THE Cl+H_2 $\rightarrow$ HCl+H REACTION INDUCED BY $IR + UV$ IRRADIATION OF Cl_2 IN SOLID PARA-HYDROGEN

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Matrix isolation spectroscopy is a technique which enables highly reactive species to be trapped in a host environment and studied spectroscopically. Solid parahydrogen (pH$_2$) has been employed as a matrix host because of its interesting quantum mechanical properties and also because of its general inertness towards trapped dopants. However, in some cases pH$_2$ can react with impurities yielding new product molecules and providing insight into non-classical reaction pathways. In this talk I will present the results from a series of experiments where molecular chlorine (Cl_2) doped pH$_2$ crystals were exposed to two different irradiation schemes (namely UV only or $IR+UV$ conditions) that gave rise to very different products. Cl_2 doped pH$_2$ crystals irradiated with $355\,nm$ UV light produced almost exclusively (99%) isolated Cl-atom photofragments, indicating the reaction Cl+H$_2$($\nu = 0, J = 0$) $\rightarrow$ HCl+H is not readily occurring. Cl_2 doped pH$_2$ exposed simultaneously to $355\,nm$ UV irradiation and broadband $cw\,IR$ light yielded HCl photoproducts indicating that the following reaction is playing a significant (15%) role in the *in situ* photochemistry: Cl+H$_2$($\nu = 1, J = 0$) $\rightarrow$ HCl+H. The kinetic analysis of these experiments with two very different reaction pathways for UV only or $IR + UV$ conditions will be presented. Further, the results of current investigations involving spin-orbit excited Cl-atoms generated using 416 nm UV photons will be discussed in order to explore the intriguing possibility of non-Born Oppenheimer reaction dynamics in the simple Cl+H_2 reaction.