Multi-directional, non-steady mass-accretion onto high-mass protostars

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We used ALMA to observe the high-mass star forming complex W51 with the longest baselines of 16∼km, which allowed us to achieve the unprecedented angular resolution of 20 milliarcseconds (corresponding to ∼100 AU at the distance of W51 - 5.4 kpc). The observed region contains three high-mass YSOs that appear to be at the earliest stages of their formation, with no signs of ionizing radiation from their central sources. Toward these three high-mass protostars, we identify fast collimated bipolar SiO outflows but find no signs of rotation towards the driving sources. We measure upper limits on the disk radii of <80 AU for one object and <350 AU for the remaining two objects. Interestingly, we identify multiple massive (several Msun), warm (50-150∼K) filamentary streamers pointing onto the central sources, across scales of 200-2000 AU, which we interpret as multi-directional accretion channels. We argue that these accretion structures inhibit the formation of a large, steady disc. Our finding contrasts with the simplified classic paradigm of an ordered (and stable) disc/jet system and provides an experimental confirmation of a multi-directional and unsteady accretion model for massive star formation supported by recent 3D (M)HD simulations.

Outflow Disks