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

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Accretion and ejection have been found to be tightly linked around stellar-mass and supermassive black holes. The monitoring of Sagittarius A*, M87 and Cygnus X-1 suggest that this junction is mediated by an intense and structured magnetic field embedded in a collisionless plasma within a few 10 gravitational radii. These environments are also prone to recurring non-thermal flares whose origin remains unclear.

In this talk, I will focus on configurations where a Kerr black hole is surrounded by a disk and a hot corona threaded by a large scale magnetic field connected to the BH. We performed global particle-in-cell simulations 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 form macroscopic plasmoids and accelerates particles up to relativistic speeds. It provides a mechanism for variable non-thermal high energy emission. Eventually, I will show particle energy distribution along with synthetic images and spectra.

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