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A correlation between supermassive black hole mass and galaxy light concentration

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Abstract. The varying global distribution of stars, or specifically, their concentration C_{r_e}, within elliptical galaxies and spiral galaxy bulges is intimately related to the mass of their central supermassive black holes ($M_{\rm bh}$), such that $\log(M_{\rm bh}/M_\odot) = 6.81(\pm 0.95)C_{r_e} + 5.03 \pm 0.41$. This correlation has a Spearman correlation coefficient $r_s = 0.91$, and a scatter of only 0.31 dex in $\log M_{\rm bh}$. Removing one well understood outlying data point and using only those galaxies whose supermassive black hole's radius of influence has been resolved (reducing the sample size from 21 to 13) results in a scatter of only 0.19 dex.

1. Summary

More massive galaxies are not simply bigger versions of less massive galaxies, as has been frequently assumed in the past; their entire structure is different – more massive galaxies are more centrally concentrated. The tight correlation between concentration and supermassive black hole mass is at least as good, if not better than, the relation between supermassive black hole mass and stellar velocity dispersion (Ferrarese & Merritt 2000; Gebhardt et al. 2000). Moreover, it provides additional insight into the formation of both galaxies and their central black holes, and enables one to predict black hole masses directly from the images of galaxies, without the expensive addition of velocity dispersion determinations. This work is discussed further in Graham, Trujillo, & Caon (2001) and Graham et al. (2001).

References

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