ON THE C-H STRETCHING MODE OF PROTONATED FULLERENES: AN IRMPD SPECTROSCOPY STUDY

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Fullerenes (C_{60}, C_{70} and C_{60}^+) have been found to be the largest molecular species identified to date in the interstellar medium (ISM), and it has already been suggested that protonated C_{60} and its complex analogues are among the most abundant C_{60} analogues present in space.

In a recent paper [a], we presented the first experimental IR spectrum of $C_{60}H^+$, although we were at the time unable to record the spectrum in the 3 μm range. In this work, the vibrational spectra of gaseous protonated and deuterated C_{60} are recorded via infrared multiple-photon dissociation (IRMPD) for the first time in the CH and CD stretching region using the free electron laser FELIX interfaced with a quadrupole ion trap. In addition to the CH stretch band, the spectrum of $C_{60}H^+$ shows in the 1600-3000 cm^{-1} range the presence of other bands, which could be tentatively assigned as combination bands and overtones. The bands observed in this region are obviously weak but well-resolved, entailing that they may be excellent diagnostic features for protonated C_{60}. In fact, the single CH stretching band of $C_{60}H^+$ falls at a frequency that is significantly lower than the CH stretching mode of aliphatic C-H bonds.

Comparison of the IR spectra of several ionized fullerene analogues to IR emission spectra from planetary nebulae suggests that these species may exist in significant amounts in the ISM and be responsible for the unidentified interstellar features.

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