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Wind accretion onto compact objects

Abstract

X-ray emission associated to accretion onto compact objects displays important levels of photometric and spectroscopic time-variability. When the accretor orbits a Supergiant star, it captures a fraction of the supersonic radiatively-driven wind which forms shocks in its vicinity. The amplitude and stability of this gravitational beaming of the flow conditions the mass accretion rate responsible, in fine, for the X-ray luminosity of those Supergiant X-ray Binaries. The capacity of this low angular momentum inflow to form a disc-like structure susceptible to be the stage of well-known instabilities remains at stake. Using state-of-the-art numerical setups, we characterized the structure of a Bondi-Hoyle-Lyttleton flow onto a compact object, from the shock down to the vicinity of the accretor, typically five orders of magnitude smaller. The evolution of the mass accretion rate and of the bow shock which forms around the accretor (transverse structure, opening angle, stability, temperature profile...) with the Mach number of the incoming flow is described in detail. The robustness of those simulations based on the High Performance Computing `MPI-AMRVAC` code is supported by the topology of the inner sonic surface, in agreement with theoretical expectations.

We developed a synthetic model of mass transfer in Supergiant X-ray Binaries which couples the launching of the wind accordingly to the stellar parameters, the orbital evolution of the streamlines in a modified Roche potential and the accretion process. We show that the shape of the permanent flow is entirely determined by the mass ratio, the filling factor, the Eddington factor and the alpha force multiplier. Provided scales such as the orbital period are known, we can trace back the observables to evaluate the mass accretion rates, the accretion mechanism (stream or wind-dominated) and the shearing of the inflow, tracer of its capacity to form a disc around the accretor.

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