Missing Opacity in the Atmospheres of Uranus and Neptune?

Michael T. Roman[1,2], Leigh N. Fletcher[2], Patrick G. J. Irwin[3]

[1] Facultad de Ingeniería y Ciencias, Universidad Adolfo Ibáñez, Santiago, Chile

[2] School of Physics and Astronomy, University of Leicester, Leicester, United Kingdom LE1 7RH

[3] Atmospheric, Oceanic, and Planetary Physics, Department of Physics, University of Oxford, Clarendon Laboratory, Parks Rd., Oxford OX1 3PU, United Kingdom

JWST NIRSpec observations have measured the continuous near-infrared spectrum of solar system's giant planets in greater detail than ever measured before. From these new data, new challenges for spectral modelling have emerged.

In the case of Uranus and Neptune, much of the faint near-infrared reflectance spectrum has been revealed for the first. While much of the spectrum can be modelled accurately, we are finding inconsistencies between observed and modelled spectra that suggest a significant source of opacity is missing from our models in windows of otherwise weak methane and hydrogen collision induced ($H_2 - H_2$), $H_2 - He$) absorption (e.g. 2.7-3.1 μm; 3200–3700 cm^{-1}). The strength of the additional absorption needed to match the data suggests that the missing opacity is gaseous rather than due to aerosols. Given the smooth spectral shape, we speculate that the missing opacity may be collision induced absorption from $H_2 - CH_4$ collisions, which have yet to be characterised by lab or theoretical work in the near-infrared. In this presentation, we will present the case and argue the need for further laboratory and/or theoretical work on $H_2 - CH_4$ collision induced absorption, with potential relevance to all cold, hydrogen and methane rich worlds.