

Electronic absorption spectroscopy of PAHs in supersonic jets and ultracold liquid helium droplets

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Abstract. Neutral and cationic polycyclic aromatic hydrocarbons (PAHs) are discussed as possible carriers of the diffuse interstellar bands (DIBs), still unassigned astrophysical absorption features observed in the spectra of reddened stars (Salama *et al.* 1999). Despite the importance of this class of molecules for astrophysics and nanophysics (PAHs can be regarded as nanoscale fragments of a sheet of graphite), the spectroscopic characterization of PAHs under well-defined conditions (low temperature and collision-free environment) has remained a challenge. Recently we have set up a cavity ring-down spectrometer combined with a pulsed supersonic jet expansion to study neutral and cationic PAHs under astrophysical conditions. PAHs studied so far include the neutral molecules anthracene (Staicu *et al.* 2004) and pyrene (Rouillé *et al.* 2004) as well as the cationic species naphthalene⁺ and anthracene⁺ (Sukhorukov *et al.* 2004). Employing another molecular beam apparatus, the same molecules (except of the cationic species) were also studied in liquid helium droplets (Krasnokutski *et al.* 2005, Rouillé *et al.* 2004). This novel technique combines several advantages of conventional matrix spectroscopy with those of gas phase spectroscopy. Notable advantages are the possibility to study molecules with low vapor pressure and to use a mass spectrometer facilitating spectral assignments. The most recent studies were devoted to phenanthrene and the more complicated (2,3)-benzofluorene. These molecules were investigated in the gas phase by cavity ring-down spectroscopy and in liquid helium droplets using depletion spectroscopy. For benzofluorene the present studies constitute the first reported measurements both in the gas phase and in helium droplets. The origin of the $S_1 \leftarrow S_0$ gas phase transition could be located at $29\,894.3\text{ cm}^{-1}$, and a series of vibronic bands was recorded below $31\,500\text{ cm}^{-1}$. In contrast to previously studied PAHs, the shift induced by the helium droplets was very small (blue shift between 4.5 and 4.9 cm^{-1} for all vibronic bands). With this new gas phase data, a value of 247 cm^{-1} is derived for the red shift experienced by the molecule in an argon matrix (Banisaukas *et al.* 2004). For the molecules studied up to now, no coincidence between experimental and interstellar band positions was found.

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References

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