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Probing the ionization states of PAHs via the 15-20 µm bands

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We report detections of new correlations between the 15-20 µm emission bands of polycyclic aromatic hydrocarbons (PAHs). These molecules lie on the small end of the dust grain size distribution and are very abundant, containing up to 15-20% of the cosmic carbon. PAHs are present in PDRs and play key roles in chemical and physical processes, such as charge exchange reactions and gas heating through photoelectric ejection. We observe PAH emission bands at 15.8, 16.4, 17.4 and 17.8 µm in a variety of PDR environments, including HII regions, reflection nebulae, planetary nebulae and the interstellar medium of galaxies. Correlations between band intensities are detected, which we interpret in terms of molecular charge and structure with the aid of spatial maps. We find the 15.8 µm band is consistent with neutral molecules, the 17.4 µm band with cations, and the 16.4 and 17.8 µm bands a combination of the two. Radial cuts in the maps show that the spatial profiles of the 12.7, 16.4 and 17.8 µm bands can be reconstructed by summing the 11.2 µm (neutral) and 11.0 µm (cationic) bands. These results highlight the importance of ionization state in driving emission variability.