Infrared opacity spectras of lava-worlds' atmospheric gases, using an Aerodynamic Laser-heated Levitation Furnace

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Abstract

The development of ground- and space-based telescopes, has enabled the spectroscopic observation of the atmospheres of lava-ocean planets. These planets offer insights into understanding their interiors, as the atmosphere and underlying mantle are expected to be in thermodynamic equilibrium. However, owing to the uncertainty in the compositions of these atmospheres, which may differ substantially from those of the four terrestrial planets, laboratory experiments remain crucial for interpreting observed data in terms of the nature and abundances of stable gaseous species.
Here we aim to determine the opacity of gas species found in the atmospheres of lava worlds at high temperatures. To do so, we used an Aerodynamic Laser-heated Levitation Furnace (ALLF) coupled with a Fourier Transform Infrared (FTIR) spectrometer in order to collect transmission spectra of the gas phase in the vicinity of the heated silicate sphere. We examined the spectral properties of methane and sulfur dioxide and determine the IR opacity of the gas plume around the sphere in the ALLF at high temperatures and atmospheric pressure using the Beer-Lambert law. The data are compared with existing data on cross-sections currently available in the ExoMol database. This research provides valuable data for understanding the atmospheric conditions on lava worlds and contributes to the interpretation of telescopic observations.

Keywords: Magma ocean, Opacity, Atmosphere, FTIR

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