DISCOVERY OF BLUE LUMINESCENCE IN THE RED RECTANGLE: POSSIBLE FLUORESCENCE BY NEUTRAL POLYCYCLIC HYDROCARBON MOLECULES

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Polycyclic aromatic hydrocarbon (PAH) molecules are thought to be widely present in many interstellar and circumstellar environments in our galaxy as well as in other galaxies, and are considered likely carriers of the unidentified infra-red (UIR) band emission. However, no specific PAH molecule has yet been identified in a source outside the solar system, as the set of mid-infra-red emission features attributed to these molecules between the wavelengths of 3.3 μm and 16.4 μm are largely insensitive to molecular sizes. In contrast, near-UV/blue fluorescence of PAHs is more specific as to size, structure, and charge state of a PAH molecule.

Long-slit, low resolution spectroscopy of the Red Rectangle nebula has revealed a heretofore unknown band of luminescence in the blue part of the spectrum. This enigmatic proto-planetary nebula is also one of the brightest known sources of extended red emission as well as of UIR-band emissions. The spectrum of this newly discovered luminescence suggests that it is most likely to be fluorescence by small neutral polycyclic aromatic hydrocarbon (PAH) molecules. This identification is further supported by spectral matching with existing laboratory spectra of such gas-phase PAHs, spatial correlations with the surface brightness distribution of the 3.3 μm PAH feature and the analysis of the FUV PAH ionization discontinuity in the spectrum of the exciting source HD44179.