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## Development of Radiation Magnetohydrodynamic Simulator of Accretion Disks

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We are developing a three-dimensional simulator of accretion disks by revising the magnetohydrodynamic simulator CANS (Coordinated Astronomical Numerical Software) we released as a product of the ACT-JST project. In addition to the simulation engines based on the modified Lax-Wendroff scheme, Roe scheme, and CIP scheme, we implemented an engine based on the HLLD scheme (Miyoshi and Kusano 2005). Radiation hydrodynamic simulation engines based on the flux limited diffusion (FLD) approximation is implemented. Since the characteristic speed becomes close to the light speed near the black hole, we can attain high parallel performance by using the time explicit radiation hydrodynamic engine. When the time scale for the radiative diffusion is shorter than the dynamical time scale for the accretion flow, the radiative diffusion equation and the equation for the matter-radiation interaction should be solved simultaneously by using the implicit scheme. We implemented parallelized matrix solvers using the multi-grid scheme and the pre-conditioned BiCG scheme. We are also developing relativistic magnetohydrodynamic engines, and Monte-Carlo modules to compute the radiation spectrum using the simulation data. This simulator has been implemented to XT4 at national astronomical observatory and T2K supercomputer at University of Tokyo. We report the simulation results for the time evolution of black hole accretion disks, and the propagation of jets launched from the accretion disk.

Keywords: accretion disk, magnetohydrodynamics, radiation hydrodynamics, simulation, black hole, jet