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Advait Huggahalli

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A Novel Atmospheric Technosignature Grading System to Optimize Detection of Extraterrestrial Activity on G-type Exoplanets Using Next-Generation Space Telescopes

The detection of Extraterrestrial Intelligence (ETI) holds the potential to greatly expand our understanding of the universe and our place within it. A recent planetary science-based approach for the search for ETI has been developed, which focuses on identifying technosignatures, or signs of technological activity, in the transmission spectra of exoplanets. This approach involves identifying specific compounds that are known by-products of industrial activity and determining their presence in the transmission spectra of exoplanets. However, previous research has not employed systematic methodologies for evaluating technosignatures as well as searching for technosignatures with next-generation space telescopes such as the James Webb Space Telescope and LUVOIR. This study proposes systematic criteria for selecting technosignature candidate compounds and a systematic methodology for evaluating experimentally observed exoplanetary molecular transmission spectra based on identifying unique features in the spectral signatures. By applying this systematic criterion, a list of promising technosignatures candidates is narrowed down, and a grading system of known technosignature candidates is compiled to prioritize the detection of certain candidates on G-type exoplanets through next-generation space telescopes, advancing the search for ETI. Future research will focus on incorporating atmospheric mixing models to simulate the concentrations of compounds throughout exoplanetary atmospheres to know where detection is easiest, optimizing the search for ETI further.