28th International Scientific Conference of Young Scientists and Specialists (AYSS-2024)

Contribution ID: **1542** Type: **Oral**

Particularities of Black Hole shadows when spinning is taken into account

Tuesday 29 October 2024 13:15 (15 minutes)

New data obtained with the Event Horizon Telescope (EHT) for black holes in the galaxy M87 (K. Akiyama, et al., Astrophys. J. 875 (1) L5 (2019)) and in the center of our galaxy Srg A (The Event Horizon Telescope Collaboration, The Astrophysical Journal Letters 930 L17 (2022)) require improvements in theoretical predictions, especially regarding the shadow profiles of black holes (BHs). It was obvious from the outset that both BHs studied are rotating. The rotation velocity of M87* was recently measured (Cui, Y.; others. Nature 621, 711–715, (2023)). At the same time, a direct search for an axisymmetric solution by directly solving the Einstein–Hilbert equations turns out to be not very simple. Therefore, an alternative method (the Newman-Janis algorithm) was proposed to generate rotating solutions from non-rotating ones (Newman, E.T.; Janis, A.I., J. Math. Phys. 6,915–917, (1965)). Recently, simulations were performed for the Bumbelbee model (Capozziello, S.; Zare, S.; Hassanabadi, H., (2023) https://arxiv.org/abs/2311.12896). This paper notes an interesting phenomenon: when a Kerr-type metric with additional parameters (e.g. tidal charge) is considered, these new parameters can change the size and shape of the shadow. Therefore, if (after improving the experimental precision) the EHT finds that the shadow does not exactly match the Kerr metric, this will allow the contribution of the tidal charge to be estimated. This means that the contribution of new physics will be measured.

We obtain black hole rotating solutions for Horndesky theory (specific partial case), bumblebee model and Gauss-Bonnet scalar gravity using the specially improved Newman-Janis algorithm. The shadow profiles for these metrics were calculated. Applying the limitations from the Event Horizon Telescope we find the opportunity to constrain model parameters from considered extended gravity theories. We show that for three considered models two of them (Horndesky theory and Gauss-Bonnet scalar gravity) weaken the effect of rotation and bumblebee model enhances it. This conclusion matches the previously obtained one that extended gravity theories by themselves correct the effect of rotation in both directions.

Primary author: ZENIN, Oleg (Lomonosov Moscow State University, Faculty of Physics, Department of Quantum Theory and High Energy Physics)

Co-authors: ALEXEYEV, Stanislav (Sternberg Astronomical Institute); Mr BAIDERIN, Artem (Lomonosov Moscow State University, Faculty of Physics, Department of Quantum Theory and High Energy Physics)

Presenter: ZENIN, Oleg (Lomonosov Moscow State University, Faculty of Physics, Department of Quantum Theory and High Energy Physics)

Session Classification: Theoretical Physics

Track Classification: Theoretical Physics