

Black hole accretion in the era of GPU-accelerated particle-in-cell simulations

John M. Mehlhaff, Alex Y. Chen, Martin Luepker, Yajie Yuan

Physics Department and McDonnell Center for the Space Sciences, Washington University in St. Louis; MO, 63130, USA

Modern general relativistic particle-in-cell (GRPIC) codes are now beginning to reveal the dynamics of black-hole accretion through the lens of first-principles plasma physics. However, meaningful GRPIC accretion simulations demand large numerical domains and long integration timescales. This makes GPU parallelization at least very useful – and in many cases completely necessary – in order to simulate a given problem. In this contribution, I will describe recent¹ simulations of black-hole accretion performed using the GPU-parallelized GRPIC code Aperture. I will emphasize why GPU acceleration is necessary for this work, as well as some of the exciting scientific payoffs that promise to make GPU-accelerated GRPIC a powerful tool for the future astrophysics community.

¹<https://arxiv.org/abs/2602.22168>