Accurate AGN Black Hole Masses and the Scatter in the $M_{ m BH}-L_{ m bulge}$ Relationship

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Abstract. A new empirical formulae is given for estimating the masses of black holes in AGNs from the ${\rm H}\beta$ 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 $M_{\rm BH}-L_{\rm bulge}$ 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

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

$$\log M_{\rm BH} = 1.65 \log(\sigma_{\rm H\beta}/1000) + 0.615(\log L_{5100} - 44) + 7.63. \tag{0.1}$$

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. Figure 1 shows the dispersion about the $M_{\rm BH}-L_{\rm bulge}$ relationship as a function of $L_{\rm bulge}$ 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 $M_{\rm BH}$ and stellar velocity dispersion also increases with decreasing bulge luminosity.

Reference

Gaskell, C. M. 2009, submitted to ApJ [arXiv:0908.0328]

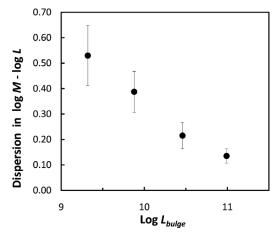


Figure 1. The scatter in the AGN $M_{\rm BH}$ - $L_{\rm bulge}$ relationship as a function of bulge luminosity.