Hubble Space Telescope

Cycle 15 AR Proposal

An Accurate Determination of the Black Hole Mass vs. Bulge Luminosity Relation for Nearby AGNs

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Abstract

Supermassive black holes today play a central role in nearly all aspects of extragalactic astronomy, from AGN physics to galaxy formation and evolution. The empirical foundation on which much of the recent progress lies came from the tight correlations found between black hole mass and the properties of the host galaxy, particularly the luminosity or velocity dispersion of the bulge. Because of the relative ease with which AGN host galaxies can be measured with HST images, the black hole mass-bulge luminosity relation provides an effective, powerful tool to study the coevolution of black holes and their host galaxies, even out to high redshifts. To this end, it is imperative that we thoroughly understand the local (low-redshift) black hole mass-bulge luminosity relation. What is its true intrinsic scatter and zeropoint? Do they depend on the properties of the host galaxy (morphology, color, environment) or the AGN (level of activity, radio-loudness)? To explore these issues, we propose to systematically analyze a sample of 142 low-z (< 0.35) broad-line AGNs (Type 1 Seyferts and quasars) that have usable broad-band images (most have multiple filters) from the HST archives. This sample spans a broad range in black hole mass, AGN luminosity, Eddington ratio, and degree of radio-loudness. The images will be analyzed using a powerful new version of the 2-D image analysis code GALFIT, which can now fit both traditional (bulge, disk, bar) and more complex substructures (spiral arms, tidal features, lopsidedness, asymmetry). This ability to fit images in 2-D to high fidelity will permit the most meaningful and accurate extraction of the bulge component to date, a critical step in calibrating the local black hole mass-bulge luminosity relation. In addition, the multi-component decomposition will yield unprecedented information concerning the detailed morphologies (bulge-to-disk ratios, bars, spiral arms) and local environment of the host galaxies. The multi-color images will also provide rudimentary, though important, constraints on the stellar population of the host galaxies, and hence on the possible connection between AGN activity and star formation.

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