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

Huggahalli, Advait (School: Horace Greeley High School)

The detection of Extraterrestrial Intelligence (ETI) holds the potential to greatly expand our understanding of the universe and our place within it. A planetary science-based approach for the search for ETI has been developed to identify technosignatures or signs of technological activity that imply intelligent life. This approach involves identifying compounds that are known byproducts of industrial activity and determining their presence in the transmission spectra of exoplanets using next-generation space telescopes like JWST and LUVOIR which allow us to view exoplanetary atmospheric compositions within their detection zone (01.-28.6 microns). Previous research has not employed systematic methodologies for evaluating and searching for technosignature candidates with these telescopes. This study presents a comprehensive methodology for evaluating potential technosignature candidate compounds and selecting which candidates to prioritize when searching with next-gen telescopes. The methodology uses eight criteria, including seven industrial chemistry attributes plus detectability criteria, to identify unique features within each compound's spectral signatures in G-type (Earth-like) planetary atmospheres. By applying these systematic criteria, promising technosignatures candidates are classified into four types: type-1(best) to type-4(worst) based on their potential for being a technosignature. This grading can be used to prioritize the detection of promising candidates (type-1 and 2) on G-type exoplanets through next-gen telescopes, advancing the search for ETI. Out of 55 evaluated compounds, 32 compounds were identified as promising, with 8 identifying as type-1. These technosignature candidates should be the focus of next-gen telescopes in the search for ETI.