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Characterizing Quasars in the Mid-IR

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Abstract. Following the Spitzer cold mission, we are in the position to try to understand the general features of mid-IR spectra of quasars. To that end, we have constructed a composite spectrum from 3.8-37.6 microns from 200 SDSS AGN with Spitzer IRS spectra. The high S/N composite reveals significant features, including PAHs (associated with star formation in the host galaxy), broad silicate bumps, and narrow emission lines (including [O IV], [Ne V], [S III] and others). Composites constructed from AGNs within luminosity bins show systematic differences; we find that less luminous AGN show redder continua, stronger PAH emission, and stronger narrow emission lines.

1. Spectral Composites

We have gathered over 200 mid-IR quasar spectra from the *Spitzer* Infrared Spectrograph (IRS) data archive and cross correlated with the SDSS quasar catalog (Abazajian et al. 2009) to investigate the average properties of emission from structure beyond the dust sublimation radius in the quasar system.

Using this data set, we have created composite mid-IR spectra (using σ-clipping about the median, with the mean reported) to boost the S/N and reveal faint and ubiquitous features. We have included a composite of all spectra (Figure 1) and luminosity-sorted composites (Figure 1). Salient features found in the total composite in Figure 1 include forbidden atomic emission lines (see labels), PAH features and vibrational transitions of H_2.

In Figure 1, where the composites have been binned according to their 5.6 micron luminosities, there are some obvious trends evident in the emission-line and continuum features. With increasing $L_{5.6\mu m}$, there is an overall decrease in the equivalent widths of the emission-line, PAH, and molecular features, as well as a change in the continuum shape. The lower luminosity composite shows a redder continua and less prominent silicate emission bumps at 10 and 18 μm. Stronger emission lines and redder continua in the lower luminosity objects is likely due to the larger contribution from star-forming host galaxies. Similarly, the higher luminosity objects likely contain a greater contribution from the quasar itself and better represents the underlying continuum of the quasar.

The next step is to characterize the specific features of AGN spectra in the mid-IR (Hill et al., in preparation) along the lines of what has been done in the optical (Vanden Berk et al. 2001).

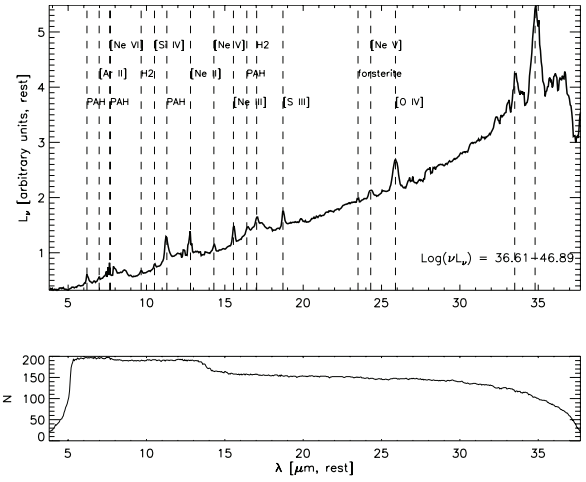

Figure 1. *Top panel*: Composite mid-IR quasar spectum in the rest frame. Vertical dashed lines represent prominent PAH features and forbidden atomic emission lines. Also reported is the 5.6 micron luminosity range of the objects in the sample. *Bottom panel*: Number of spectra in each wavelength bin.

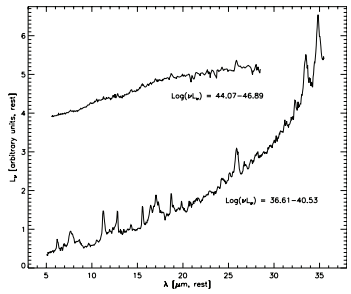

Figure 2. The spectra were sorted according to their 5.6 micron luminosity, and a composite was constructed from all of the objects in each quartile. Above are the first and last quartiles (each containing 50 objects) with the 5.6 micron luminosity range reported.

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