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Radiation magnetohydrodynamic models and spectral signatures of plasma flows accreting onto Classical T Tauri Stars

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CTTSs are young stars accreting mass from their circumstellar disks. According to the largely accepted magnetospheric accretion scenario, the disk extends until the truncation radius, where the magnetic field is strong enough to disrupt the disk and to channel the material towards the star forming an accretion column. The material falls into the star at free fall velocity and hits the stellar surface producing shocks, that heat the plasma at few million degrees.
In the last twenty years the X-ray and UV observations of these systems have raised several questions. In particular, the observed X-ray luminosity is systematically below the value predicted by theoretical models, and the UV lines show complex profiles which cannot be easily interpreted with current accretion models based only on magnetohydrodynamical effects.

To tackle these problems we modeled the structure and the dynamics of the plasma in the impact regions using 3D magnetohydrodynamical simulations, but including the effects of radiative transport, for the first time in the Non Local Thermodynamical Equilibrium (NLTE) regime.

We found that the radiation arising from the shocked plasma is partially absorbed by the unshocked accretion column, and this might explain the excess of X-ray flux predicted by MHD models not including absorption effects. Moreover, due to the absorption of radiation, the pre-shock down-falling accreted material is gradually heated up to a few 10^5 K due to irradiation of X-rays arising from the shocked plasma at the impact region. We discuss the implication of this pre-shock heating for the UV and X-ray emission arising from the impact region.

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Contribution

Talk

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