ISOMERIZATION, PERTURBATIONS, CALCULATIONS AND THE S_1 STATE OF C_2H_2

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Preliminary analysis of the energy region of the *cis-trans* isomerization transition state on the S_1 surface of C_2H_2 has revealed novel patterns and surprising perturbations, including unusually large (and high-order) anharmonicities, as well as K-staggerings of several vibrational levels. These effects complicate the analysis considerably, and require new models and calculations to account for and predict features of the observed spectra. The $\tilde{A} - \tilde{X}$ spectrum of acetylene has been studied both experimentally and theoretically for almost a century, and this cycle of unexpected phenomena eliciting innovative responses is found throughout its history. Especially in the last ten years, progress in understanding the S_1 state rovibrational level structure and *cis-trans* isomerization has been accelerated by combining the information available from both *ab initio* computation and spectroscopic observations. The resulting dialogue has then frequently suggested fruitful avenues for further experiments and calculations. Current challenges and recent results in understanding the *cis-trans* isomerization transition state region will be discussed in this context.