

FeLoBAL quasars: evolution, orientation or just oddBALs?

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Abstract. FeLoBAL quasars may be an early evolutionary stage of merger-triggered quasar activity. We test this hypothesis using *HST* imaging of four FeLoBAL quasars. The host galaxy colors are consistent with early-type quiescent galaxies or heavily-obscured starbursts.

Keywords. galaxies: active, quasars: general, quasars: absorption lines

1. Introduction

Broad absorption line (BAL) quasars display strong, high-velocity absorption lines in their UV/optical spectra. Iron low-ionization broad absorption line quasars (FeLoBALs) are a rare subtype that also show absorption due to excited Fe II and Fe III transitions.

The origin of the strong absorption in FeLoBAL objects is unknown. In the context of an orientation-based unification scenario (e.g., Urry and Padovani 1995), BAL quasars are objects for which our line of sight intersects a high-velocity outflow – perhaps a wind launched from the disk (e.g., Elvis 2012). An alternative scenario suggested by Voit *et al.*(1993) is that FeLoBALs represent young (perhaps merger-triggered) quasars observed in the process of breaking through a cocoon of enshrouding dust and gas.

2. HST imaging observations

To test this issue, we observed four of the most heavily absorbed ‘overlapping-trough’ FeLoBAL quasars (Hall *et al.*2002) at $z \approx 1.5$ in rest-frame ultraviolet and optical bands using the *Hubble Space Telescope*. We provide basic information on the *HST* observations in Table 1. We selected UV photometric filters that sample the BAL absorbing troughs, so as to minimize the contribution of the active nucleus to the total light, aiding host galaxy detection. Our aim was to determine the nature of the FeLoBAL host galaxies: are they quiescent ellipticals, as seen for bright quasars in the local Universe, or galaxies showing signs of recent merger activity, as the Voit *et al.*(1993) scenario suggests?

3. Modeling nuclear and host galaxy contributions

We use GALFIT (Peng 2010) to model the nuclear and extended emission in each bandpass. We determine the uncertainties on the measured nuclear and host galaxy magnitudes using a sample of simulated quasar observations generated using FERENGI (Barden *et al.*2008). In the rest-frame UV we obtain upper limits on the host magnitudes. In the rest-frame optical we detect a compact, bright host galaxy for the FeLoBAL J1154+0300. We marginally detect faint host galaxies for two other quasars, and obtain an upper limit for the last object. Our data and results will be presented in a forthcoming paper (Lawther *et al.*2015, in prep.).

Table 1. *HST* imaging data

Object name	z	ACS/WFC filter	ACS (UV) magnitude	NICMOS filter	NICMOS (Opt) magnitude	Orbits (ACS,NIC)	Exp. time [s] (ACS,NIC)
J0300+0048	0.89	F435W	20.0	F110W	16.4	1,1	2185,2560
J1154+0300	1.46	F550M	21.1	F110W	17.3	2,2	5141,5367
J0819+4209	1.93	F625W	22.7	F160W	19.2	3,3	8150,8695
J1730+5850	2.04	F625W	21.9	F160W	18.0	4,4	6517,8191

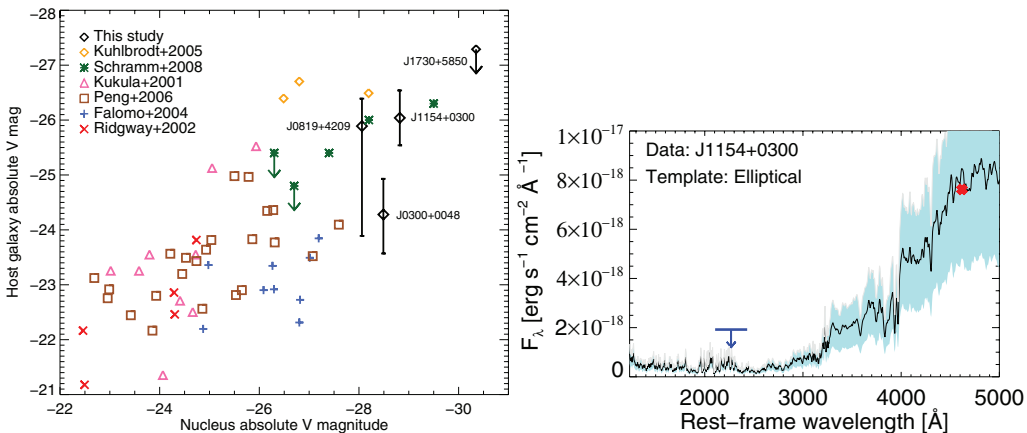


Figure 1. *Left:* Comparison of our sample with literature studies in the V band nuclear luminosity versus host galaxy luminosity plane. Our objects are shown as black diamonds; the uncertainties on our host galaxy magnitudes are based on simulations. *Right:* The flux density of the host galaxy of FeLoBAL J1154+0300 in the rest-frame optical (red) and an upper limit on the host galaxy flux in the UV (blue arrow). Also shown is a template spectrum of an elliptical galaxy, scaled to our optical flux density. The blue shaded area shows the uncertainty on the template scaling due to our measurement uncertainties, as determined using simulated observations.

4. Results

The V-band luminosities of the host galaxies of our FeLoBAL quasars are consistent with those of ‘normal’, non-BAL quasars. Our constraints on the UV-optical color are consistent with early-type host galaxies (Figure 1, right panel). However, we are unable to exclude the possibility of a strongly dust-reddened starburst galaxy. We are in the process of obtaining additional data to further investigate this issue.

References

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