

## The search for radio emission from exoplanets using LOFAR beam-formed observations

Jake D. Turner<sup>\*1</sup>, Jean-Mathias Grießmeier<sup>2</sup>, Philippe Zarka<sup>3</sup>, and Iaroslavna Vasylieva<sup>4</sup>

<sup>1</sup> Department of Astronomy, Cornell University, Ithaca, NY, USA

<sup>2</sup> Laboratoire de Physique et Chimie de l'Environnement et de l'Espace (LPC2E) Université d'Orléans/CNRS, Orlans, France

<sup>3</sup> LESIA, Observatoire de Paris, CNRS, PSL, Meudon, France

<sup>4</sup> Institute of Radio Astronomy, National Academy of Sciences of Ukraine, Kharkov, Ukraine

Detection of radio emission from exoplanets can provide information on the star-planet system that is very difficult or impossible to study otherwise, such as the planets magnetic field, magnetosphere, rotation period, orbit inclination, and star-planet interactions. Such a detection in the radio domain would open up a whole new field in the study of exoplanets, however, currently there are no confirmed detections of an exoplanet at radio frequencies.

In this talk, we discuss our ongoing observational campaign searching for exoplanetary radio emissions using beam-formed observations within the Low Band of the Low-Frequency Array (LOFAR). To date we have observed three exoplanets: 55 Cnc, Upsilon Andromedae, and Tau Boötis. These planets were selected according to theoretical predictions, which indicated them as among the best candidates for an observation. Data analysis for Stokes-I and Stokes-V is currently ongoing. Conclusions reached at the time of the meeting, about detection of or upper limit to the planetary signal, will be presented.

In order to test, validate, and quantify the sensitivity reached with our LOFAR pipeline, we apply it to a LOFAR observation of Jupiter's magnetospheric radio emission in which the signal from Jupiter is attenuated. The idea is simple: we observe Jupiter, divide its signal by a fixed factor before adding it to an observation of sky background, thereby creating an artificial dataset best described as "Jupiter as an exoplanet". We then run our pipeline and check whether the (attenuated) radio signal from Jupiter is detected. The maximum factor by which we can divide Jupiter's signal and still achieve a detection gives the sensitivity of our setup. We find that circularly polarized exoplanetary radio bursts can be detected up to a distance of 20 pc (encompassing the known exoplanets 55 Cnc, Tau Boötis, and Upsilon Andromedae) assuming the level of emission is  $10^5$  times stronger than the peak flux of Jupiter's decametric burst emission ( $\sim 6 \times 10^6$  Jy). Such signals are indeed expected to exist according to theoretical models.