Astrophysical Sciences & Technology
Ph.D. Dissertation Defense

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Aspects of Supermassive Black Hole Growth in Nearby Active Galactic Nuclei

A Search for Recoiling Supermassive Black Holes
Gas Kinematics in the Circum-nuclear Region of Two Seyfert Galaxies

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Abstract

Super-massive black holes (SBHs) have long been identified as the engines of active galactic nuclei (AGNs) and are now considered to play a key role in galaxy evolution. In this dissertation I present results of two observational studies conducted on nearby AGNs with the aim of furthering our understanding of SBH growth and their interplay with the host galaxies.

The first study is an observational search for SBHs spatially offset from the center of their host galaxies. Such offsets can be considered signatures of gravitational recoil following the coalescence of an SBH binary system (formed in the aftermath of a galaxy merger) due to emission of gravitational waves. The study is based on a photometric analysis of fourteen nearby elliptical galaxies observed with the Hubble Space Telescope. I find that parsec-scale offsets are common. However, while these are individually consistent with residual gravitational recoil oscillations, there is a high probability that larger offsets than those actually observed should have been found in the sample as a whole. There are a few possible explanations for this result: the galaxy merger rate may be lower than current estimates; SBH-binaries may reach the merger stage with a configuration which minimizes recoil velocities; or the SBH oscillations are more quickly damped than predicted.

In the second study I use integral field spectroscopy obtained with the Gemini South telescope to investigate the kinematics of the circum-nuclear ionized gas in two active galaxies: NGC 1386, a Seyfert 2, and NGC 1365, a Seyfert 1. The goal of the study is to investigate outflows in low-luminosity AGNs, and the mechanisms channeling gas (the SBH fuel) from the inner kiloparsec down to few tens of parsecs from the SBH. I find that the dominant kinematic components can be explained as a combination of rotation in the large-scale galactic disk and compact outflows along the axis of the AGN "radiation cone". However, in the case of NGC1386, there is also compelling evidence for an *equatorial* outflow, which provides a new clue to the physical processes operating in AGN.