Kinetic plasma physics of black-hole coronae

D. Grošelj[1], H. Hakobyan[2,3], A.M. Beloborodov[3,4], L. Sironi[3,5], A. Philippov[6]

[1] *Centre for mathematical Plasma Astrophysics, KU Leuven, Leuven, Belgium*

[2] *Princeton Plasma Physics Laboratory, Princeton, USA*

[3] *Columbia Astrophysics Laboratory, Columbia University, New York, USA*

[4] *Max Planck Institute for Astrophysics, Garching, Germany*

[5] *Center for Computational Astrophysics, Flatiron Institute, New York, USA*

[6] *Department of Physics, University of Maryland, College Park, USA*

Bright emission in hard X-rays from black-hole accretion flows is attributed to a hot and spatially compact region near the black hole, frequently referred to as the corona. Black-hole coronae are likely powered by the dissipation of magnetic energy via collective plasma processes, such as kinetic turbulence and/or magnetic reconnection. These processes have been extensively studied by means of kinetic particle-in-cell (PIC) simulations in regimes with slow radiative cooling of particles, or with radiative cooling in the optically thin limit. However, previous studies do not apply to the radiation-dominated environments of black-hole coronae, which have moderate optical depths. The intense radiation alters the particle energetics through rapid radiative cooling and their composition via production of electron-positron pairs. This presents new challenges and opportunities for the study of kinetic plasma turbulence and magnetic reconnection, which is crucial for the design of physically grounded models of emission from black-hole coronae.

Here, we will present results from recent *radiative* PIC simulations of turbulence [1] and magnetic reconnection, which model the self-consistent interaction between high-energy photons and charged particles in the radiation-dominated environments of black-hole coronae. The method employed allows us to study how the dissipated magnetic energy is partitioned between the observable radiation and (nonthermal) charged particles, and how radiative effects feed back on the plasma kinetic processes.

References

[1] D. Grošelj *et al.*, Phys. Rev. Lett. (in press), arXiv:2301.11327