

Extreme plasma astrophysics of black holes and neutron stars

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Neutron stars and black holes are powerful sources of broad-band non-thermal electromagnetic emission, including coherent radio and high-energy radiation. The collective behavior of plasmas that produce these emission signatures is still poorly understood. In order to allow modeling emission signatures from first principles, we constructed first global radiative kinetic plasma simulations of neutron star and black hole environments. In this talk I will describe applications of these methods to the understanding of the multi-wavelength emission mechanism of rotating magnetized neutron stars (pulsars), including the 50-year old problem of the generation of coherent radio waves. I will also highlight recent and future work on pair plasma discharges and magnetic flares near supermassive black holes and electromagnetic precursors to gravitational wave events.