03/07/2013
12h15 - 12h40

Global simulations of accretion onto magnetized stars: results of 3D MHD simulations and 3D radiative transfer

Marina M. Romanova[1], Ryuichi Kurosawa[2], Min Long[3], Alisa A. Blinova[1] and Richard V. E. Lovelace[1]

[1] *Cornell University, Ithaca, NY 14853, USA*
[2] *Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany*
[3] *Flash Center for computational science, Chicago, IL 60637, USA*

Spectro-polarimetric observations of several young classical T Tauri stars (CTTSs) show that the magnetic field of stars may be *complex*, and can be represented as a superposition of different multipoles [1]. We use a "Cubed Sphere" code to perform global 3D MHD simulations of disk accretion onto stars with complex magnetic fields, and investigate matter flow around these stars [2, 3]. We observe that at large distances from the star, the dipole component often dominates and determines the disk-magnetosphere interaction. However, closer to the star, the higher-order multipoles dominate and determine the shapes of hot spots at the surface of the star. The model has been applied to a young star V 2129 Oph. To compare the results of our simulations with observation, we calculate hydrogen spectral lines from the magnetospheric flow, using the three-dimensional radiative transfer code TORUS [4]. The results of 3D MHD and 3D radiative transfer models are in good agreement with the observations [5]. In another set of 3D MHD simulations and 3D radiative transfer analysis, we investigate accretion onto a star with a dipole field in either stable or unstable regimes. We investigate the boundary between these two regimes [6], and calculate the photometric and spectral properties of modeled stars [7]. We found that in the stable regime, the light-curves and spectral lines vary orderly in time with one or two peaks per period, while in the unstable regime, a stochastic light curve and stochastic spectral variability are observed, with several peaks per period.

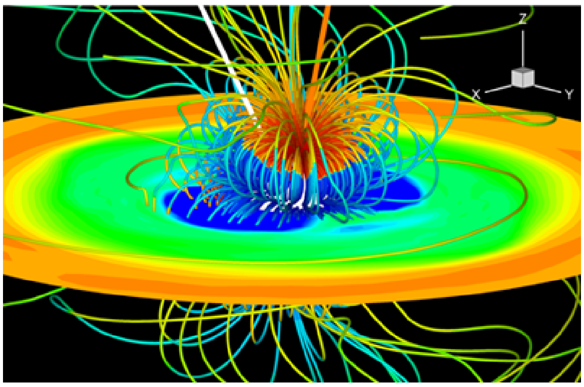

Figure 1: An example of accretion onto a star with a predominantly octupolar field. Magnetic field lines and a slice of the density distribution are shown (from [8]).

[1] J.-F. Donati et al., Mon. Not. R. Astron. Soc., **386**, 1234 (2008).
[2] M. Long et al., Mon. Not. R. Astron. Soc., **413**, 1961 (2011).
[3] M.M. Romanova et al. Mon. Not. R. Astron. Soc., **411**, 915 (2011).
[4] R. Kurosawa, M.M. Romanova, T. Harries, Mon. Not. R. Astron. Soc., **411**, 915 (2008).
[5] S.H.P. Alencar et al., Astron. & Astrophys., **541**, 1 (2012).
[6] A.A. Blinova, M.M. Romanova, R.V.E. Lovelace, in prep. (2013).
[7] R. Kurosawa, M.M. Romanova, Mon. Not. R. Astron. Soc., **431**, 2673 (2013).
[8] M. Long, M.M. Romanova, F.K. Lamb, New Astronomy, **17**, 232 (2012).