VUV Absorption Cross-Section of HCN for Photochemistry Modelling of Hot Exoplanets

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The spectroscopic characterization of exoplanetary atmospheres is rapidly advancing thanks to observations from JWST and upcoming missions like ARIEL. Recent observations of JWST have proven that the atmospheres of warm and hot Jupiters might not been at thermochemical equilibrium. Thus, to interpret those observational infrared spectra, reliable photochemical models are needed. In hot exoplanet atmospheres, strongly irradiated by their host stars, photochemistry is driven by vacuum ultraviolet (VUV) absorption. However, available VUV absorption cross section data are mostly measured at room temperature, while exoplanet atmospheres can exceed 1500 K. The use of room-temperature absorption cross section data for high-temperature atmospheres introduces uncertainties into the predicted composition of the atmospheres. We present new experimental measurements of the VUV absorption cross-section of HCN between 300 K and 700 K over the 115-200 nm wavelength range. A clear thermal dependence is observed, with the cross-section increasing at higher temperatures. These data have been implemented in the thermo-photochemical model FRECKLL to observe their impact on the chemical composition and radiative transfer. Our results highlight the critical need for temperature-dependent spectroscopic databases to properly model and interpret UV observations of hot exoplanets. They call for continued experimental efforts to provide high-temperature data under conditions relevant to these extreme environments.