X-Ray Bursts Simulations

The simulations present a first cut as understanding how a disk interacts with a magnetosphere. Three movies are presented from a fiducial simulation of a 3keV accretion disk interacting with the magnetic field of a 1.4 solar mass neutron star. The star initially has a dipolar magnetic field. The first movie shows the log of the density. The second movie shows the evolution of the flow velocity vectors with a color overlay showing the magnitude of the velocity. The third movie shows the evolution of the magnetic field, where, as before, the vectors show the direction of the magnetic field and the color shows the strength of the field. The movies show the r-theta half-plane ($0 < \theta < \pi/2$).

Alfven wave interaction between the disk and the halo sets off an initial transient. After that, the disk settles into a pattern of accretion. We see that the flow develops initially pinches the field, making it possible for a certain fraction of the disk's matter to be ejected magnetocentrifugally. The rest of the matter threads the magnetic field and sets up motions that begin to fill the magnetosphere. Notice that the accretion on to the polecap is not steady state, but rather strongly episodic. This clearly shows that a one-zone model of this scenario would eventually prove inadequate and the only way to do this problem is to make a self-consistent integration of the dynamical code with the nuclear reaction network codes, a JINA goal which we are pursuing.