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PAH emission in NGC2023: how subtle variations reveal sub-populations with different molecular structure and charge.

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The mid-IR spectra of photodissociation regions (PDRs) are dominated by the well-known emission features at 3.3, 6.2, 7.7, 8.6, 11.3, and 12.7 micron, generally attributed to polycyclic aromatic hydrocarbon molecules (PAHs). PAHs drive much of the physics and the chemistry in these PDRs, e.g. by heating the gas and as a catalyst in the formation of molecular hydrogen on their surfaces. Thus, PAHs and PDRs are intimately connected, and a complete knowledge of PDRs requires a good understanding of the properties of the PAH population.

One of the best ways to investigate the detailed characteristics of the PAH population is by analyzing IR spectral maps. Here, we present the results of such an analysis of spectral maps obtained with Spitzer/IRS in the 5-20 micron range toward the reflection nebula NGC 2023. These maps show subtle, but significant spatial variations in individual PAH emission bands. The overall dominant charge state of the PAH population is certainly a key factor in driving these variations. However, with our maps, we can also probe changes within the so-called ionic PAH emission bands that all originate from PAHs with the same charge state. We find that even within these bands, spatial variations occur that indicate contributions from at least 2 spatially distinct components, and thus PAH sub-populations, to the 7–9 micron PAH emission. We attribute these changes to molecular structure variations in the PAH sub-populations.

REFERENCES