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INFRARED OBSERVATIONS OF PHOSPHINE ON VENUS

Abstract

We follow up the discovery of the proposed biosignature phosphine (PH3) in the Venusian atmosphere with infrared observations from ground-based telescopes. We discuss the possibility for observing PH3 and other trace gasses on Venus from Earth based observatories.

PH3 has been proposed as a biosignature gas in planetary atmospheres (Sousa-Silva+ 2020). In 2021, a group detected PH3 gas in Venus' middle atmosphere via a molecular rotational transition at 1.1 mm wavelength using radio telescopes JCMT and ALMA (Greaves+ 2021). They argued that our current understanding of the atmosphere lacks the mechanisms to produce or sustain PH3 at the observed abundance, and hinted at a biological origin for the PH3. Further studies by the group reinforce this conclusion, arguing proposed sources (e.g. volcanism) could not explain the detection (Bains+ 2021, Bains+ 2022). If a biological origin is to be believed, it would suggest the presence of microbial life in Venus' mesosphere, where conditions are more similar to Earthlike temperatures and pressures rather than the hellish conditions on Venus' surface.

Since its initial publication, the observation of PH3 on Venus has been hotly debated, with a number of papers (e.g. Rimmer 2021, Lincowski+ 2021, Akins+ 2021, Villanueva+ 2021, Thompson 2021) contesting the results. It is clear that more data needs to be taken to determine the veracity of this signal. If PH3 could be detected at a distinct wavelength from the original study's 1.1mm its existence on Venus would be confirmed with certainty. This paper discusses the possibility of observing Venusian PH3 in the infrared (2.2 um) from Earth based observatories.

We have taken measurements of the dayside reflected-light infrared spectrum of Venus using the iSHELL instrument on NASA's IRTF telescope. We observed Venus for 4.5 hours on the mornings (daylight hours) of Nov 19 and 20, 2020. Our measurements target phosphine's strong rotational-vibrational band at 2.2 um, a region uncontaminated by other spectral features in either Earth or Venus' atmospheres, at spectral resolution R 75,000. We discuss the results of these observations and the possibility for detecting Venusian PH3 in the infrared. We discuss further possibilities for validating the detection of Venusian PH3 from Earth.