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# Discovering the Climatology of the Ionosphere via Scintillation at Low Frequencies

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Research conducted by the Epoch of Reionisation (EoR) team associated with the Murchison Widefield Array (MWA) [3] has recently characterised ionospheric activity by observing positional shifts of radio sources in their EoR data [1]. As ionospheric activity increases, the difference between a source's expected and apparent position may also increase. Measuring these positional differences, a generalization of the ionosphere's movements can be determined, allowing the team to study the impact of ionospheric activity on the MWA's data. From this research, four 'types' of activity were identified [1], ordered by increasing grades which have larger impacts on the quality of EoR data and other low-frequency radio astronomy sciences. While the identification of these types have been useful as a starting point, additional information is required to develop a deeper understanding of ionospheric behaviour.

By employing interferometric techniques used on low-frequency radio telescopes to analyze interplanetary scintillation (IPS), it was theorized that the MWA would also be effective in detecting ionospheric scintillation [2]. Using 100 MWA EoR observations, it was shown that not only was it possible to detect scintillation but also distinguish it from other sources of variability, such as IPS. With such promising results, the study was then expanded to over 3800 eligible MWA EoR observations. Subsequently, this identified an additional metric that can illustrate the level of ionospheric activity.

Based on the aforementioned work, it was theorized that an increase in scintillation could be linked to a higher mode of ionospheric behaviour. Despite both metrics effectively being able to summarize ionospheric conditions, there is very weak correlation between the two. Investigations are currently being conducted into this discrepancy. We present the results and theories as to why this discrepancy exists.

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2. J. S. Morgan, J. P. Machquart, R. Ekers, R. Chhetri, M. Tokumaru, P. K. Manoharan, S. Tremblay, M. M. Bisi, and B.V. Jackson. 2018. "Interplanetary Scintillation with the Murchison Widefield Array I: A sub-arcsecond Survey over 900 square degrees at 79 and 158 MHz." *Monthly Notices Of The Royal Astronomical Society* 473 (3): 2965-2983. https://doi.org/10.1093/mnras/stx2284

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