Co-Evolution of Central Black Holes and Galaxies
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An Estimate of the Local Active Black Hole Mass Function and the Distribution Function of Eddington Ratios

Andreas Schulze and Lutz Wisotzki

Astrophysikalisches Institut Potsdam, An der Sternwarte 16, 14482 Potsdam, Germany
Email: aschulze@aip.de

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The observed relations between the black hole mass and the properties of the spheroidal galaxy component imply a close connection between the growth of supermassive black holes and the evolution of their host galaxies. An effective approach to study black hole growth is to measure black hole masses and Eddington ratios of well-defined type 1 AGN samples and determine the underlying distribution functions.

One of the best datasets to study low-redshift type 1 AGN is provided by the Hamburg/ESO Survey (HES). From this survey, we draw a well-defined sample of 329 broad-line AGN with $z < 0.3$. We estimate black hole masses and Eddington ratios for our AGN sample by using the Hβ line width and the common virial relationship. We see a lack of objects with high mass and high Eddington ratio, explained by the shape of the underlying black hole mass function and Eddington ratio distribution function.

We used this sample to determine the active black hole mass function (BHMF) in the local universe. As definition of an active black hole, we used a lower limit for the Eddington ratio of 0.01. However, the selection criteria of our sample causes AGN with low black hole mass and low Eddington ratio to be systematically missed. We developed a Monte-Carlo approach to correct for this selection effect, matching simulated samples to the observed sample. We thereby put tight constraints on the underlying active BHMF as well as on the Eddington ratio distribution function. The Eddington ratio distribution function is well described by a Schechter function, with evidence for a steady increase even toward lower Eddington ratios, up to an Eddington ratio of 0.01. This is in contrast to the narrow Eddington ratio distribution often assumed, based on the observed distribution, without accounting for the underlying selection effects.

We compared our local active BHMF with the local quiescent BHMF from Marconi *et al.*(2004), determining the active fraction of local black holes. This active fraction is decreasing with increasing black hole mass. Thus, the most massive black holes in the present universe are less active than their lower mass companions. Our results support the notion of anti-hierarchical growth of black holes. They are consistent with a picture where the most massive black holes grew at early cosmic times, whereas at present mainly smaller mass black holes accrete at a significant rate.

References

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