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Zooming-in on protostellar multiple formation

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Stars form as a consequence of gravitational collapse in Giant Molecular Clouds. Contrary to models of individual stars forming due to the collapse of an isolated core, we account for the molecular cloud environment during the epoch of star and protoplanetary disk formation. Using zoom-in simulations with the magnetohydrodynamical codes RAMSES, we investigate the accretion process of young stars that are embedded in different environments during their first ~100 kyr after formation. Starting initially from a turbulent (40 pc)^3 Giant Molecular Cloud, efficient use of adaptive mesh refinement allows us to resolve the formation process of stars and their protoplanetary disks with a resolution down to 0.06 AU. We find that the accretion process of stars is heterogeneous in space, time and among different protostars with a tendency of more violent accretion for deeply embedded objects. We show that large-scale infall can trigger accretion bursts leading to enhanced protostellar luminosities. Apart from that, we investigate the formation of wide companions at distances of ~1000 au due to turbulent fragmentation for one of the objects. A comparison with observations shows that filamentary structures connecting two protostellar sources, such as kinematically quiescent 'bridges' as observed for e.g. IRAS16293-2422, appear to be transient phenomena of multiple star formation. Such structures occur as a consequence of compression induced by the underlying turbulence. Finally, we suggest that protostellar companions initially form with wider separation of ~1000 au, and migrate to smaller separations of ~100 au on time scales of a few 10 kyr.

Presenter: KÜFFMEIER, Michael (Zentrum für Astronomie Heidelberg (ZAH))

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