

Vibrational Excitation and Dissociative Electron Attachment Cross Sections in Cyanoacetylene HC₃N

M. Ranković¹, P. Nag¹, M. Zawadzki^{1,2}, M. Polásek¹, J. Žabka¹, J. Kočišek¹, J. Fedor¹

¹J. Heyrovský Institute of Physical Chemistry, Academy of Sciences of the Czech Republic,
Dolejškova 3, 182 23 Prague, Czech Republic

²Atomic Physics Division, Department of Atomic, Molecular and Optical Physics, Faculty of Applied Physics and Mathematics, Gdansk University of Technology, ul. Gabriela Narutowicza 11/12, 80-233 Gdansk, Poland
juraj.fedor@jh-inst.cas.cz

Cyanoacetylene, HC₃N, has been attracting attention due to its abundance in a number of extraterrestrial environments, such as molecular clouds or Titan's atmosphere. It is believed, that the chemical transformation in such environments is to a large degree driven by an electron impact. At the same time, there is very little data on the electron collisions with HC₃N available, we are aware only of one experimental quantitative DEA study. [1]

We have used three electron collision setups: an electrostatic spectrometer with hemispherical analyzers, quantitative DEA spectrometer with time-of-flight analyzer, and high-resolution DEA spectrometer with quadrupole analyzer. With the first one, we probed the elastic and vibrationally inelastic cross sections at 135° scattering angle, combining the two later ones, we determined the partial DEA cross sections.

The vibrational excitation cross sections reveal presence of four shape resonances. The first one gives rise to a pronounced boomerang structure which overlaps with the threshold peak originating from the electron-dipole excitation, and thus creates an interesting pattern. This resonance is visible in all the vibrations. The other resonances are much more selective, especially the two σ^* states are prominent only in the excitation of the CH and CN stretch modes. The DEA cross sections are in an excellent qualitative agreement with the data of Gilmore and Field [1], however, the present absolute data are approximately by a factor of two lower. The comparison with the vibrational excitation data allows for assignment of the DEA bands.

References

- [1] T. D. Gilmore, T. A. Field, *J. Phys. B*, **48**, (2015), 035201.
- [2] M. Ranković et al., *Phys. Rev. A*, **98**, (2018), 052708.