A SUB-PARSEC ACCRETION DISK IN NGC 4261

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Abstract. We observed the nuclear region of NGC 4261 (3C270) with the VLBA to determine the morphology of the central radio source on parsec scales. Our highest angular resolution image at 8.4 GHz shows a very narrow gap in emission just east of the radio core (on the counterjet side), which we interpret as an absorption feature caused by a small, dense inner accretion disk whose width is less than 0.1 parsec. If the inclination of this inner disk is close to that of the much larger-scale disk imaged by HST, it becomes optically thin to 8.4 GHz radiation at a deprojected radius of about 0.8 pc. September 1997 VLBA observations at higher frequencies should allow us to determine the radial electron density distribution of the inner disk.

1. Introduction

The FR-I radio source 3C 270 associated with NGC 4261 has symmetric kpc-scale jets extending along position angle $88 \pm 1°$ (Birkinshaw & Davis 1985). The optical nucleus of NGC 4261 is surrounded by a large disk of gas and dust with a projected rotation axis which is several degrees away from the radio jet axis (Ferrarese, Ford, & Jaffe 1996). Our initial motivation for observing NGC 4261 with VLBI was to see if the parsec-scale radio structure was aligned with the kpc-scale jets or with the rotation axis of the large disk imaged by HST. These two possibilities could be interpreted

Y. Sofue (ed.), The Central Regions of the Galaxy and Galaxies, 413-414.

as requiring either a change in rotation axis between the HST disk and the (much smaller) accretion disk feeding the presumed central black hole or a bend in the radio jet during its first few parsecs of travel.

2. Observations and Results

We observed NGC 4261 with the VLBA in April 1995 at both 1.6 and 8.4 GHz. The observations revealed highly symmetric radio structures at both 1.6 and 8.4 GHz. At both frequencies the parsec-scale jets are aligned with the kpc-scale jets images by the VLA. This implies that the plane of the innermost accretion disk at the base of the radio jets differs from the plane of the 100-pc-scale HST disk.

Surprisingly, there is little evidence for free-free absorption in the inner few pc, despite the fact that the HST disk appears to be within 20-30° of edge-on. The implied electron density over the inner 10 pc, assuming a temperature of $\sim 10^4$ K, is less than $\sim 10^3$ cm^{-3}.

However, our highest resolution images (8.4 GHz with uniform weighting) show a very narrow gap in emission just east of the brightest peak (Jones & Wehrle 1997). The spectral index distribution between 1.6 and 8.4 GHz indicates that the brightest peak corresponds to the core of the radio source. Based on the relative brightness of the VLA jets and the orientation of the HST disk, the eastern jet is the receding jet (the counterjet). Thus, the gap in emission appears to be located at the base of the counterjet. This is the expected signature of absorption by a thin inner accretion disk seen nearly edge-on. The thickness of the inner disk must be less than 0.1 pc. If the inclination of this inner disk is close to that of the larger-scale HST disk, it becomes optically thin to 8.4 GHz radiation at a deprojected radius of 0.8 pc. The much lower angular resolution at 1.6 GHz prevents this feature from being detectable, but higher frequency VLBA observations in September 1997 should allow us to determine the radial electron density distribution in the disk (*e.g.*, Walker, *et al.* 1997).

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration. The Very Long Baseline Array is a facility of the National Radio Astronomy Observatory, which is operated by Associated Universities, Inc., for the National Science Foundation. AEW gratefully acknowledges support from the NASA Long Term Space Astrophysics program.

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