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Impacts of non-thermal emission on the images of black hole shadow and extended jets in two-temperature GRMHD simulations

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The recent 230 GHz observations of the Event Horizon Telescope (EHT) are able to image the innermost structure of M87 and show a ring-like structure that agrees with thermal synchrotron emission. However, at lower frequencies, M87 is characterized by a large-scale jet with clear signatures of non-thermal emission. In this study, we investigate the impact of non-thermal emission on the black hole shadow images and broadband spectrum from various two-temperature GRMHD models utilizing different black hole spins and different electron heating prescriptions coupling with different electron distribution functions (eDFs). Through the comparison with GRRT images and SEDs, we found that when considering variable kappa eDF, parameterized prescription of $R-\beta$ model with $R_{\rm h}$ = 1 is similar to the model with electron heating in the morphology of images, and the SEDs at the high-frequency. However, the nuance between them could be differentiated through the diffuse extended structure seen in GRRT images, especially at a lower frequency, and the behavior of SEDs at low frequency. Compared with the thermal eDF, the emission from the nearside jet region is enhanced, and the peaks of SEDs shift left when we consider non-thermal eDF.

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