High-energy neutrino emission from collisionless shocks in black hole coronae by particle-in-cell simulations

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Purpose

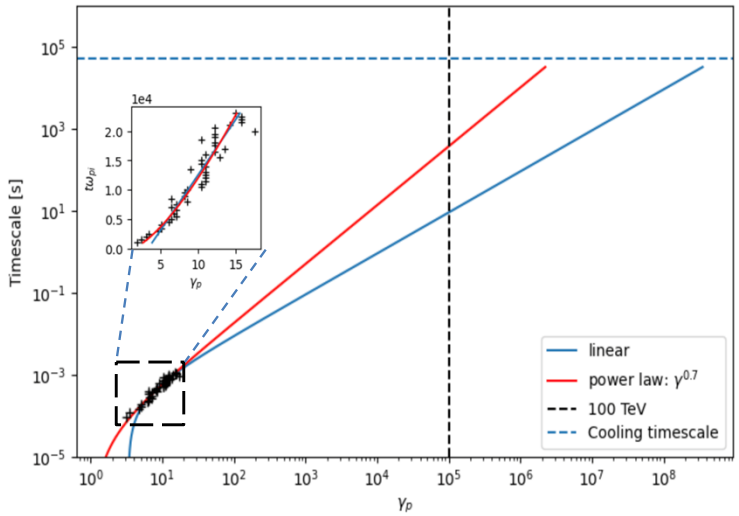
To explain high-energy (TeV) neutrinos from nearby galactic centers (black hole coronae) detected by IceCube observatory, proton acceleration model is needed. While collisionless shock acceleration has been proposed as the mechanism for proton acceleration, the details have not been investigate using kinetic simulations.

Outline

We use particle-in-cell (PIC) simulations with black hole coronal region parameters to study proton acceleration. In particular, we focus on uncertain parameters such as varying initial proton-to-electron temperature and magnetic obliquity of the shock (e.g. the shock is parallel or perpendicular). From the simulations, we derive proton acceleration efficiency and other properties such as injection energy to proton and electron of the shocks to answer whether collisionless shock can be responsible for the detected neutrino signals

Result

From time evolution of maximum proton energy in our PIC simulation results, we can conclude that collisionless shock especially parallel shocks are a possible mechanism for proton acceleration and subsequent high-energy neutrino emissions.



Computing system:	SQUID General Purpose CPU nodes	
	node-hour	3,100 node-hour
	memory used	8 TB
	Hybrid parallelization	8 nodes (2 OpenMPI processes/node) x 76 cores (1 OpenMP thread/core)