How to fuel an AGN: mapping circumnuclear gas in NGC 6240 with ALMA

Cita

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Abstract

Dynamical black hole mass measurements in some gas-rich galaxy mergers indicate that they are overmassive relative to their host galaxy properties. Overmassive black holes in these systems present a conflict with the standard progression of galaxy merger–quasar evolution; an alternative explanation is that a nuclear concentration of molecular gas driven inward by the merger is affecting these dynamical black hole mass estimates. We test for the presence of such gas near the two black holes in NGC 6240 using long-baseline ALMA Band 6 observations (beam size $0\farcs06 \times 0\farcs03$ or 30 pc × 15 pc). We find (4.2–9.8) $\times 10^7\ M_\odot$ and (1.2–7.7) $\times 10^8\ M_\odot$ of molecular gas within the resolution limit of the original black hole mass measurements for the north and south black holes, respectively. In the south nucleus, this measurement implies that 6%–89% of the original black hole mass measurement actually comes from molecular gas, resolving the tension in the original black hole scaling relations. For the north, only 5%–11% is coming from molecular gas, suggesting the north black hole is actually overmassive. Our analysis provides the first measurement of significant molecular gas masses contaminating dynamical black hole mass measurements. These high central molecular gas densities further present a challenge to theoretical black hole accretion prescriptions, which often assume accretion proceeds rapidly through the central 10 pc.