Beryllium bonding probed by anion photodetachment spectroscopy

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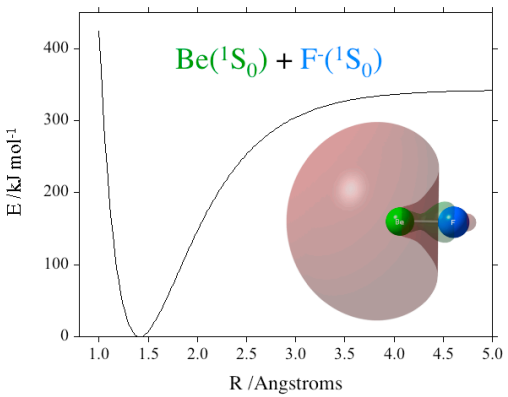
The chemistry of beryllium is known to be significantly different from the behavior exhibited by the heavier group IIA elements. Due to its high ionization energy and small size, the bonding of beryllium is significantly more covalent than the bonds of typical group IIA metals. As a consequence, beryllium and its compounds exhibit unique properties. However, the chemistry of beryllium is underexplored due to its toxicity. To circumvent this problem there have been many theoretical studies of beryllium and its compounds. Being a light element with just four electrons, beryllium appears to be well suited for investigation using non-relativistic quantum chemical methods. However, calculations for Be-compounds frequently prove to be difficult due to subtle (but dominant) electron correlation effects.

We are currently studying a series of BeX diatomics by means of anion autodetachment spectroscopy to examine the bonding. BeX^- anions are generated by pulsed laser ablation, mass selected and then photodetached. Electron imaging and autodetachment techniques are used to recover spectroscopic data. Recent results for the BeO^-, BeS^- and BeF^- anions will be presented. BeO^- and BeS^- both exhibit dipole-bound excited states, permitting the observation of rotationally resolved spectra. BeF^- shows an unusually strong bond between the closed-shell Be and F^- moieties. Electronic structure calculations, validated by comparison with the spectroscopic observations, have been used to examine the bonding in the anionic and neutral species.



Which spectroscopy to study astro-PAHs?

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Polycyclic aromatic hydrocarbons (PAHs) absorb UV radiation from stars and play a key role in the physical and chemical evolution of astronomical objects. Following the absorption of UV photons, radiative cooling gives rise to the aromatic infrared bands (AIBs) that are observed in emission in many regions of space. Although PAHs should contain at least 10% of the carbon in the Galaxy, no individual molecule of this family could be identified so far.

Interstellar PAHs are expected to contribute to the 220 nm bump and the far-UV rise of the extinction curve [1]. They could be the carriers of (some of) the diffuse interstellar bands (DIBs) [2]. In addition of the AIBs that fall in the mid-IR, bands are expected in the far-IR range [3]. Rotational lines should also be present in the mm-cm range, especially for molecules, which carry a significant dipole moment [4]. Various laboratory setups and spectroscopic techniques are required to ultimately mimic a collision free environment and sample a range of temperatures from hot (~1000 K) for the AIBs, to warm/ cold for rotational lines, to cold (~10 K) for the DIBs.

In this talk, I will summarise the status of this field in the various spectral ranges, emphasising the synergy between laboratory astrophysics activities (e.g [5, 6]) and recent/coming observational investigations. These make use of ground-based telescopes [7] and radiotelescopes [8, 9], as well as of space missions such as *Herschel* [10], and the coming James Webb Space Telescope [11]. I will then discuss the importance of guiding these spectroscopic studies by experiments in which the formation and evolution of large carbonaceous molecules under astrophysical conditions are simulated, notably as part of the ERC Synergy project Nanocosmos [12].

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