



Radio Imaging of the NGC 1333 IRAS 4A Region: Envelope, Disks, and Outflows of a Protostellar Binary System

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The NGC 1333 IRAS 4A protobinary was observed in the 1.3 cm and 6.9 mm continuum and the ammonia and SiO lines, with an angular resolution of about 0.4 arcseconds. The continuum maps show the circumstellar structures of the two protostars, A1 and A2. The A1 system is brighter and more massive than the A2 system. The ratio of mass, including dense gas and protostar, is about 6. The properties of the circumstellar disks and outflows suggest that A1 may be younger than A2. The deflected part of the northeastern jet of A2 is bright in the SiO line, and the distance between the brightest peak and deflection point suggests that the enhancement of SiO takes about 100 yr after the collision with a dense core. The ammonia maps show a small structure that seems to be a part of the obstructing core. The outflow properties were studied by comparing interferometric maps of SiO, ammonia, formaldehyde, and HCN lines. Their overall structures agree well, suggesting that these species are excited by the same mechanism. However, the intensity distributions show that SiO is chemically unique. SiO may be directly linked to the primary jet while the other species may be tracing the entrained ambient gas.

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