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IS THE BALDWIN EFFECT DUE TO QUASAR EVOLUTION?

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The Baldwin effect is a weak albeit significant anti-correlation between the equivalent width of high-ionization lines (typically C IVλ1549) and luminosity. However, the rest-frame equivalent width W(C IVλ1549) depends more strongly on Eddington ratio than on luminosity. We show in this preliminary contribution that the dependence on Eddington ratio may entirely account for the Baldwin effect (i.e., for the weak luminosity trend) in two idealized samples: a first one that is complete and volume-limited, and a second one that is flux-limited.

C IVλ1549 measures for 141 low-z quasars and bright Seyfert 1s on HST/FOS and STIS spectra yield $\log W(\mathrm{C\,IV}\lambda1549) \approx 1.60 - 0.353 \cdot \log L/L_{\mathrm{Edd}}$, where the black hole mass ($\propto L_{\mathrm{Edd}}$, the Eddington luminosity) has been estimated from Hβ, assuming virial motions (see Bachev et al. 2004; Sulentic et al. 2007, for more details).

We consider the occupation probability density in the plane Eddington ratio vs. specific luminosity at 1550 Å (L_ν) to reproduce the Baldwin effect (BE). This plane can be transformed into the observed plane W(C IVλ1549) vs. L_ν via the linear transformation provided above, under several assumptions. (1) The Eddington ratio distribution is assumed as found by Marziani et al. (2003) for a sample of about 300 low-z quasars. (2) The L/L_{Edd} and the luminosity distribution are regarded as independent. (3) The luminosity distribution is provided by the AGN luminosity function. We further assume that (4) all AGN radiate in the range $0.005 \leq L/L_{\mathrm{Edd}} \leq 1.00$, and that (5) there is black hole limiting mass $\approx 5 \times 10^9 M_\odot$ (see Sulentic et al. 2006, for justification).

Under these assumptions, it is possible to recover the BE slope. Figure 1 shows two lsq best fits. The first one is done on an ideal, volume-limited sample at $z \approx 2$, with complete detection down to the faintest quasars within the parallelogram of Figure 1. The parallelogram vertices are set at the extreme black hole masses radiating at the lowest Eddington ratio (top of the diagram), and at $L/L_{\mathrm{Edd}} = 1$ (bottom).

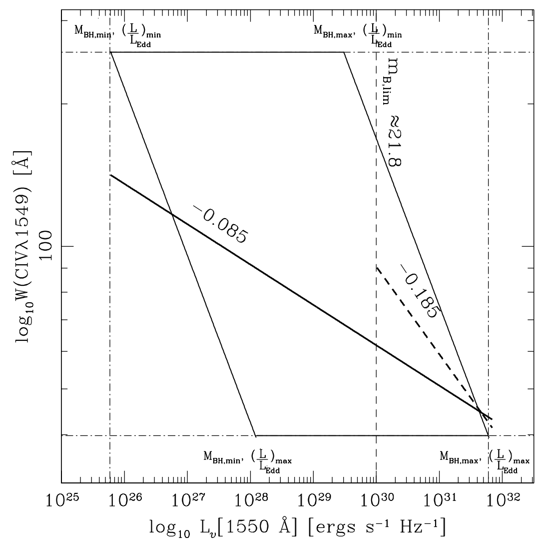

Fig. 1. Plane W(C IVλ1549) vs. specific luminosity L_ν at 1550 Å. The thick solid line represents the fit for an ideal, complete sample; the dashed line shows the fit for a flux limited sample of $m_{\mathrm{B}} \lesssim 21.8$.

The second sample corresponds to a survey of very bright quasars, with limiting B magnitude $m_{\mathrm{B}} \approx 21.8$ (i.e., there is low-end luminosity cutoff). The correlation is steeper in this case, with a slope of −0.19. The slopes are very close to the ones obtained from large surveys like the LBQS and the 6dF. Eddington ratio evolution can only strengthen the luminosity dependence, since it would increasingly populate the low equivalent width, high luminosity part of the diagram. Therefore, it seems plausible that the BE may entirely disappear once the source-intrinsic L/L_{Edd} dependence is properly taken into account.

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