Colloquium

SFB 956

Conditions and Impact of Star Formation

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Physikalische Institute Köln
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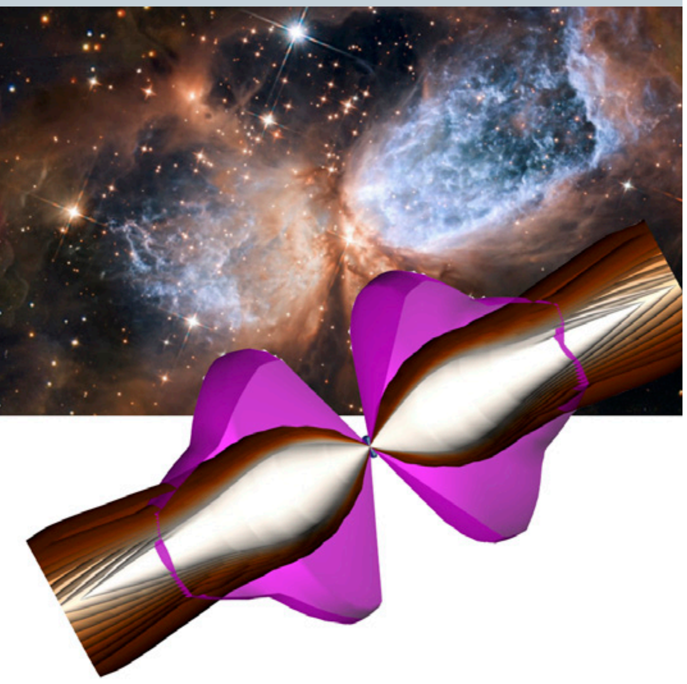

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Conditions and Impact of Massive Star Formation

The formation of massive stars yields strong feedback effects onto its host core and stellar cluster environment via protostellar outflows, radiation heating, radiation pressure, ionization, stellar winds, and supernova (in chronological order). From a theoretical point of view, the question arises, how a massive protostar is able to accrete its mass up to the observed upper mass limit despite e.g. its strong radiation pressure feedback alone.
In this talk, I present results of several series of self-gravitating radiation hydrodynamics simulations of core collapse towards high-mass star formation, including the effects of radiation heating, radiation pressure, protostellar outflows, (and preliminary: ionization). We propose a solution to the radiation pressure problem in the formation of massive stars via the so-called flashlight effect: due to the formation of an optically thick accretion disk, the thermal radiative flux becomes strongly anisotropic and preferentially escapes through the disk's atmosphere, i.e. perpendicular to the sustained accretion flow through the disk's midplane. Furthermore, including feedback of early protostellar outflows yields a large scale anisotropy, which extends the disk's flashlight effect from the few hundred AU scale of the circumstellar disk to a core's flashlight effect up to a 0.1-parsec scale. This core's flashlight effect allows core gas to accrete on the disk for longer, in the same way that the disk's flashlight effect allows disk gas to accrete on the star for longer. Finally, stability analyses of the forming accretion disks around high-mass protostar suggest that early disk fragmentation explains the observed multiplicity of massive stars.
In summary, I will demonstrate straight-forward mechanisms, which allows the formation of the most massive stars known in the present-day universe despite of their strong feedback. The basic theory of star formation herein is just a scaled-up version of low-mass star formation, i.e. based on accretion flows from core to disk to protostellar scales.

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