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Title : Hydrodynamical simulations of wind interaction in transitional millisecond pulsars

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Abstract :

The number of known galactic-field "spider" millisecond pulsar binaries has greatly increased in the last decade in particular thanks to multi-wavelength follow-up of unidentified Fermi sources. Those systems are constituted of a neutron star orbiting with a low-mass stellar companion in a few hours. Some systems have been observed to alternate between a pulsar-binary state and a faint low-mass X-ray binary state on a timescale of a few years. These so-called transitional millisecond pulsars (tMSPs) offer a rare opportunity to study the interplay between winds and accretion in pulsar binaries and particularly the recycling scenario of formation of millisecond pulsars.
Using an Adaptative Mesh Refinement (AMR) code we perform high precision 2D hydrodynamical (HD) simulations of the interaction between the flows from both stars, accounting for the effect of gravity and orbital motion.

Exploring the ratio between the ram pressures or mass fluxes of both winds, we are able to categorise three phenomenologically different regimes: accretion, intra-binary shock (IBS), and pulsar radio. In the IBS regime, we construct the corresponding X-ray light curves in order to compare to known observations.
The HD approach seems to be already complex enough to provide a qualitative understanding of such interactions. Relativistic magnetohydrodynamics simulations are the next step for a better understanding.