Boundary layer emission in luminous LMXBs

M.Gilfanov and M.Revnivtsev

MPA, Garching

We show that aperiodic and quasiperiodic variability of bright LMXBs – atoll and Z-sources, on $\sim$ sec – msec time scales is caused primarily by variations of the luminosity of the boundary layer. The kHz QPOs have the same origin as variability at lower frequencies, i.e. independent of the nature of the "clock", the actual luminosity modulation takes place on the neutron star surface. The boundary layer spectrum remains nearly constant in the course of the luminosity variations and is represented to certain accuracy by the Fourier frequency resolved spectrum. In the investigated range of $\dot{M} \sim (0.1-1)\dot{M}_{\rm Edd}$ it depends weakly on the global mass accretion rate and in the limit $\dot{M} \sim \dot{M}_{\rm Edd}$ is close to Wien spectrum with $kT \sim 2.4$ keV. Its independence on the global value of $\dot{M}$ lends support to the theoretical suggestion by Inogamov & Sunyaev (1999) that the boundary layer is radiation pressure supported.

Based on the knowledge of the boundary layer spectrum we attempt to relate the motion along the Z-track to changes of physically meaningful parameters. Our results suggest that the contribution of the boundary layer to the observed emission decreases along the Z-track from conventional $\sim 50\%$ on the horizontal branch to a rather small number on the normal branch. This decrease can be caused, for example, by obscuration of the boundary layer by the geometrically thickened accretion disk at $\dot{M} \sim \dot{M}_{\rm Edd}$. Alternatively, this can indicate significant change of the structure of the accretion flow at $\dot{M} \sim \dot{M}_{\rm Edd}$ and disappearance of the boundary layer as a distinct region of the significant energy release associated with the neutron star surface.