University of Crete
Department of Physics

FORTH
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Joint Physics & IA/FORTH Colloquium

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Galaxies and Their Black Holes: Tracing and Harnessing a Cosmic Partnership

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ABSTRACT

Supermassive black holes (SMBHs) and galaxies grow together over cosmic time, but the physical drivers of this joint evolution remain an open question. In this talk, I will summarize a statistical, population-based approach that links long-term SMBH growth to measurable galaxy properties. The key observable we use is the sample-averaged SMBH accretion rate (BHAR), inferred from sensitive X-ray surveys and interpreted as the long-term growth of SMBH populations. We compare BHAR against well-studied galactic quantities - including stellar mass, star-formation rate, and structural compactness - using large, well-controlled samples (millions of galaxies and thousands of active galactic nuclei) and partial-correlation methods that isolate the dominant connections.

Some broad conclusions are the following: (1) across z = 0-4 the generally strongest predictor of SMBH growth is galaxy stellar mass; (2) in systems dominated by a bulge component, the SMBH accretion rate tracks star formation closely, indicating synchronized SMBH and bulge growth; and (3) among star-forming galaxies, more compact systems show enhanced BHAR, plausibly because higher central gas densities feed accretion more efficiently. I will also describe how these empirical correlations can be folded into cosmological simulations to map SMBH mass assembly - via both accretion and mergers - and to explore consequences such as the evolving SMBH mass function, SMBH-galaxy scaling relations, and the drivers of the strong decline in SMBH accretion at z < 2.