Detection of interstellar radio recombination lines with NenuFAR

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Abstract:
We report the detection of low frequency carbon radio recombination lines (RRLs) towards multiple galactic radio sources using the NenuFAR array. Based at Nançay Radio astronomy station, NenuFAR (New Extension in Nançay Upgrading LOFAR) is a LOFAR extension and SKA precursor that can detect Carbon atoms at quantum numbers between n~400 and n~850, with a frequency range spanning from 10 MHz to 85 MHz. Observations were carried out between 2019 and 2024. In this talk, we briefly describe the data structure and reduction pipeline we have developed. We then compare our observations with previous LOFAR ones towards the two bright sources Cassiopeia A and Cygnus A, in terms of sensitivity, spectral and angular resolutions. We subsequently illustrate how the electron density and temperature can be measured from these observations in foreground interstellar clouds. We present unprecedented detections obtained towards: i) another bright source, Tau A, and most surprisingly ii) lines-of-sight peering through the diffuse interstellar medium, such as NRAO150 and HD210839. We conclude by providing our plans for more systematic modelling of radio recombination lines in general, and a global perspective on the study of the ISM with the Square Kilometer Array.