W16a Wakefield Acceleration in a Jet from a NDAF around a Black Hole

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We have investigated electromagnetic pulses in a jet from a neutrino dominated accretion flow (NDAF) around a black hole. NDAFs are massive accretion disks of accretion rates $\dot{M} \approx 0.01 - 10 M_{\odot}/\mathrm{s}$ for black holes of several solar masses $M \leq 10 M_{\odot}$, such extreme accretions are investigated as a model of gamma-ray bursts (GRBs) as well as supernovae and hypernovae. Recently, Ebisuzaki & Tajimi 2019 have proposed a model of acceleration mechanism of charged particles to very high energies including energies above 10^{20} eV for the case of protons and nucleus, and 10^{12-15} eV for electrons by electromagnetic wave-particle interaction. If the episodic eruptive accretions generate Alfvénic pulses along the magnetic field in the jet, such Alfvénic pulses act as a driver of the collective accelerating pondermotive force whose direction is parallel to the motion of particles. This pondermotive force drives the wakes. Because the wakes propagate at the same speed with the particles, the so-called wakefield acceleration has a robust built-in coherence in the acceleration system itself.

In this study we extend a model of the accretion disk presented by Ebisuzaki & Tajimi 2019 into a NDAF. We estimate the energy flux of both the electro-magnetic pulses and neutrino emission from the NDAFs. We find that the total luminosity of electro-magnetic pulses $L_{\mathrm{wave}} = \frac{2\pi}{3\alpha}\sqrt{\frac{\pi}{\beta^3}}\dot{M}c^2$ and the that of neutrinos $L_{\nu} = \frac{1}{4}\dot{M}c^2$ where α and β are the viscosity parameter and the plasma-β of the disk, respectively. The properties of the NDAFs and magnetically driven jet and the maximum energy of accelerated charged particles in the jet will be discussed.