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Frontiers in Relativistic Radiation Magnetohydrodynamics

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Recent years have seen remarkable successes in novel observational techniques for studying strongly gravitating systems, including plasma around black holes and merging compact objects. The fidelity of data now available and expected in the near future demands dramatic advances in modeling, but the environments around black holes and neutron stars include a broad range of conditions that present numerous challenges for numerical simulation. Like many complex systems, these phenomena are also strongly multi-scale and multi-physics. Among the most acute challenges, adequate treatments of photon and/or neutrino transport and coupling to matter are critical in determining the properties of these systems and unambiguously interpreting observational data. In this talk, I will describe recent advances in modeling capability, particularly associated with radiation, and applications to several relativistic systems. I will also describe a novel method for radiation transport in these environments that will substantially broaden the applicability of our codes. Finally, I will describe ongoing development of a new highly scalable, performance portable code for relativistic astrophysics that promises to unveil new vistas on strongly gravitating systems.