S29a Study of Active Galactic Nuclei using Water Vapor Masers

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Water vapor megamasers at 22 GHz provide a unique opportunity to probe the dynamics of circumnuclear disks in active galactic nuclei (AGNs) at sub-parsec scales. We present a uniform analysis of 23 megamaser-hosting AGNs using high-resolution VLBI data from the literature. These maser systems exhibit spectrally and spatially resolved emission from nearly edge-on disks, enabling precise modeling of their rotation curves. To disentangle the gravitational effects of the central black hole from the surrounding molecular disk, we employ a two-component mass model, an extension of the Keplerian model by adding a disk term with a Mestel surface density profile. By fitting position-velocity diagrams with this model, we derive updated black hole and disk masses for all sources. Our results show that while some AGN disks closely follow Keplerian motion, others exhibit sub-Keplerian rotation, indicating non-negligible disk mass contributions. For these systems, we find significant deviations between our black hole mass estimates and previously reported enclosed masses, demonstrating the importance of accounting for extended mass distributions. We also examine the structural properties of the maser disks, including surface density profiles, scale heights, and Toomre Q stability parameters. This study provides revised black hole masses and insights into disk stability, contributing to a deeper understanding of AGN central engines and the conditions that support maser emission.