What can we learn about AGN from $\alpha_{OX}$ measurements in GBHs?

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with

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Outline:

X-ray and Radio in Galactic black holes
Definition of $\alpha_{\text{OX}}$ in GBHs
Comparison of $\alpha_{\text{OX}}$ in GBHs and AGN
Results
Conclusions
X-ray and Radio coupling in Galactic black holes

Fender, Belloni, Gallo (2004)
Parametrization of quasar SED

\[ L_\nu \propto \nu^\alpha \]

Elvis et al. (1994)
Parametrization of quasar SED

Elvis et al. (1994)

$L_\nu \propto \nu^\alpha$
Distribution of $\alpha_{OX}$ in AGN

$$\alpha_{OX} \approx 0.3838 \log\left(\frac{F_{2500A}}{F_{2 \text{ keV}}}ight)$$

RLQs, Green et al. (1994)
$\alpha_{ox} = 1.32$

RQQs, Kelly et al. (2007)
$\alpha_{ox} = 1.50$
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- RLQs, Green et al. (1994)
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- RLQs, Gambill et al. (2003)
  $\alpha_{OX} = 1.23$

- LINERs, Maoz (2007)
  $\alpha_{OX} = 1.10$

- RQQs, Kelly et al. (2007)
  $\alpha_{OX} = 1.50$
Definition of $\alpha_{\text{GBH}}$ in Galactic Black Holes
Definition of $\alpha_{\text{GBH}}$ in Galactic Black Holes

Outburst of GRO J1655-40, about 270 days, RXTE data
Definition of $\alpha_{\text{GBH}}$ in Galactic Black Holes

GRO J1655-40

Radio Galaxies in the Chandra Era, 2008

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Definition of $\alpha_{\text{GBH}}$ in Galactic Black Holes

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Definition of $\alpha_{\text{GBH}}$ in Galactic Black Holes

\[
\alpha_{\text{OX}} \approx 0.3838 \log\left(\frac{F_{2500\text{A}}}{F_{2\text{ keV}}}\right)
\]

\[
\alpha_{\text{GBH}} \approx 1.2137 \log\left(\frac{F_{3\text{ keV}}}{F_{20\text{ keV}}}\right)
\]
\( \alpha'_{\text{GBH}} \) in Galactic Black Holes

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GRO J1655-40       XTE J1859+226
XTE J1550-564      GX 339-4
XTE J1650-500      H1743-322

soft state
(very high, typical soft, ultra-soft)

intermediate state

hard state
$\alpha'_{\text{GBH}}$ in Galactic Black Holes

Fender, Belloni, Gallo (2004)

MS et al. (2008)
\( \alpha'_{\text{GBH}} \) in Galactic Black Holes

Fender, Belloni, Gallo (2004)

MS et al. (2008)
Radio Galaxies in the Chandra Era, 2008

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$\alpha'_{\text{GBH}}$ in Galactic Black Holes

Fender, Belloni, Gallo (2004)

Jet line?

MS et al. (2008)
Comparison of $\alpha_{OX}$ in AGN and $\alpha'_{GBH}$ in GBHs
Comparison of $\alpha_{\text{OX}}$ in AGN and $\alpha_{\text{GBH}}'$ in GBHs

Transition between the intermediate/very high and typical soft spectral state corresponds to the ‘jet line’ with $\alpha_{\text{GBH}}' = 1.4 - 1.5$

RLQs, Green et al. (1994) $\alpha_{\text{OX}} = 1.32$

RQQs, Kelly et al. (2007) $\alpha_{\text{OX}} = 1.50$

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Method 1:
Fits to the 3–200 keV continuum

Method 2 (AGN-like):
Fits to the 20–40 keV hard X-ray band

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Average properties of RLQs:

Elvis et al. 1994

Kelly et al. 2007

SGS 2008
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- Elvis et al. 1994
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Radio Galaxies in the Chandra Era, 2008

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Comparison of $\alpha_{\text{OX}}$ in AGN and $\alpha'_{\text{GBH}}$ in GBHs

Average properties of RLQs:

Elvis et al. 1994
Gambill et al. 2003
Maoz 2007 (LINERs)
Kelly et al. 2007

SGS 2008
What about $\alpha_{RO}$ and $\alpha_{RX}$ in AGN and GBHs?
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Corbel et al. 2001

Radio Galaxies in the Chandra Era, 2008

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What about $\alpha_{RO}$ and $\alpha_{RX}$ in AGN and GBHs?

<table>
<thead>
<tr>
<th>Source</th>
<th>$\alpha_{RX}$</th>
<th>$\alpha_{RO}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>RLQs</td>
<td>-0.71</td>
<td>-0.44</td>
</tr>
<tr>
<td>XTE J1550-564 o1</td>
<td>-0.52</td>
<td>-0.10</td>
</tr>
<tr>
<td>XTE J1550-564 o2</td>
<td>&gt; -0.32</td>
<td>&gt; 0.23</td>
</tr>
<tr>
<td>XTE J1550-564 o3</td>
<td>-0.50</td>
<td>-0.29</td>
</tr>
<tr>
<td>RQQs</td>
<td>-0.28</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Corbel et al. 2001
Conclusions

Radio-loudness and X-ray loudness can be scaled between AGN and Galactic Black Hole binaries.

In particular $\alpha'_{\text{GBH}}$ provides an adequate analogy for $\alpha_{\text{OX}}$.

Both RQQs and RLQs are in a spectral state similar to a very high/intermediate state of GBHs.

Some RLQs may correspond to a hard state GBHs.

Are we missing AGN with $\alpha_{\text{OX}}$ clustered around 1 and 2?