J32a Spectral properties of super-critical accretion flow

Dominikus Heinzeller (U. Heidelberg), ○ Shin Mineshige (Kyoto U.), Ken Ohsuga (Rikkyo U.)

There are observational implications that at least some of Ultra-Luminous X-ray Sources (ULXs) undergo super-critical (or super-Eddington) accretion flow. However, the observational properties of such extreme flow were poorly understood theoretically due mainly to technical difficulties. We investigate the spectral properties of super-Eddington accretion flows by means of a parallel line-of-sight calculation. The subjacent model taken from two-dimensional radiation hydrodynamic simulations made by Ohsuga et al. (2005) is composed of a disc accretion region and an extended atmosphere with high velocity outflows. The non-gray radiative transfer equation is solved, including relativistic effects, by applying the flux limited diffusion approximation.

The calculated spectrum is composed of a thermal, blackbody-like emission from the disc, which depends sensitively on the inclination angle, and high energy X-ray and gamma-ray emission from the atmosphere. The former radiation is rather enhanced for small inclination angles. When we compare photon number density and the average photon energy of the thermal component in the face-on case to those in the edge-on case, the former increases by a factor of ~ 3.7 due to mild beaming effects caused by anisotropic matter distribution around the central hole, while the latter increases by a factor of ~ 1.7 due mainly to the Doppler boosting arising from the sub-relativistic gas motion. This will explain the observed high X-ray temperatures of ULXs that are too high to explain in the framework of intermediate-mass black holes.