Mid-infrared interferometry of the massive young stellar object NGC 2264 IRS 1

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The optically invisible infrared-source NGC 2264 IRS 1 is thought to be a massive young stellar object (~10 Msun). Although strong infrared excess clearly shows that the central object is surrounded by large amounts of circumstellar material, no information about the spatial distribution of this circumstellar material has been available until now. We used the ESO Very Large Telescope Interferometer to perform long-baseline interferometric observations of NGC 2264 IRS 1 in the mid-infrared regime. Our observations resolve the circumstellar material around NGC 2264 IRS 1, provide the first direct measurement of the angular size of the mid-infrared emission, and yield direct constraints on the spatial distribution of the dust. We use different approaches (a geometrical model, a temperature-gradient model, and radiative transfer models) to jointly model the observed interferometric visibilities and the spectral energy distribution. The derived visibility values between ~0.02 and ~0.3 show that the mid-infrared emission is clearly resolved. The characteristic size of the MIR-emission region is ~30-60 AU; this value is typical for other YSOs with similar or somewhat lower luminosities. A comparison of the sizes for the two position angles shows a significant elongation of the dust distribution. Simple spherical envelope models are therefore inconsistent with the data. The radiative transfer modeling of our data suggests that we observe a geometrically thin and optically thick circumstellar disk with a mass of about 0.1 Msun. Our modeling indicates that NGC 2264 IRS 1 is surrounded by a flat circumstellar disk that has properties similar to disks typically found around lower-mass young stellar objects. This result supports the assumption that massive young stellar objects form via accretion from circumstellar disks.

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