GR 10: GR and Astrophysics I

Zeit: Donnerstag 11:00–13:00 Raum: HS 4

Hauptvortrag GR 10.1 Do 11:00 HS 4

Critical Phenomena in Gravitational Collapse — •Thomas Baumgarte — Bowdoin College, Brunswick, Maine, USA

Critical Phenomena, including the appearance of universal scaling laws and critical exponents in the vicinity of phase transitions, appear in different fields of physics and beyond. Critical phenomena in gravitational collapse to black holes were first observed by Matt Choptuik about 25 years ago - a seminal discovery that launched an entire new field of research. Until recently, however, most numerical work in this field was restricted to spherical symmetry and - with some notable exceptions - could not account for effects that break this symmetry. In this talk I will review the appearance of scaling laws and self-similarity close to the onset of black hole formation. I will then present new numerical relativity simulations of gravitational collapse to black holes in the absence of spherical symmetry, and will discuss the effects of rotation and aspherical deformations.

GR 10.2 Do 11:45 HS 4

Accretion disks in axially symmetric space-times — •Claus Lämmerzahl — ZARM, University of Bremen, Germany

For axially symmetric space-times we present the general analytic theory of thick accretion disks (Polish doughnts) based on an ideal fluid which also can be charged. Based on that, accretion disks can be constructed and can be characterized in terms of the effective gravitational potential, shape, mass density and pressure. First steps in order to extend this approach to viscous fluids are presented.

GR 10.3 Do 12:00 HS 4

Black hole shadow in an expanding universe with a cosmological constant — •Volker Perlick[1], Oleg Tsupko[2], and Gennady Bisnovatyi-Kogan[2] — [1]ZARM, University of Bremen, 28359 Bremen, Germany — [2]Space Research Institute, Russian Academy of Sciences, Profsoyuznaya 84/32, Moscow 117997, Russia

We analytically investigate the influence of a cosmic expansion on the shadow of the Schwarzschild black hole. We suppose that the expansion is driven by a cosmological constant only and use the Kottler (or Schwarzschild-eSitter) spacetime as a model for a Schwarzschild black hole embedded in a deSitter universe. We calculate the angular radius of the shadow for an observer who is comoving with the cosmic expansion. It is found that the angular radius of the shadow shrinks to a non-zero finite value if the comoving observer approaches infinity. – The talk presents results that have been published in Phys. Rev. D 97, 104062 (2018).

GR 10.4 Do 12:15 HS 4

Accretion disk in distorted BH — •Shokoufeh Faraji and Eva Hackmann — Zarm, Bremen

The space-time in the vicinity of the horizon in the presents of a static distribution of matter localized outside the black hole horizon in the form of accretion disks,remain vacuum; however, this presence of matter distort the metric. This solution is called distorted black hole. The metric near horizon of a general statistic black hole was studied by V.P. Frolov and N. Sanchez in 1986. In general, if the distribution of matter outside the black hole is axisymmetric, the metric of the distorted black hole allows a details description that discussed by R. Geroch and J.B. hartle in 1982. In this work, we describe the construction of a thin accretion disk outside a distorted black hole horizon, when only low order multipols are present. The physical characteristics of the resulting thin disk are discussed. ”

GR 10.5 Do 12:30 HS 4

The influence of electromagnetic fields on the ISCO in Schwarzschild spacetime — Jan Hackstein and •Eva Hackmann — ZARM, University of Bremen

Astrophysical black holes are often surrounded by a geometrically thin accretion disk, whose inner edge is approximately given by the innermost stable circular orbit (ISCO) of test particles. Moreover, they are usually embedded in magnetic fields, for instance of interstellar origin. The rotation of a black hole then enables selective accretion of charged particles, leading to a small net electric charge. Here we discuss the influence of electromagnetic test fields, which do not influence the spacetime geometry, on the radius of the ISCO of charged particles in the equatorial plane of a (non-rotating) Schwarzschild black hole.

GR 10.6 Do 12:45 HS 4

A toy model of viscous relativistic geometrically thick disk in Schwarzschild geometry — •Sayantani Lahiri and Claus Laemmerzahl — ZARM, Universität Bremen, Am Fallturm 2, 28359 Bremen, Germany

In this work we study relativistic geometrically thick accretion disks, commonly known as Polish doughnuts in Schwarzschild spacetime, in the presence of dissipative effects generated as a consequence of differential rotation of the fluid within the disk around a given black hole. We therefore aim to study quasi-stationary solutions of the disk using causal Navier-Stokes equation proposed in Israel-Stewart formalism and later reformulated by Romatschke et al. In this work, we focus only on shear viscous effects and the bulk viscosity is not taken into consideration. The viscosity is introduced as perturbation to the ideal fluid configuration of the disk and we categorically investigate effects of both shear viscosity and curvature of the Schwarzschild black hole on the shape of the geometrically thick disk. As a simplifying assumption, the heat flow which may arise as a result of viscosity within the fluid, is assumed to be small and consequently the heat flux is neglected in our study.