

## **Observing the Ionosphere with LOFAR**

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The LOw Frequency ARray (LOFAR) is world's largest radio telescope operating at frequencies between 10 and 240 MHz. At these frequencies the ionosphere poses one of the main challenges in the calibration of the radio astronomical data, but this challenge for the radio astronomer is an opportunity for the ionospheric physicist: the level of detail in the information on ionospheric structures that can be extracted from the calibration parameters and dedicated observations is astonishing.

In this presentation we illustrate the range of possibilities for ionospheric measurements with LOFAR, detailing a few of the ionospheric studies undertaken so far. These include methods for detecting Traveling Ionospheric Disturbances (TIDs), a novel method for calculating absolute Total Electron Content, and studies of ionospheric scintillation data. In particular we will present a case from August 2013 which shows quite strong scintillation above the Dutch array in the dynamic spectra of observations of the bright radio source Cassiopeia A. Delay-Doppler spectra (the 2-D FFT of the dynamic spectrum) showing two arc structures which indicate scintillation from two different ionospheric layers. Analysis of this scintillation event has revealed that it is likely due to two, simultaneous, TIDs traveling in perpendicular directions, one possibly the result of high-latitude geomagnetic activity, and the other likely to be due to an Atmospheric Gravity Wave.