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Possibility of black hole spin estimation with time-variable “crescent-shaped” shadow in M87

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It is a great challenge to constrain the spin magnitude of the black holes (BHs). We have calculate a radio image of M87 in a flaring state using a part of time-dependent general relativistic radiative transfer code: CARTOON (Takahashi et al. 2022), and found that a time variable “crescent-shaped” shadow appears and its width depends on the BH spin magnitude. Following our previous work (Kawashima et al. 2019, here after TK19), we assume that the accretion flow is optically thick against the synchrotron self-absorption (SSA) in a flaring state, where the mass accretion rate will be relatively higher than that observed by the Event Horizon Telescope (EHT) in 2017. As is known that M87 shows a time variability over a few days, we have developed a steady model of TK19 by incorporating a time variability of accretion flow with a time scale of a few days, as observed in M87. In the light curves of the radio images, we have also found a time-delayed variability of the photon ring component, which would be also an important feature to probe the BH spin. The time variability of the “crescent-shaped” shadow may depends on the BH spin magnitude. In this talk, we discuss about a behavior of the “crescent-shaped” shadow in a toy model and future issues.

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