Using infrared spectroscopy to probe the temperature dependence of the H + N$_2$O reaction in parahydrogen crystals

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In situ photolysis of precursor molecules trapped in a solid parahydrogen matrix has been successfully used in our group to study H atom reactions with other species at temperatures in the range of 1.6 to 4.3 K. At these temperatures, H atoms are known to continuously move through the solid by the H + H$_2$ → H$_2$ + H tunneling exchange reaction. We recently studied the reaction of H atoms with $^{15}$N$_2$O and in the preliminary communication of this work,\textsuperscript{a} we reported a very strange non-Arrhenius temperature dependence to the reaction; the reaction only occurs below 2.4 K and not at higher temperatures. This talk will present our subsequent work on the high-resolution infrared spectroscopy of $^{15}$N$_2$O molecules trapped in solid parahydrogen with a focus on the $\nu_1 + \nu_3$ and 2$\nu_1$ vibrational bands. For both these vibrational bands we observe multiple peaks and the relative intensities of the observed peaks change with temperature over the measured range similar to the temperature dependence of the $\nu_3$ fundamental reported earlier by Lorenz and Anderson.\textsuperscript{b} The temperature dependent changes in intensity imply that there are at least two trapping sites which could potentially explain the observed temperature dependence to the H + $^{15}$N$_2$O reaction.