The jet-disc connection in blazars & blazars at high redshift

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Jets and discs in blazars

G. Ghisellini, L. Maraschi, M. Colpi
Blazar SED: jet dominance
Jet and disc tracers

**disc emission**

\[(\dot{M}, M_{\text{BH}})\]

\[L_{\text{BLR}}\]

**jet power**

\[(P_j)\]

\[L_\gamma\]

- SDSS DR7 Quasar Catalog (Schneider et al. 2010) analysed by Shen et al. (2011)
- Plotkin et al. (2011)
- SDSS DR6 (Adelman-McCarthy et al. 2008)
60 FSRQs optically selected from Ghisellini et al. 2011 and Shen et al. 2011

103 BL Lacs:
- 18 with both \( L_{\text{det}} \),
- 23 UL on \( L_{\text{BLR}} \),
- 62 UL on both \( L \)

from Ghisellini et al. 2011, Plotkin et al. 2011 and Adelmann-McCarthy et al. 2008

Sbarrato et al. (2012a)
+ 124 Fermi selected FSRQs spectroscopically analysed by Shaw et al. 2012
Is this correlation expected?

Good correlation:
- Inverse Compton on BLR photons?
- Deeper connection? accretion?

\[ L_d = \eta \dot{M} c^2 \]

Mahadevan (1997)
Is this correlation expected?

Good correlation: 

$$L = \eta M c^2$$

inefficient regime 

$$\dot{m}c, \dot{M}$$

$$\alpha \dot{m}^2$$

$$\alpha \dot{m}^{3.5}$$

$$\nu_c$$

$$\nu_{\text{min}}$$

$$\nu_F$$

$$\nu_P$$

$$\nu_C$$

$$\nu_S$$

$$\nu_B$$

$$\alpha = 0.3$$

$$\beta = 0.5$$

$$m = 5 \times 10^9$$

$$\dot{M}$$

Mahadevan (1997)
Is this correlation expected?

Good correlation: Inverse Compton on BLR photons? deeper connection? accretion?

Ghisellini et al. 2010
Is this correlation expected?

Good correlation: Inverse Compton on BLR photons? deeper connection? accretion?

we expect a break!
Is this correlation expected?

No Break!

$P_r = \text{better proxy for } P_j$
Jets and discs at high redshift

G. Ghisellini, M. Nardini, G. Tagliaferri, L. Foschini, G. Ghirlanda, F. Tavecchio, J. Greiner, A. Rau, N. Gehrels
Blazars at high redshift

- intrinsic high luminosity & beaming of jet likely visible at very high redshift
- each blazar counts for $2\Gamma^2 \sim 400$ analogous AGN not aligned
- most powerful quasars host most massive BH

search of high-z blazars is competitive with search of high-z radio-quiet AGN to study most massive early BH
The discovery of a blazar at $z=5.3$

$M_{BH}$ estimate: see talk by Giorgio Calderone!

Sbarrato et al. (2012b)
Conclusions

✓ $L_{\text{BLR}} \propto L_\gamma$ (normalized to $L_{\text{Edd}}$)

✓ **blazars’ divide**: $L_{\text{BLR}} = 5 \times 10^{-4} L_{\text{Edd}}$ (*new classification!*)

✓ different accretion regimes responsible for the **blazars’ divide**?

✓ search of **high-z blazars** → search of **very massive early BH**

✓ we found a **blazar at $z=5.3$** with a **systematic approach**