SENSITIVITY OF INTERSTELLAR CHEMISTRY TO THE RATIO OF THE COSMIC-RAY IONIZATION OF HE AND H_2

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The equations describing the chemical evolution of quiescent cores (aka molecular clouds) are highly non linear and may result in extreme sensitivity to the initial conditions (for instance, bistability) or to some of the parameters. Applying a Monte Carlo method, which we developed to compute the theoretical abundance errors due to the rate coefficient uncertainties, we have found a new manifestation of this non-linearity that has important implications in interstellar chemistry. Some of the calculated molecular abundances prove to be extremely sensitive to the ratio $\zeta_{\mathrm{He}}/\zeta_{\mathrm{H_2}}$, where ζ is the ionization rate by cosmic-rays. A small change in this ratio can result in a sharp transition between two different chemical compositions of the gas. The two phases may differ by 4 and 3 orders of magnitude in the atomic carbon and molecular oxygen abundances, respectively. In some conditions (elemental abundances and H_2 density), this high sensitivity even leads to a bistable solution, depending on the chosen initial set of abundances. In this presentation, we would like to present the effects and implications of this newly found sensitivity and bistability.