray mass composition measurements with LOFAR

Thursday, June 26, 2014 6:00 PM (15 minutes)

It is generally believed that ultra-high-energy cosmic rays are produced in extragalactic sources like gamma-ray bursts or active galactic nuclei, while the lower energy cosmic rays come from our own Galaxy. At what energy the transition from Galactic to extragalactic origin takes place is still a mystery, but most models place it somewhere between 10^{17} and 10^{19} eV. With LOFAR we can measure the mass composition of cosmic rays in this important regime and disentangle the Galactic and extragalactic components.

LOFAR detects the radio signals 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 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 accurately reconstruct the interaction depth of cosmic rays, and infer their mass composition. We present an analysis based on the first results, revealing a strong proton component below 10^{18} eV.

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