Mid-Infrared Observations of the Orion Bar

MIRSI instrument team:
PI L. Deutsch, Co-I J. Hora, J. Adams, M. Kassis

In high mass star forming regions like the Orion Nebula, a photodissociation region (PDR) represents the neutral interface between the optically visible HII region and a cold, dark molecular cloud. PDRs are bright in the infrared because ionizing (ultraviolet) radiation from the young stars heats dust grains and excites Polycyclic Aromatic Hydrocarbons (PAHs). Both the dust grains and PAHs re-emit this absorbed energy at infrared wavelengths.

We have used our new MIRSI (Mid-InfraRed Spectrometer and Imager; see below, also Deutsch *et al.* 2002, *SPIE*, **4841**-13) system on the IRTF to observe the PDR in the Orion Bar. By comparing our observations to theoretical models we can constrain properties of the environment and composition in the Orion Bar PDR such as the ultraviolet photon flux, gas and electron densities, and the gas temperature. These properties will vary with depth into the PDR.

Figure 1 is a 4 x 5 mosaic of MIRSI images showing the Orion Nebula at a wavelength of 20.9 μm. The most prominent features in this image are the Bar (extending diagonally across the image from middle left to lower right), Trapezium, and the BN/KL region (the very bright region in the upper right). The intensity range and contrast of this image have been set to show the faint diffuse emission near Trapezium and the Bar. Figure 2 shows a blow-up of the BN/KL region as imaged by MIRSI.

Figure 1.

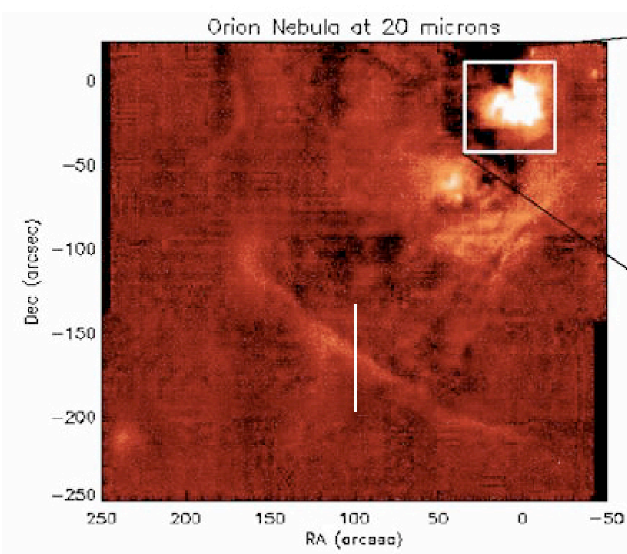
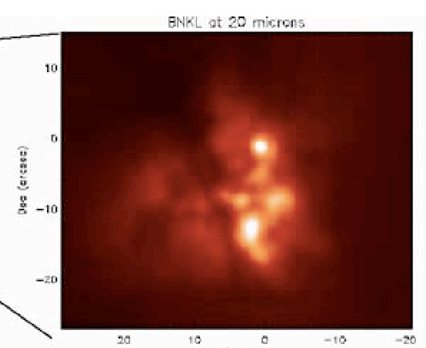
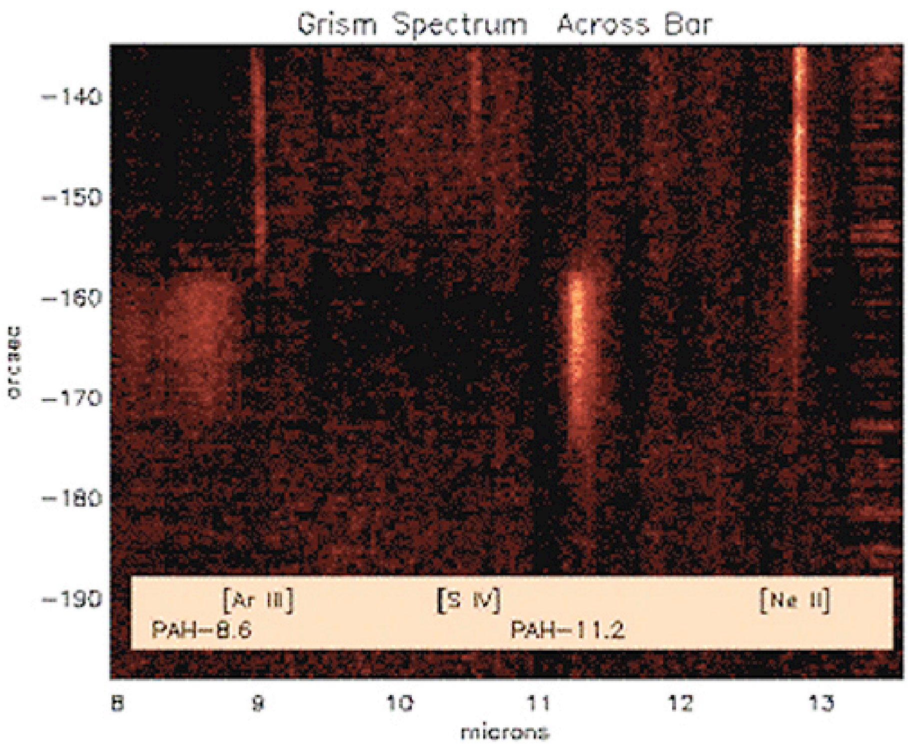


Figure 2.



Because of the Bar's favorable edge-on geometry, MIRSI grism spectra can be used to trace the relative strengths of ionized gas and PAH features as a function of depth into the Bar (Figure 3). In this spectral mode, the MIRSI array records spatial information along the vertical, or y-axis dimension and spectral (wavelength) information along the horizontal dimension. For this particular spectrum, the slit was oriented in a North-South direction on the sky and was centered on the Bar at the position 100 in RA and –150 in Dec (depicted by a white line in Figure 1). The prominent spectral features are labeled at the bottom of the spectrum. The sharp transition between emission from ionized gas ([ArIII] at 8.99 μm) and PAHs (at 8.6 and 11.2 μm) demonstrates that PAH emission peaks near the edge of the HII region.

Figure 3.



MIRSI is a mid-infrared spectrometer and image that utilizes a Raytheon 320 x 240 Si:As high-background IBC array. MIRSI offers a large field of view (85 arcsec x 64 arcsec on the IRTF, with a pixel scale of 0.27 arcsec), diffraction-limited spatial resolution, complete spectral coverage of the 8 – 14 μm and 17 – 26 μm atmospheric windows for both imaging and spectroscopy, and high sensitivity. In imaging mode, MIRSI offers broad N- and Q-band filters and discrete filters at 4.9, 7.8, 8.7, 11.7, 12.28, 12.3, 18.4, 20.9, and 24.5 μm, as well as a CVF operating from 7.9 to 14.5 μm. In spectroscopic mode, MIRSI offers a grism that covers the interval from 8 – 14 μm at a resolution of 200 and a grism covering 17 – 26 μm with a resolution of 100. Slit widths of 0.6 and 1.2 arcsec are available.

MIRSI is available for collaborative programs at the IRTF. Interested parties must contact PI L. Deutsch regarding the submission of collaborative observing proposals.

MIRSI website: http://mirador.bu.edu/mirsi/mirsi.html