Co-Evolution of Central Black Holes and Galaxies
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Accurate AGN black hole masses and the scatter in the $M_\bullet$ – L_{bulge} relationship

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Abstract. A new empirical formulae is given for estimating the masses of black holes in AGNs from the Hβ velocity dispersion and the continuum luminosity at 5100 Å. It is calibrated to reverberation-mapping and stellar-dynamical estimates of black hole masses. The resulting mass estimates are as accurate as reverberation-mapping and stellar-dynamical estimates. The new mass estimates show that there is very little scatter in the $M_\bullet$ – L_{bulge} relationship for high-luminosity galaxies, and that the scatter increases substantially in lower-mass galaxies.

Keywords. black hole physics – galaxies: active – galaxies: bulges – galaxies: fundamental parameters – galaxies: nuclei – quasars: emission lines

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Accurate AGN black hole masses, $M_\bullet$, can be estimated from the velocity dispersion of the broad Hβ line, $\sigma_{H\beta}$, and the luminosity at 5100 Å, L_{5100}, by the equation:

$$\log M_\bullet = 1.65 \log(\sigma_{H\beta}/1000) + 0.615(\log L_{5100} - 44) + 7.63, \qquad (0.1)$$

These masses agree with reverberation-mapping masses to ±0.22 dex. This suggests that the masses are determined by the new empirical relationship to ±0.16 dex. Fig. 1 shows the dispersion about the M_{bh}–L_{bulge} relationship as a function of L_{bulge} for 34 AGNs (in equal bins). Note the very small scatter for the most luminous galaxies. Gaskell (2009) shows that the dispersion in the relationship between $M_\bullet$ and stellar velocity dispersion also increases with decreasing bulge luminosity.

References

Gaskell, C. M. 2009, *Ap.J.* submitted [arXiv:0908.0328]

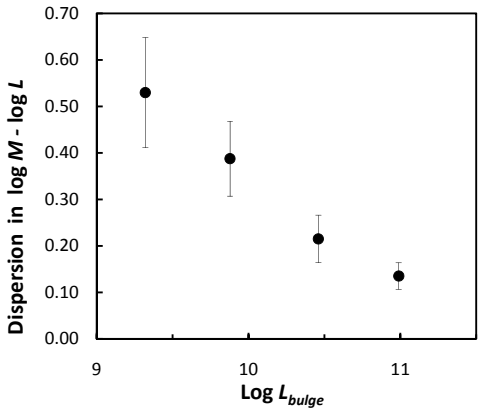

Figure 1. The scatter in the AGN $M_\bullet$ – L_{bulge} relationship as a function of bulge luminosity