

FESCHBACH RESONANCE IN TETRACENE RADICAL ANION: THE SECRET TO A LONG LIFETIME OF NEGATIVITY

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Polycyclic aromatic hydrocarbons (PAH) have been surmised as carriers of the diffuse interstellar bands (DIB), hundreds of unidentified spectral lines in the infrared through ultraviolet regions. These PAH are often thought to be in their cationic or neutral forms in the interstellar medium, although there have been models that feature these molecules as the primary carriers of negative charge in dense interstellar clouds, rather than just free electrons. We monitored the photodetachment cross section as a function of wavelength for tetracene radical anion ($C_{18}H_{12}^-$) to explore the resonances of the tetracene radical anion above the detachment threshold. The observed electronic states closely align with a previously reported absorption spectrum of the molecule, with one major exception. Sharp features (less than 10 cm^{-1}) corresponding to a long-lived Feschbach resonance of the molecule were found in the near-IR. This corresponds to a lifetime of no faster than 600 fs, a much longer lifetime than typically observed for above detachment resonances. These features can potentially be used to detect the presence of anionic polyaromatic species in the interstellar medium. However, we were not able to make any assignments based on our spectra for tetracene and available DIB data. Still, by acquiring photoelectron spectra at these anion excited electronic states, we identify specific photodetachment channels by which these resonances relax to the ground neutral electronic state. These features will be compared to the anthracene radical anion ($C_{14}H_{10}^-$) and the tetracenyl anion to explore the effect of PAH size and dehydrogenation on these resonances. In addition, we will report on possible fragmentation in the UV spectral region mediated by these resonances. Finally, photoelectron spectra are collected using slow electron velocity-map imaging (SEVI), yielding high precision electron affinity values and T_1 term energies for tetracene, as well as identifying active vibrations in these transitions. Interestingly, the T_1 state in the tetracene radical anion photoelectron spectrum features highly non-Franck Condon activity, most likely due to vibronic coupling. The anion resonances shown here along with the photoelectron spectra acquired have interesting implications for the possibility of tetracene as a negative charge carrier in the interstellar medium.