Evidence for Outflow-Infall Interactions Terminating Accretion in Protostellar Disks

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Abstract

We discuss the first evidence for the process of terminating accretion in protostellar disks through the interaction between infall and a very wide opening angle outflow in a YSO IRS1 in B5. IRS1 is a relatively young object with a dynamical age of 10^1 yr for its molecular outflow and pc scale optical jet. The OVRO-MMA interferometer maps obtained with 1" resolution at 1.3 mm in the continuum and in CO isotopes are presented. The $C^{18}O$(2-1) traces the dense infalling gas, while the line wings of ^{12}CO(2-1) trace the molecular outflow. The most remarkable feature revealed in these maps is the geometrical shapes and clear demarkation of the outflow and infall boundaries. The infall is confined to a narrow equatorial region perpendicular to the jet's outflow axis, while the high velocity outflow originates in bipolar cones which can be traced deep down to within 0.4" (150 AU) from the star. Outflow cones are widest at the vertices indicating a significant widening of the outflow with time. We suggest that this widening of outflow marks the final stages of isolating the disk from further accretion. The widening of the outflow cones and the flattening of the infall must be coupled to each other through the processes involved in generating the molecular outflow near the star and provides a natural mechanism for the end of infall, and hence, the end of the accreting phase in YSOs. By tracing the time evolution in the outflow cones, we estimate that the infall will be totally shut down in $\sim 10^4$ yr in IRS1 in B5. Therefore, once outflow begins, typically the entire accretion phase lasts only $\sim$ 20,000 yr.

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