Measuring the black hole environment of a quasar nucleus

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An optical image of a quasar, the bright core of an active galaxy, seen here at the tip of the arrow. New results using submillimeter wavelength techniques have been able to resolve detailed structures only about a half a light-year in size in a quasar about a billion light-years distant. Credit: WIYN Telescope

(Phys.org)—Quasars are among the most powerful energy sources known—some are as luminous as one hundred thousand Milky Way galaxies. Astronomers know that quasars have massive black holes at their cores and believe that matter falling in to the environment of the

black hole powers the quasar's tremendous luminosity—but the details remain uncertain. No one is quite sure, for example, how quasars form, how they develop into such luminous monsters, or how their massive black holes and environments become so bright.

Despite their reputation for being pitiless devourers of matter and radiation, black holes have environments that are often sources of powerful radiation as material falls into the region. Quasar nuclei, however, are often embedded in obscuring dust (perhaps a remnant of the violent process that formed the black holes), and although the regions emit from short wavelength X-rays to long wavelength radio bands, it is difficult to study them at the shorter wavelengths which are more effectively blocked.

CfA astronomers Jonathan Weintroub, Jim Moran, Rurik Primiani, and Ken Young teamed up with colleagues to make the first detailed measurements of the inner region of a quasar nucleus at submillimeter wavelengths. They used Sub-millimeter Array technology with four submillimeter telescopes working simultaneously around the globe, united into an effective single large array, and they used it to study a quasar about one billion light-years distant.

The quasar itself was known to have strongly variable emission, indicative of periods of infalling material powering the activity, but until now it had not been possible to probe the spatial structures in the region. Using their new techniques, the scientists were able to resolve dimensions of only about half a light-year (!), enough to conclude that there is a jet of material being ejected form the region of the black hole (confirming earlier conclusions), that the jet is oriented about 53 degrees from the nucleus disk, and that it contains a bend in its length whose cause needs further research. The new results are significant not only because they probe this extreme galaxy, but also because they demonstrate the success and power of the new technique of combining

multiple submillimeter telescopes into a single advanced instrument.

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