W66b High-energy neutrino emission from accretion shocks in black hole coronae

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A recent IceCube Collaboration survey has revealed possible detections of high-energy neutrinos ($\sim$ 10 TeV) from nearby Seyfert galaxies, including NGC 1068. The insufficient flux of GeV gamma rays from these sources suggests that the neutrinos are emitted from the hot plasma in the coronal regions surrounding the central black holes, likely through hadronic processes. To explain the observed TeV neutrinos, the acceleration of protons is necessary. Diffusive shock acceleration (DSA) in infalling accretion shocks is proposed as one of the most prominent mechanisms. However, acceleration features of particles through DSA remain poorly understood due to uncertainties in black hole corona parameters and the complex dynamics of the hot plasma. In this study, we investigate collisionless shock acceleration scenarios of particles by particle-in-cell (PIC) simulations. Here, we focus on the particle acceleration process in a substantial temperature imbalance between protons and electrons and with the effects of positron populations. Our results strongly suggested that high-energy protons accelerated at a collisionless shock can be accounted for the neutrino signals detected by IceCube from NGC 1068. On the other hand, the fraction of accelerated leptons is lower than earlier predictions, suggesting that secondary leptons are the primary contributors to the detected MeV gamma-rays.