J20a Wind accretion in the gamma-ray binary LS 5039

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The high mass X-ray binary LS 5039 consists of an O6.5V star and a compact object in the ~ 3.9-day orbit with a moderate eccentricity ($e \sim 0.35$). It is one of the three binaries from which persistent TeV gamma-rays have been detected. The system shows a persistent radio emission, the morphology of which is consistent with mildly relativistic jets (Paredes et al. 2000). However, the nature of the compact object is not established. Casares et al. (2005) proposed that it is a black hole, which would place LS 5039 in the microquasar class, whereas some argue that the system is a colliding-wind binary with a non-accreting pulsar (e.g., Dubus 2006). As a test for the microquasar scenario for LS 5039, it is important to study whether the mass-accreion rate onto the black hole is high enough to power jets to produce the gamma-rays detected by HESS.

In this talk, we report on the result from three dimensional, numerical simulations of wind accretion by a black hole in LS 5039. In order to roughly emulate the effect of the stellar radiation effectively canceling the stellar gravity, we assume that the O star's gravity does not exert on the wind. The wind particles are ejected with half the observed terminal velocity in a narrow range of azimuthal and vertical angles toward the black hole, in order to emulate the wind significantly slower than the terminal speed, and optimize the resolution and computational efficiency of simulations. We find that the mass-accretion rate closely follows the classical Bondi-Hoyle-Littleton accretion rate, which is of the order of $10^{16}\,\mathrm{g\,s^{-1}}$ around periastron. The accretion rate at this level would provide jets enough power to produce the gamma-rays detected by HESS.