GR 1: Schwarze Löcher 1

Zeit: Montag 8:30–10:30 Raum: SFG 0140

Hauptvortrag GR 1.1 Mo 8:30 SFG 0140

The Shadow of Black Holes. An Analytic Description — •Arne Grenzebach — ZARM, Universität Bremen

Black holes are perhaps the most intriguing objects in Astrophysics. Due to the strong gravity and the resulting deflection of light, the black hole will cast a shadow. I will introduce an analytic geometrical way to construct the black hole's shadow whose shape varies in different space-times. The resulting formulas describe the boundary of the shadow for the general Plebański-Demiański class of stationary, axially symmetric type D solutions of the Einstein-Maxwell equations seen by an observer at arbitrary position. Furthermore, the shadow-plots can be compared with those of a moving observer. An observed image of the shadow would be a strong evidence for the existence of black holes. Thus, the upcoming high-resolution observations of the Galactic center, will reveal whether the center of our Milky Way hosts a black hole.

GR 1.2 Mo 9:10 SFG 0140

Shadow of a distorted black hole with a quadrupole moment — •Efthimia Deligianni — ZARM - University of Bremen, Germany

The No-Hair-Theorem has shown that astrophysical black holes are to be described by two parameters, namely their mass and spin. For these black holes the shadow has been well described.

However, if there is an external matter structure around the black hole, e.g. an external galaxy, then the structure induces a quadrupole moment. It is interesting to investigate in how far the shadow of such a deformed black hole varies from the Schwarzschild- or Kerr-case.

In this talk I will present our results for the shadow of a black hole with a quadrupole moment.

GR 1.3 Mo 9:30 SFG 0140

Shadow of a Kerr black hole in a plasma — •Volker Perlick[1] and Oleg Yu. Tsupko[2] — [1]ZARM, Universität Bremen, 28359 Bremen — [2]Space Research Institute of the Russian Academy of Sciences, Profsoyuznaya 84/32, Moscow 117997, Russia

We consider light propagation in a plasma around a Kerr black hole. The plasma is assumed to be pressureless ("cold") and non-magnetised. We find the necessary and sufficient condition on the plasma electron density that guarantees separability of the Hamilton-Jacobi equation for the light rays (i.e., that guarantees existence of a Carter constant). For all cases where this separability condition is satisfied, we give an analytical formula for the boundary curve of the shadow of the Kerr black hole. The general results will be illustrated with several examples of specific plasma electron densities. The perspectives of actually observing the influence of the plasma on the shadow will be discussed.

GR 1.4 Mo 9:50 SFG 0140

The Meissner Effect of generic black holes — •Norman Gürlebeck[1,2] and Martin Scholtz[3] — [1]ZARM, University of Bremen, Am Fallturm, 28359 Bremen — [2]DLR Institute of Space Systems, 28359 Bremen, Germany — [3]Institute of Theoretical Physics, Charles University, V Holesovickach 2, 180 00 Praha 8, Czech Republic

Black holes are important astrophysical objects describing an end state of stellar evolutionm, which are observed frequently. There are theoretical predictions that Kerr black holes with high spins expel magnetic fields. However, Kerr black holes are pure vacuum solutions, which do not include accretion disks, and additionally previous investigations are mainly limited to weak magnetic fields. We show here in full general relativity that generic rapidly spinning black holes including those deformed by accretion disks or other matter still expel even strong magnetic fields. Analogously to a similar property of superconductors, this property is called Meissner effect.

GR 1.5 Mo 10:10 SFG 0140

Rotating non-singular black holes — •Roman Smit and Piero Nicolini — Frankfurt Institute for Advanced Studies (FIAS), Frankfurt am Main, Germany

A variety of non-singular spherically symmetric black hole solutions have been found in the past. Their energy momentum tensor is usually an anisotropic perfect fluid with a dark-energy-like equation of state ($p=-\rho$) for the radial pressure.

Historically, the Kerr-Newman solution was found by applying a complexification algorithm – the Newman-Janis algorithm – to the Reissner-Nordstroem solution.

I will show how to modify and apply this algorithm to the known spherical non-singular black holes to obtain rotating non-singular black holes.