GR 1: Black Holes I

Time: Monday 16:45–18:05 Location: HBR 14: HS 2

GR 1.1 Mon 16:45 HBR 14: HS 2

Examine of Quasi-Periodic Oscillations of X-ray Flux Seen in Stellar-Mass Black Holes — •Gizem Dilara Açan Yildiz[1,2] and Ertan Güdekli[1] — [1]Istanbul University, Turkey — [2]Piri Reis University, Turkey

Stellar-mass Black Hole (BH) binaries have long been known to exhibit quasi-periodic oscillations (QPO) in their X-ray flux curves, and this phenomenon is considered one of the most effective tests of strong gravity models. In this study, we take into account the observation data of three well-known microquasars such as GRO 1655-40, XTE 1550- 564 and GRS 1915+ 105 and investigated QPOs. We successfully fit the observational data of epicyclic resonance and variants of high-frequency QPO models, investigated relativistic precession and its variants, tidal decay and warped disk models with perfect dark energy under the influence of the relevant parameter in the Kerr BH. We show that traditional geodetic models of QPOs can explain observationally generated data from microquasar models.

GR 1.2 Mon 17:05 HBR 14: HS 2

Kilometer-scale ultraviolet regulators and astrophysical black holes — •Jens Boos[1] and Christopher D. Carone[2] — [1]KIT, Karlsruhe, Germany — [2]William & Mary, Williamsburg VA, USA

Regular black hole metrics involve a universal, mass-independent regulator that can be up to $\mathcal{O}(700\,\mathrm{km})$ while remaining consistent with terrestrial tests of Newtonian gravity and astrophysical tests of general relativistic orbits. However, for such large values of the regulator scale the horizon is lost. We solve this problem by proposing mass-dependent regulators. This allows for large, percent-level effects in observables for regular astrophysical black holes. By considering the deflection angle of light and the black hole shadow, we demonstrate the possibility of large observational effects explicitly.

GR 1.3 Mon 17:25 HBR 14: HS 2

Wave Optical imaging by point-source scattering for a KTNdS black hole — •Felix Willenborg[1,2], Dennis Philipp[1,2], and Claus Lämmerzahl[1,2] — [1]Zentrum für angewandte Raumfahrt und Mikrogravitation (ZARM), University of Bremen, 28359 Bremen, Germany — [2]Gauss-Olbers Center, c/o ZARM, University of Bremen, 28359 Bremen, Germany

The Kerr-Taub-NUT-de Sitter (KTNdS) spacetime is an interesting model due to its special property of conical singularities and the so-called Misner string in the presence of a gravitomagnetic monopole, the NUT charge parameter ℓ. Gravitational lensing maps have shown that these become apparent to an observer for light- and time-like geodesics. Furthermore, the background appears "twisted" depending on the value of ℓ. Instead of describing the observation with ray-optical methods, we have already shown the observations for Schwarzschild-de Sitter as well as Kerr-de Sitter black holes for very low frequencies in a wave-optical approach. There, the scattering of a monochromatic point source was observed as seen by an observer at a larger distance from the black hole. We are interested in how the previous observations of the ray-optical approaches turn out at very low frequencies, and whether the same characteristic observations can be made, since the wave-optical approach coincides with the ray-optical approach at high frequencies. We present wave-optical images for both Taub-NUT-de Sitter (TNdS) and Kerr-Taub-NUT-de Sitter black holes and discuss the results.

GR 1.4 Mon 17:45 HBR 14: HS 2

Analytical studies of higher-order photon rings — •Oleg Tsupko[1,2], Volker Perlick[1], and Fabio Aratore[3] — [1]ZARM, University of Bremen, Bremen, Germany — [2]Moscow, Russia — [3]University of Salerno, Salerno, Italy

Higher-order photon rings can be expected to be detected in a more detailed image of the black hole found in future observations. These rings are lensed images of the luminous matter surrounding the black hole and are formed by photons that loop around it. Analytical calculations of higher-order images are possible with the use of so-called the strong deflection limit, which provides a simple logarithmic expression for large angles of gravitational deflection that is particularly suited for rays making revolutions around a black hole. In this work we compute analytically the shape of higher-order photon rings for an arbitrary spherically-symmetric metric using strong deflection limit. The shape is found as the explicit equation of the curve in polar coordinates. The formula describes the apparent shape of the higher-order image of the equatorial emission ring with the given radius around black hole as viewed by distant observer with an arbitrary inclination. Further, we discuss how the metric can be constrained through measurements of higher-order photon rings, the possible observation of which in future projects is currently being discussed. The work of Oleg Tsupko is supported by Humboldt Research Fellowship for experienced researchers.