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Toward laser-induced vibrational emission spectroscopy of C_{60}^+

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Synopsis C_{60}^+ has been proposed to be responsible for two of the *diffuse interstellar bands* (DIBs), the absorption features observed in the visible-to-near-infrared spectra of the interstellar medium. However, a confirmation requires laboratory gas-phase spectra, which are so far not available. We plan to develop a novel spectroscopy technique that will allow us to obtain *the first gas-phase spectra* of C_{60}^+, and that will be applicable to other complex organic molecules such as polycyclic aromatic hydrocarbons. The current status of the experimental setup, the ideas behind the measurement scheme and the preparatory work toward its implementation will be presented.

The *diffuse interstellar bands* (DIBs) [1] are absorption features that can be observed in the visible to near-infrared spectra of the interstellar medium. Despite the observation of several hundred lines over the last few decades, none of them has been unequivocally attributed to a known chemical species. Still, astronomical observations and laboratory spectra of C_{60}^+ [2] isolated in neon matrix suggest that this molecular ion could be responsible for two DIB features at 957.7 nm and 963.2 nm. However, a definitive conclusion will have to be based on laboratory gas phase spectra, which are not available to date. Using the Cryogenic Trap for Fast ion beams (CTF) [3], we intend to carry out *the first gas-phase spectroscopy* of C_{60}^+. The CTF allows us to prepare conditions that have close resemblance to the interstellar medium, where temperatures go down to ∼10 K and background gas densities are extremely low. We will store the molecular ions inside the CTF and excite them with laser light at the relevant wavelengths, spanning the absorption features attributed to C_{60}^+. At resonance, the excitation is expected to be followed by the delayed emission of infrared radiation through vibrational transitions in the mid-infrared [4, 5]. A fraction of the emitted light will be guided onto an array of highly sensitive blocked impurity band (BIB) detectors, which feature an extremely low dark current. The delayed emission intensity will be observed as a function of the excitation wavelength, and this signal will be used for a novel type of extremely sensitive, almost background-free gas-phase spectroscopy.

After the proof-of-principle experiments with C_{60}^+, this spectroscopic scheme can be applied to a wide range of other complex organic molecular ions such as polycyclic aromatic hydrocarbons. The current status of the experimental setup, the measurement scheme and the preparatory work toward its implementation will be presented.

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