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Blowing in the wind : accretion in high mass X-ray binaries

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Compact objects in high mass X-ray binaries (HMXB), where the companion star underfills its Roche lobe, have been spotted as X-ray emitters, probably due to the presence of a surrounding disc, along with their low mass counterparts (LMXB). However, if the disc formation is well understood in LMXB where matter is poured through the first Lagrangian point, things get messier in HMXB, especially in Supergiant-HMXB whose number has almost tripled thanks to recent observations with Integral (Chaty 2011, Walter et al 2015). Indeed, the massive companion stars have dense and fast winds which can lead to a Bondi-Hoyle like accretion (a.k.a. wind accretion) onto the compact body. Given the variability of the instantaneous mass and angular momentum accretion rates in this configuration, the disc formation is way more uncertain. The observed photometric and spectral variabilities of the flux might reflect transient accretion phases due to orbital scale modulations like a clumpy wind or non-homogeneous streamlines.

So as to get a better feel of the properties of the subsequently formed disc, we designed a numerical setup able to grasp the huge spatial dynamics of the Bondi-Hoyle accretion onto a compact object for non-relativistic wind velocities (El Mellah and Casse, 2015). From the accretion radius of the black hole down to the vicinity of its event horizon, the flow spans up to 5 orders-of-magnitude. Taking the most of the highly parallelized code MPI-AMRVAC, we characterized the flow properties in the axysymmetric configuration, both in terms of observable-related quantities (e.g. mass accretion rates as a function of the Mach number of the unperturbed flow) and in terms of topology of the sonic surface, confirming the result derived in Foglizzo and Ruffert (1996). We then introduced non axysymmetric effects for specific sets of orbital parameters in full 3D simulations and monitored the formation and permanence of a disc-like structure.

Collaboration

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