

TSI SPECIAL SEMINARS 2026

Multimessenger Insights into SMBH–galaxy Growth and Coevolution Across Cosmic Time

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Abstract: Supermassive black hole (SMBH) mass is the most important quantity in evaluating its effect on the surrounding host galaxy. Outside the local universe, direct SMBH mass measurements are infeasible, leaving large uncertainties in SMBH growth rates and coevolution with their host. The recent detection of the nanohertz gravitational wave background (GWB) has opened up a new route for probing the number density of SMBHs out to moderately high redshifts ($z \sim 3$). The high amplitude of the GWB requires a greater SMBH number density than predicted from electromagnetic constraints. Most models assume a constant ratio between SMBH mass and host galaxy bulge mass, but recent studies have suggested that differences in growth rates may cause this ratio to change with redshift. Using a semi-analytic model, I have found that the GWB spectrum is easily reproduced when using a relationship between black hole mass and host galaxy bulge mass ($M_{\text{bh}}\text{--}M_{\text{bulge}}$) that evolves positively with redshift both in normalization and scatter. Recently, I have taken the results of this work and turned these simulated black hole populations into bolometric quasar luminosity functions (QLFs). Compared to a model based on galaxy and local $M_{\text{bh}}\text{--}M_{\text{bulge}}$ observations, the SMBH populations that match the GWB can reproduce the observed QLFs with lower Eddington fractions and without requiring significant super-Eddington accretion. In my talk I will discuss my methods, results, and the implications for SMBH growth and coevolution with their host galaxies.



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