The accretion of matter on white dwarfs

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Dwarf novae is a subclass of cataclysmic variables where a thermal instability in the accretion disk around a white dwarf increases the matter transfer rate through the disk and thus increases the rate of gravitational energy release increasing the disk luminosity by 2-5 mag during the outburst.

Half of this energy is released in the disk itself while the other half is released in a small boundary layer as the matter comes into corotation with the star. Since the BL is much smaller than the disk itself, the disk emits mainly in the optical, whereas the BL emits in the far UV and in soft X-rays.

However, the energy in the boundary layer may also be converted into winds, WD rotation or heating, so the emitted spectrum depends on the structure of the BL. Therefore it is important to understand the dynamical processes that lead to the formation of the boundary layer.

We have used the RIEMANN code to carry out high-resolution simulations of the Navier-Stokes eqs. in 2.5d along with physically realistic inner and outer boundary conditions. The efficiency the MRI/turbulence based angular momentum transport have been parametrized by a coefficient, α.

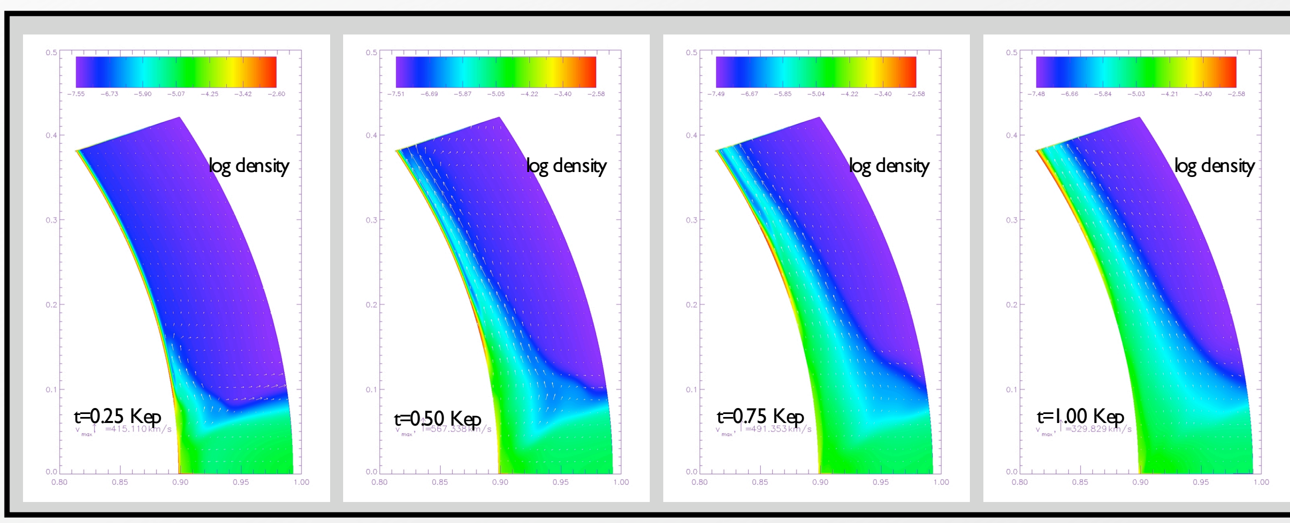
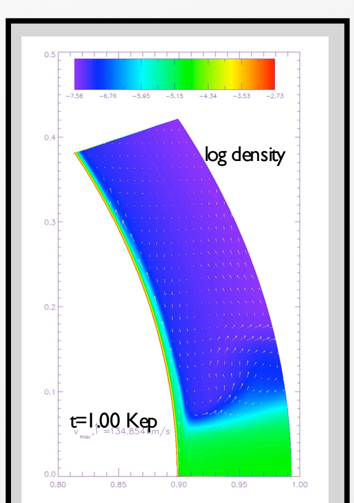


Fig. shows a build up of a multi-dimensional optically thick boundary layer which covers a significant fraction of the accreting WD during outburst.

For high values of $\alpha(=0.1)$, the BL is optically thick and extends more than 30 degrees to either side of the disk plane after a Keplerian rotation period (t=19s). The simulations show that high values of α cause a spreading BL that sets off gravity waves in the surface matter, where the accretion flow moves supersonically over the cusp and makes it susceptible to gravity wave and/or Kelvin-Helmholtz instabilities. This mechanism can drive mixing with deeper layers.



In quiescence. the BL is optically thin.

The low viscosity case also show a spreading boundary layer, but here the accretion flow does not set off gravity waves and the BL is optically thin. The boundary layer is thus only apparent during the outburst stage of the dwarf novae.

References for this work:
Fisker & Balsara, ApJ. 635(2005)L69
Fisker et al. sub. to New Astr. Rev.

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