

Multifrequency VLBI detection of supermassive black hole binaries at millimeter wavelengths

Direct detection of supermassive black hole binaries (SMBHBs)—via resolved imaging of dual sources and precise orbital tracking—demands extreme astrometric precision ($\sim 1 \mu\text{as/yr}$). Linking SMBHB evolution (from ~ 10 kpc dynamical friction to ~ 0.01 pc gravitational-wave stages) with observational capabilities, we estimate detectability: For AGNs with 5% SMBHB occurrence, a 86 GHz VLBI system achieving $40 \mu\text{as}$ resolution, 10 mJy sensitivity, and $1 \mu\text{as/yr}$ proper motion precision could uncover ~ 20 binaries. Simultaneous multi-frequency observations are critical, boosting sensitivity and astrometric accuracy to meet these stringent requirements.

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