By virtue of their powerful gravitational attraction, black holes are often deluged by a stream of infalling ambient matter. This matter in the form of ionized fluid (plasma) has to loose its excess rotation before it falls onto the black hole, and it does so by forming a rotating disk, called an accretion disk. Such disks are usually extremely luminous, making the supermassive black holes at the centers of galaxies the brightest persistent sources of radiation in the Universe. These so called active galactic nuclei (AGNs) or quasars are among the most intensely observed objects in contemporary astronomy. They also have smaller counterparts in the Milky Way and neighboring galaxies in the form of black hole X-ray binaries, where the black hole has a mass of only a few suns and the matter is fed into the disk from an ordinary stellar companion of the black hole, some two dozen such system are known in our Galaxy.

It is only in the last few years that computer techniques have advanced to the point where the structure of such accretion disks can be reliably computed with the inclusion of turbulent magnetic fields and of the all important radiation. A new accretion disk model has recently been discovered in such computations in a collaborative effort between the Copernicus Astronomical Center, Silesian University in Opava, and Harvard University (published in the Astrophysical Journal Letters, Lančova et al. 2019). Unexpectedly, while most of the matter is concentrated in a thin disk, the actual surface of the disk forms a steep funnel, so that astronomers will only be able to observe the bright inner parts of the flow onto the black hole if they are located close to the axis of the system (“face-on”), if observed instead from the side, the accreting black hole would appear to be rather dim.

The research project proposes to investigate this model in detail and to compute the brightness and color of the accretion disk for black holes of various masses, spins and orientations, so that the computer model can be compared with the observations.