Near-IR Selected Quasars in the NDWFS Bootes Field

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Scientific Goals

- We report preliminary results from a survey to construct a complete, near-IR selected sample of quasars from the NOAO Deep Wide-Field Survey.

- The scientific goals are to
  - compare the apparent volume densities of color outlier samples selected with optical and K-band limits;
  - detect a complete sample of quasars in the "redshift desert" $2.5 < z < 3.2$;
  - determine the population fraction of moderately reddened quasars;
  - ultimately measure the K-band luminosity function to $z=4$.

- The selection technique is to identify color outliers among stellar objects, guided by model expectations.
Croom’s plot illustrates synthesized colors of the SDSS composite quasar spectrum as a function of redshift with different amounts of extinction in the quasar rest frame.

The LMC extinction law was used. Loci from blue to red in (I-K) are $E(B-V) = 0$, $E(B-V) = 0.1$ mag, and $E(B-V) = 0.2$ mag.
The criterion \((I-K) > 1 + (R-I)\) distinguishes reddened quasars from the stellar locus for the first experiment in selection.

A generous stellarity cut includes some compact galaxies, which are interesting in their own right.

One area of the Bootes Field of \(~0.85\) sq. deg. was investigated with 3 configurations of the WIYN / Hydra multi-fiber spectrograph.

Each configuration targeted \(~70\) different objects, many very faint.

Exposure time was 220 minutes/configuration. Three were taken in 1” or better seeing in clear or thin cirrus conditions.

Classifiable spectra were obtained for (nearly) all objects with \(R \leq 20.4\) mag.

Given our spectroscopic completeness, the color selection criterion, and the sample limit of \(K<18.5\), the typical \((R-I)\sim0.4\). That value is expected for unreddened objects with the template SED.
- 28 broad-line quasars were identified, of which 26 were within the reliable ID limit.
- The 2 reddest and faintest objects were consistent with $E(B-V) \geq 0.04$.
- The redshift distribution is non-uniform, indicative of large-scale structure, with a substantial peak at $z \sim 1.1$. 

![Graph showing the redshift distribution of quasars. The x-axis represents redshift, ranging from 0.5 to 3.5, and the y-axis represents the number of quasars, ranging from 0 to 6.]
Inclusion of the very deep Bw data creates a baseline of over a factor of 5 in wavelength. It should enable selection of “blue excess” objects and a more complete census of lower z, mildly reddened objects. Note the presence of non-stellar energy distribution objects selected by including Bw that fall on the stellar locus in RIK. For inclusion of higher z cases, B-dropout objects are included by applying an RIK criterion, but with the cut shifted redward in (I-K) by ~0.2 mag to reduce stellar contamination.
Conclusions

- A sample of color outliers with stellar PSF in BwRIK with $K < 18.5$ mag contains some 200 objects / sq.deg.
- An RIK-selected prototype sample of color outliers was observed spectroscopically with WIYN Hydra to $> 1$ mag deeper than the SDSS NGP sample.
- 2 / 28 objects classifiable as broad-line AGN were consistent with intrinsic reddening $E(B-V) \geq 0.4$ mag.
- The reddest, faintest candidates have not yet been confirmed, creating interesting discovery space for greater reddening and higher $z$. 