

Astrophysical tests of general relativity

вторник, 28 ноября 2023 г. 15:00 (45)

At the initial stage of its development, the general theory of relativity received verification and confirmation in the limit of a weak gravitational field. However, with the development of astronomical observation technologies, predictions of GRT and in a strong gravitational field began to be discussed and confirmed, such as the profile of the X-ray iron $K\alpha$ line (in the case if the emission region is very close to the event horizon), the trajectories of particles and stars near black holes and the shapes and sizes of shadows of supermassive black holes in M87 and Sgr A. In 2019 the Event Horizon Telescope (EHT) team presented the first image reconstruction around the shadow for the supermassive black hole in M87. In 2021 the EHT team constrained parameters ("charges") of spherical symmetrical metrics of black holes from an allowed interval for shadow radius. Earlier, we obtained analytical expressions for the shadow radius as a function of charge (including a tidal one) in the case of Reissner–Nordström metric. Based on results of the shadow size evaluation for M87 done by the EHT team we constrain a tidal charge. We discuss opportunities to use shadows to test alternative theories of gravity and alternative theories for galactic centers.

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Session Classification : Afternoon session 28/11/2023

Track Classification : Gravitation & Cosmology