Abstract

The observed radiation of accreting black holes shows the existence of hard and soft photons with very high energies (X-rays or gamma rays). These hard photons are observed at high frequencies, implying that they are created near the black hole horizon. The blackbody radiation observed in the soft X-ray domain is well fitted by the emission of a thin Keplerian accretion disk. With the development of observational techniques and the availability of high-quality observational data, evidence has accumulated that the highest energy photons must be produced in the hot coronal flow, a region above the accretion disk located also very close to the black hole. This geometrically thick region can be radiatively inefficient and dominated by advection.

Low angular momentum flow is concerned with this coronal region. Despite several theories developed over the years to explain this kind of flow onto the black hole, there is no complete relativistic, analytical picture explaining the observed spectral states and variability. Various studies show that the power-law component in the hard X-ray spectrum is caused by the comptonization of cooler photons by hot electrons in the intermediate layer where there is a centrifugal barrier described by the so-called CENBOL (CENtrifugal barrier dominated BOundary Layer) model. This barrier creates a subsonic flow below the shock wave in the accreting matter around the black hole. Other test results, such as the impact of the shock waves with the wind, used in particular for the analysis of the emission of the Cyg X-1 source, are undertaken based on the model that incorporates Keplerian flow surrounded by a sub-Keplerian halo. Our models are in some respects similar to the CENBOL model, but we do not yet account for the presence of a thin disk in the simulations. However, we use a numerical, two-dimensional low angular momentum flow model to address the time-dependent evolution of the flow.

My research aims to find the most accurate explanation of the observed states and the temporal variation associated with the low angular momentum flow and to recreate the known observational data available for several astronomical sources. In my doctoral dissertation, I conducted full analysis and numerical simulations of flows with low angular momentum. They reflect many astrophysical sources observed. My research focuses on the systems with accreting black holes present in Active Galactic Nuclei and X-ray binaries with a stellar black hole. Furthermore, these models might be used to describe gamma-ray bursts produced by the collapse of massive and rotating stars.