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Modelling Line Emission from T Tauri Binaries

Miguel de Val-Borro (1), Gösta Gahm (2), Eric Stempels (3), and Adam Peplinski (2)

(1) Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany (deval@mps.mpg.de), (2) Stockholm University, Sweden, (3) Department of Physics and Astronomy, Uppsala University, Sweden

Young close binaries open central gaps in the surrounding circumbinary accretion disk, but the stellar components may still gain mass from gas crossing through the gap. It is not well understood how this process operates and how the stellar components are affected by such inflows. Our main goal is to investigate how gas accretion takes place and evolves in close T Tauri binary systems. In particular, we model the accretion flows around two close T Tauri binaries, V4046 Sgr and DQ Tau, both showing periodic changes in emission lines, although their orbital characteristics are very different. In order to derive the density and velocity maps of the circumbinary material, we employ 2-D hydrodynamic simulations with a locally isothermal equation of state. From the derived density distribution, and assuming that the gas is optically thin in the higher Balmer lines, we derive expected line profiles for the case of V4046 Sgr. The profiles are compared to spectroscopic observations of the V4046 Sgr system, which are known to vary strongly with phase. Our simulations indicate that significant non-axisymmetric gas flows are generated in close T Tauri binary systems that become quasi stable after a few orbits. Gas flows across the circumbinary gap through the co-rotating Lagrangian points, and local circumstellar disks develop around both components. Non-axisymmetric gas flows are generated inside the inner gap in close binary systems on circular and eccentric orbits. Mass is preferentially channelled towards the primary and its circumstellar disk is more massive than the disk around the secondary. The line profile variability tracing the gas flows in the central cavity shows clear similarities with the corresponding observed line profile variability in V4046 Sgr, when the local circumstellar disks emission was excluded. Closer to the stars magnetospheric accretion may dominate while further out the dynamic accretion process outlined here dominates.