THE GAS-PHASE SPECTRA OF RESONANCE-STABILIZED RADICALS AND THE RED RECTANGLE EMISSION

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Alpha aromatic radicals may explain some of the emission features of Red Rectangle (RR), a nearby protoplanetary nebulae. Erosion of amorphous hydrogenated carbon may lead to resonance-stabilized products by breaking aliphatic side-chains to aromatic “islands”. The resulting radicals may be excited by starlight to give rise to the characteristic emissions. As a part of the ongoing research [a] [b] and in order to investigate this hypothesis, the gas-phase excitation and emission spectra of some of these radicals have been identified in a molecular beam using laser induced fluorescence (LIF) spectroscopy. Resonance-stabilized 1-naphthylmethyl, 2-naphthylmethyl and acenaphthenyl radicals were produced from the discharge of 1-methylnaphthalene, 2-methylnaphthalene and acenaphthene precursors in argon, respectively. In order to determine the ground state vibrational energies of these species, their fluorescence bands were dispersed. The results are consistent with the Density Functional Theory (DFT) calculated ground state frequencies. As a complementary experiment, and to further confirm the identity of the spectral carriers, resonant two color two photon ionization (R2C2PI) spectra were also recorded. The origin bands of all these three molecules show up in the 5790 - 5840 Å range of the spectrum, the well-known RR emission region.

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[a] N. J. Reilly, D. L. Kokkin, M. Nakajima, K. Nauta, S. H. Kable, and T. W. Schmidt *J. Am. Chem. Soc.* **130**(10), 3137 (2009).
[b] T. P. Troy, M. Nakajima, N. Chalyavi, R. G. C. R. Clady, K. Nauta, S. H. Kable, and T. W. Schmidt *J. Phys. Chem. A* **113**, 10279 (2009).