Numerical insights into disk accretion, eccentricity, and kinematics in the Class 0 phase

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The formation and early evolution of protoplanetary disks during a gravitational collapse are governed by a wide variety of physical processes. Observations have begun probing disks in their earliest stages, and have favored the magnetically regulated disk formation scenario. Disks are also expected to exhibit ellipsoidal morphologies in the early phases, an aspect that has been widely overlooked. We aim to describe the birth and evolution of the disk while accounting for the eccentric motions of fluid parcels. Using 3D radiative magnetohydrodynamic simulations with ambipolar diffusion, we self-consistently modeled the collapse of isolated 1 $M_\odot$ and 3 $M_\odot$ cores and the subsequent formation of a central protostar surrounded by a disk. We find that magnetic fields and turbulence drive highly anisotropic accretion onto the disk via dense streamers. This streamer-fed accretion, occurring from the vertical and radial directions, drives vigorous internal turbulence that facilitates efficient angular momentum transport and rapid radial spreading. Crucially, the anisotropic inflow delivers material with an angular momentum deficit that continuously generates and sustains a significant disk eccentricity ($e \sim 0.1$). Our results reveal ubiquitous eccentric kinematics in Class 0 disks, with direct implications for disk evolution, planetesimal formation, and the interpretation of cosmochemical signatures in Solar System meteorites.