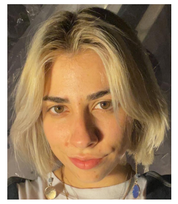
A Dual Red QSO at Cosmic Noon



Rachel Langgin, Department of Astrophysics, Haverford College, Bryn Mawr College

Middlebury College

Advisor: Eilat Glikman, Department of Physics, Middlebury College, Middlebury, VT 05753, USA

HAVERFORD COLLEGE

MOTIVATION

Quasi-stellar objects are strong radio sources that are starlike. We report the discovery of a dual QSO at z=1.87, a redshift that is in the era known as “cosmic noon" where most of the black hole and stellar mass growth occurred. Based on Hubble Space Telescope WFC3/IR images showing two closely separated point sources (at a projected separation of 0.26 arcsec, or ~2 kpc), the source in question is a dust-reddened quasar which was targeted for imaging **to test the hypothesis that red quasars are hosted by merging galaxies.**

The very close separation between the sources means that there will be some blending of their spatial profiles, requiring a careful treatment of the spectral extraction in order to cleanly separate the two spectra and verify their distinct nature.

METHODS

- ★ The STIStools default extraction boxcar size is 7 pixels; we set our **extraction box size** to 3 pixels.
- ★ We constrain the region that the STIStools **x1d** tool searches for a peak in the extraction profile by setting MAXSRCH to 1.5 for each source and A2CENTER to 506 and 511 pixels, respectively.
- ★ We fit a Gaussian profile to the Mg II line in both spectra to measure individual source characteristics.

RESULTS

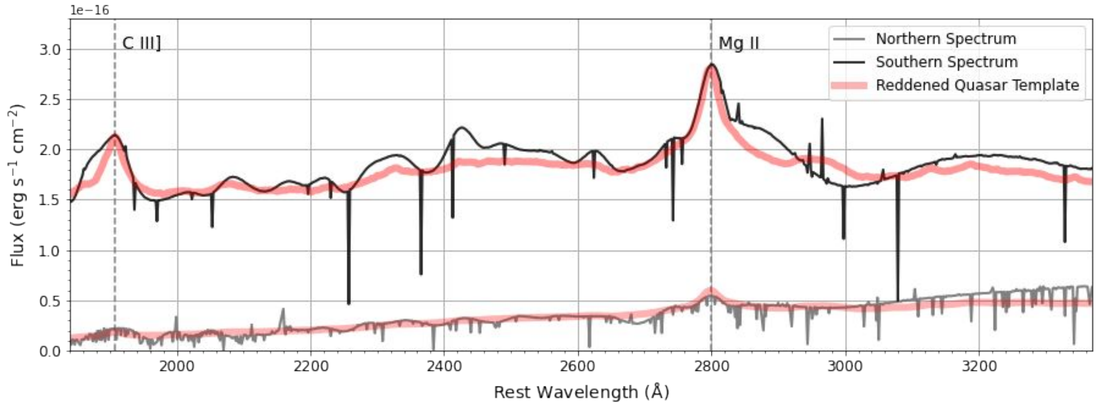


Figure 1. Individual spectra of the two quasar components plotted at rest wavelengths. The pink curves represent the best-fit reddened quasar template. The northern source (gray line) is reddened by E(B-V) = 0.432 while the southern source (black line) is reddened by E(B-V) = 0.184. Mg II and III lines are labeled.

Table 1. Individual source characteristics from the optical

Source:	***E (B - V)*** **(mag)**	v_{FWHM} **(km s^{-1})**	**log M_{BH} (10^7 $M_\odot$)**	**log L_{bol} (erg s^{-1})**	***L/L$_{edd}$***
North	0.432	3140 ± 800	7.2 - 7.7	44.68	0.08 - 0.22
South	0.184	3800 ± 230	7.39 - 7.69	44.48	0.05 - 0.1

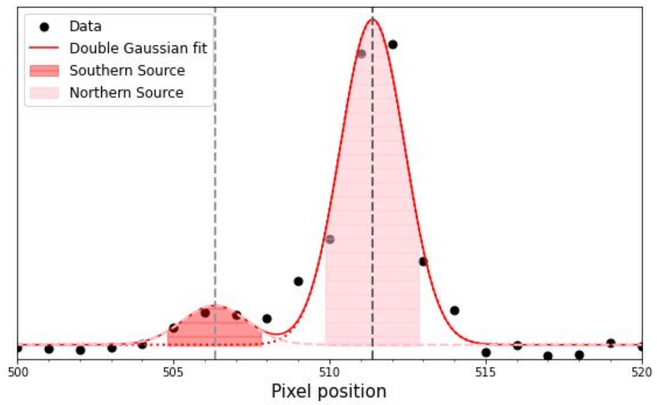


Figure 2. Spatial profile of the source spectrum collapsed along the x-direction. Black points are the summed counts at each spatial pixel position, and the red line is a double Gaussian fit to the data. The shaded areas represent our 3 arcsec extraction regions, chosen to minimize blending. Two distinct peaks are shown with the southern spectrum overlapping the northern spectrum by ~0.6%.

DISCUSSION

- ★ We fit a reddened quasar template to both spectral components to measure the extinction values.
- ★ We correct the observed F160W photometry by these extinction values and apply a bolometric correction of 9.2 (Richards et al. 2016).
- ★ We follow the single-epoch virial black hole mass estimator M_{BH} following the formalism of Shen & Lui (2012) and measure each Eddington Ratio.
- ★ Identifying large samples of dual Active Galactic Nuclei will not only constrain models of galaxy mergers and evolution, but also in the next generation gravitational wave experiment, LISA, will inform the kinds of sources whose GW signal will be detected from the coalescence of SMBHs.

CONCLUSION

We obtained a spatially resolved STIS spectrum of the system, verifying the presence of two distinct AGN components. Given that only ~30 red QSOs have been observed with HST, finding a dual AGN in such a small sample is unexpected.

This result makes W2M1220+1126 the highest-redshift dual quasar discovered to date and the only known dual AGN at the epoch of peak AGN and merger activity in the universe.