Forming spectroscopic massive proto-binaries by disk fragmentation

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The surroundings of massive protostars constitute an accretion disc which has numerically been shown to be subject to fragmentation and responsible for luminous accretion-driven outbursts. Moreover, it is suspected to produce close binary companions which will later strongly influence the star's future evolution in the Hertzsprung-Russell diagram. We present three-dimensional gravitation-radiation-hydrodynamic numerical simulations of 100 Mo pre-stellar cores. We find that accretion discs of young massive stars violently fragment without preventing the (highly variable) accretion of gaseous clumps onto the protostars. While acquiring the characteristics of a nascent low-mass companion, some disc fragments migrate onto the central massive protostar with dynamical properties showing that its final Keplerian orbit is close enough to constitute a close massive proto-binary system, having a young high-mass and a low-mass component. We conclude on the viability of the disc fragmentation channel for the formation of such short-period binaries, and that both processes --close massive binary formation and accretion bursts-- may happen at the same time. FU-Orionis-type bursts, such as observed in the young high-mass star S255IR-NIRS3, may not only indicate ongoing disc fragmentation, but also be considered as a tracer for the formation of close massive binaries -- progenitors of the subsequent massive spectroscopic binaries -- once the high-mass component of the system will enter the main-sequence phase of its evolution.

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