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Spectral energy distributions for transonic accretion flow in non-Kerr spacetime

The study of accretion flow for astrophysical sources like active galactic nuclei (AGNs), black hole X-ray binaries (BHXRBs), etc., is essential to understand their spectral features. Nowadays, theorists hugely focused on the alternative gravity theory to explain some distinctive observational results from the usual Kerr BH. One such emerging non-Kerr spacetime is the Johannsen-Psaltis (JP) metric, which is described by a deformation parameter in addition to the mass and spin of BH. Also, based on spacetime parameters in JP metric, the central object can become a BH or naked singularity (NS). However, isolating BH and NS objects by the accretion disc theory is very challenging. The disparity between the disc properties around these objects has been reported in the literature. But, no one considers the transonic accretion flows, which are yet to be explored. Motivated by this, we explore the spectral properties of accretion disc around BH and NS objects by studying the transonic accretion flow in the JP non-Kerr background. To do this, we numerically solve the energy and momentum equations under the framework of general relativistic hydrodynamics. We find all classes of accretion solutions in the parameter space of the flow energy and angular momentum. Then, we calculate corresponding disc luminosity (L) and spectral energy distributions (SEDs) by considering thermal bremsstrahlung emission. It is observed that I-type solutions generate high L and SEDs compared to the remaining solutions for both BH and NS models. Moreover, for BH model, SEDs for O and A-type solutions significantly differ from W and I-type solutions, especially for low energy accretion flow. On the other hand, for NS model, SEDs for different accretion solutions are identical in the whole parameter space. Most importantly, from a comparative study between the SEDs at a given flow parameters, we find that a NS object can produce a higher luminous power spectrum than a BH. These results open a window to find the nature of central singularities through the spectral analysis of accretion disc.

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