S15a Study on the outflow impact of SMBH seed at high-z through radiation hydrodynamic (RHD) simulations

Ignacio Botella Lasaga (Kyoto Universiy), Takaaki Kitaki, Shin Mineshige (Kyoto Universiy), Ken Ohsuga (Univeristy of Tsukuba), Tomohisa Kawashima (University of Tokyo)

We study the structure and impact of the outflow generated by supermassive black holes (SMBH) seeds. Our objective is to simulate the evolution of the gas outflow ejected from the vicinity of a SMBH seed (with mass of $10^3 M_\odot$) to the edge of cosmological simulations ($r \sim 0.1$pc) with a new method. In this new method, we perform consecutive RHD simulations that allow us to cover a larger range. These computational boxes are set to be $2r_{\rm Sch} - 3 \times 10^3 r_{\rm Sch}$ and $2.5 \times 10^3 r_{\rm Sch} - 10^6 r_{\rm Sch}$ (where $r_{\rm Sch}$ is the Schwarzschild radius). Each simulation is consistently connected through boundary conditions. Thus, our simulations reveal the global outflow structure with $< 10^{-4}$pc. The outflows that we find as a result of out simulations, are characterized by a high temperature ($\sim 10^{6-8}$K), moderately high speed ($\sim 0.1 - 0.7c$, with c being the light speed), low density ($\sim 10^{-16} - 10^{-18}$g/cm^3) gas, with a total escape ($v_r \geq v_{\rm esc}$) mass outflow rate is $\sim 200 L_{\rm Edd}/c^2$ where $L_{\rm Edd}$ is the Eddington luminosity. This outflow rate is about 20% of the total mass inflow rate. By extrapolating the outflow structure (1×10^{-4}pc) up to the scales of 0.1pc, we find that, the impact of our AGN model would have is, momentum (energy) flux $\sim 1 - 10 L_{\rm Edd}/c$ ($\sim 0.1 - 1 L_{\rm Edd}$).