GR 11: Black Holes

Zeit: Donnerstag 14:00–16:00 Raum: NW-Bau - HS3

GR 11.1 Do 14:00 NW-Bau - HS3

Solitons and Black Holes in 5d Einstein-Maxwell-Chern-Simons Theory — Jose Luis Blazquez-Salcedo[1], •Jutta Kunz[1], Francisco Navarro-Lerida[2], and Eugen Radu[3] — [1]Universität Oldenburg, Germany — [2]Universidad Complutense de Madrid, Spain — [3]Universidade de Aveiro, Portugal

We consider black holes in 5-dimensional Einstein-Maxwell-Chern-Simons (EMCS) theory in the presence of a negative cosmological constant. These possess equal-magnitude angular momenta and a non-trivial magnetic field at spatial infinity. Their boundary metric corresponds to the product of time and a squashed 3-dimensional sphere. The black holes are then described by their mass, angular momenta, electric charge, magnetic flux, and squashing parameter. Under certain conditions globally regular solitonic configurations are approached. Supersymmetric solutions arise as well.

GR 11.2 Do 14:20 NW-Bau - HS3

On the Present Ability to Test Theories of Gravity via Black-Hole Shadows — •Yosuke Mizuno[1], Ziri Younsi[1], Christian Fromm[1], Oliver Porth[1], Mariafelicia De Laurentis[1], Hector Olivares[1], Heino Falcke[2], Michael Kramer[3], and Luciano Rezzolla[1] — [1]Institut für Theoretische Physik, Goethe Universität, Frankfurt am Main, Germany — [2]Department of Astrophysics/IMAPP, Radboud University Nijmegen, Nijmegen, The Netherlands — [3]Max-Planck-Institut für Radioastronomie, Bonn, Germany

Upcoming sub-millimetre VLBI images of Sgr A* carried out by the Event-Horizon-Telescope Collaboration (EHTC) are expected to provide critical evidence for the existence of this supermassive black hole. In this work we assess our present ability to use EHTC images to determine if they correspond to a Kerr black hole as predicted by Einstein's theory of general relativity or to a black hole in alternative theories of gravity. To this end, we perform GRMHD simulations and use GRRT calculations to generate synthetic shadow images of a magnetised accretion flow onto a Kerr black hole. In addition, and for the first time, we perform GRMHD simulations and GRRT calculations for a dilaton BH, which we take as a representative solution of an alternative theory of gravity. Taking into account the configuration of the VLBI observing array from the 2017 EHTC campaign, we find that it could be extremely difficult to distinguish between black holes from different theories of gravity, thus highlighting that great caution is needed when interpreting BH images as tests of general relativity.

GR 11.3 Do 14:40 NW-Bau - HS3

The shadow of a collapsing dark star — Stefanie Schneider and •Volker Perlick — ZARM, U Bremen, 28359 Bremen

According to general relativity a black hole is seen as a black disc against a bright backdrop of light sources. This black disc is usually called the "shadow" of the black hole. A US-led coordinated project known as the Event Horizon Telescope, in partnership with a European project known as the BlackHoleCam, is under way to actually observe the shadow of the black hole candidates at the centre of our own galaxy and at the centre of M87. For theoretical considerations of the shadow, the black hole is usually considered as eternal, i.e., as existing in a time-independent state forever. Here we ask the question of how the shadow comes about in the course of time if a black hole is formed by gravitational collapse. We consider the simplest model of a gravitational collapse, assuming that the collapsing "star" is a dark ball of dust.

GR 11.4 Do 15:00 NW-Bau - HS3

Light propagation near a black hole distorted by an external quadrupole moment — •Efthimia Deligianni — ZARM, Universität Bremen

For isolated and stationary black holes analytical descriptions of the shadow already exist. Surrounding such a black hole with an external matter distribution, e.g. an external galaxy, leads to deformation of the spacetime – we speak of distorted black holes. Consequently, the shadow of such black holes deviates from the Schwarzschild- or Kerr-case.

In this talk I will present our progress in analytically describing this distorted shadow. In particular, I will discuss the photon region of a black hole under the influence of an external quadrupolar gravitational field.

GR 11.5 Do 15:20 NW-Bau - HS3

The zeroth law in quasi-homogeneous thermodynamics and black holes — Alessandro Bravetti[1], •Christine Gruber[2,4], Cesar Lopez-Monsalvo[3], and Francisco Nettel[2] — [1]IIMAS, UNAM, Mexico City, Mexico — [2]ICN, UNAM, Mexico City, Mexico — [3]UAM, Mexico City, Mexico — [4]University of Oldenburg, Germany

Motivated by black holes thermodynamics, we consider the zeroth law of thermodynamics for systems whose entropy is a quasi-homogeneous function of the extensive variables. We show that the generalized Gibbs-Duhem identity and the Maxwell construction for phase coexistence based on the standard zeroth law are incompatible in this case. We argue that the generalized Gibbs-Duhem identity suggests a revision of the zeroth law which in turns permits to reconsider Maxwell's construction in analogy with the standard case. The physical feasibility of our proposal is considered in the particular case of black holes.

GR 11.6 Do 15:40 NW-Bau - HS3

Horizon Wave Function in Quantum-Modified Black Hole Models — Andrea Giugno[1], Andrea Giusti[1,2,3], Piero Nicolini[4,5], and •Michael Florian Wondrak[4,5] — [1]Arnold Sommerfeld Center, Ludwig-Maximilians-Universität München, München, Germany — [2]Dipartimento di Fisica e Astronomia, Università di Bologna, Bologna, Italy — [3]INFN, Sezione di Bologna, Bologna, Italy — [4]Frankfurt Institute for Advanced Studies (FIAS), Frankfurt am Main, Germany — [5]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität Frankfurt, Frankfurt am Main, Germany

From a physical viewpoint, matter takes up a finite, nonvanishing volume. There are no point-like objects. This raises the question in which cases a given matter distribution describes a quantum particle or alternatively a (quantum) black hole.

To address this issue, one can compare the Schwarzschild radius with the width of the matter distribution which is typically of the order of the Compton wavelength. If the Schwarzschild radius is larger, one can speak of a black hole. A more refined ansatz to determine the character of a matter distribution is offered by the horizon wave function. It allows for the horizon radius to take on a range of values and yields the probability of being a black hole. In this talk we discuss modifications in the realm of quantum-modified black hole models.