The Role of LoBALs in Quasar Evolution

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Introduction
Quasar/ galaxy co-evolution

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Gültekin+09

Aird+15

M (M⊙)

σ (km/s)

Redshift

Madau & Dickenson (2014)

Log ψ (M⊙ yr⁻¹ Mpc⁻¹)

Space density (Mpc⁻³)

45 < log Lx < 46

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The Role of LoBALs in Quasar Evolution
Introduction
What are BALs and why should we care?

Broad Absorption Line quasars (BALs) are important yet poorly-understood class of quasars.

Identified by their blue-shifted absorption lines and make up ~15 – 40 % of total quasars.

Evidence for energetic mas outflows

Ideal laboratories in which to study quasar feedback
Introduction

What are BALs and why should we care?

BALs are classified into two main types:

- **HiBALs**: 85%
  - Contain only high-ionization lines in their spectra (e.g. $C_{IV}$, $Si_{IV}$)

- **LoBALs**: 15%
  - Contain additional low-ionization lines in their spectra (e.g. $Mg_{II}$, $Al_{III}$)

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*The Role of LoBALs in Quasar Evolution*
Two main explanations exist for the BAL phenomenon:

BAL winds exist in most (or all) quasars, but can only be observed along specific sightlines due to the high covering factor of the broad absorption line region (BALR).

BALs mark a distinct phase in the lifetime of a quasar and exist in a short-lived transition between a merger-induced starburst and a UV-luminous (non-BAL) quasar.
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We aim to test the evolutionary picture of LoBALs by looking for enhanced star and overdensities in their local environments.
LoBALs selected from BAL catalogue (Allen+11)

12 LoBALs selected to overlap targeted programs with Herschel SPIRE

2.0 > z > 2.5 – a peak epoch in both star formation and black hole accretion

Observed at 250μm, 350μm and 500μm (tracing peak of cool dust emission)
Results

Do we detect our sample with Herschel?

Three of the 12 LoBALs are detected at >5σ in all SPIRE bands (25%)
Results

LoBALs vs. HiBALs and non-BALs

LoBALs appear to have higher FIR detection rates than HiBALs
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Even for the stacked non-detections we cannot rule out active star formation.
Results

The local environments of LoBALs

250μm

350μm

500μm

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The Role of LoBALs in Quasar Evolution
Results

The local environments of LoBALs

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The local environments of LoBALs

The environment of our LoBAL sample appears entirely consistent with that of ‘typical’ galaxies

Results

The Role of LoBALs in Quasar Evolution
Conclusions
Take home message

LoBALs at $2.0 < z < 2.5$ show evidence for prolific star formation ($770$-$1290 \, M_\odot/yr$)

There is evidence to suggest and enhancement in the FIR detection rates of LoBALs compared to both HiBALs (by a factor $\sim 8.5$) and non-BALs (by a factor $\sim 1.6$)

The environment of our LoBAL sample appears entirely consistent with that of ‘typical’ galaxies

Overall, we find tentative evidence that LoBALs exist in a special evolutionary phase, but cannot rule out an orientation scenario.