Particle acceleration via magnetic reconnection near spinning black holes coupled to a surrounding disk

Accretion and ejection have been found to be tightly linked around stellar-mass and supermassive black holes (BHs). The EHT results suggest that this junction is mediated by the intense and structured magnetic field within a few 10 gravitational radii. Since the seminal work by Blandford & Znajek in the 70's, most models of BH magnetospheres focused on a specific configuration where magnetic field lines threading the BH event horizon are open, a particularly convenient framework to launch jets and outflows. In contrast, fewer studies considered the alternative case: a Kerr BH surrounded by a disk and a hot corona threaded by a large scale magnetic field connected to the BH.

In this talk, I will report on recent results we obtained by performing global particle-in-cell simulations in Kerr metric to capture the dynamics of the electromagnetic fields and of the pair plasma in the corona. We find that a hybrid magnetic topology develops with: (i) magnetic loops connecting the disk to the event horizon, which enables energy and angular momentum exchanges between the 2 components, (ii) open field lines threading the horizon and funneling a Blandford-Znajek jet, and (iii) open magnetic field lines anchored in the disk and inclined enough to launch a magneto-centrifugal wind. Although the corona is essentially force-free, a Y-point at the intersection of these 3 regions seeds a current sheet where magnetic reconnection heats the corona. At the intersection of these regions, a Y-point seeds a current sheet where magnetic reconnection heats the corona and accelerates particles up to relativistic speeds, which provides a source of hard X-rays above the disk. Eventually, I will show particle energy distribution along with synthetic images and spectra of the synchrotron emission associated to this mechanism.