GR 11: Hauptvorträge Schwarze Löcher und Felder (gemeinsam mit MP)

Zeit: Mittwoch 16:45–18:45 Raum: ZHG 002

Hauptvortrag GR 11.1 Mi 16:45 ZHG 002

On the Consistency of Classical and Quantum Supergravity Theories — •Thomas-Paul Hack[1], Mathias Makedonski[2], and Alexander Schenkel[3] — [1]II Institute for Theoretical Physics, University of Hamburg — [2]Department of Mathematical Sciences, University of Copenhagen — [3]Department of Stochastics, University of Wuppertal

It is known that pure N=1 supergravity in d=4 spacetime dimensions is consistent at a classical and quantum level, i.e. that in a particular gauge the field equations assume a hyperbolic form - ensuring causal propagation of the degrees of freedom - and that the associated canonical quantum field theory satisfies unitarity. It seems, however, that it is yet unclear whether these properties persist if one considers the more general and realistic case of N=1, d=4 supergravity theories including arbitrary matter fields. We partially clarify the issue by introducing novel hyperbolic gauges for the gravitino field and proving that they commute with the resulting equations of motion. Moreover, we review recent partial results on the unitarity of these general supergravity theories and suggest first steps towards a comprehensive unitarity proof.

Hauptvortrag GR 11.2 Mi 17:15 ZHG 002

Analytical approach to the geodesic equations in General Relativity — Victor Enolski[2,3,4], Eva Hackmann[4], •Valeria Kagramanova[1], Jutta Kunz[1], and Claus Lämmerzahl[4] — [1]Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg — [2]Hanse-Wissenschaftskolleg (HWK), 27733 Delmenhorst, Germany — [3]Institute of Magnetism, 36-b Vernadsky Blvd, Kyiv 03142, Ukraine — [4]ZARM, Universität Bremen, Am Fallturm, ZARM, Universität Bremen, Am Fallturm, D-28359 Bremen, German

The motion of test particles and light is of great importance for the investigation of the physical properties of gravitational fields since only matter and light can be observed. There are two main methods to solve the geodesic equations: analytical and numerical. Analytical solutions deliver an exact solution of the equations of motion, have arbitrary accuracy and allow to investigate the properties of the motion and hence of the gravitating body itself in detail. In this talk we present the analytical solution of the geodesic equation in many well-known black hole space-times. In particular, in the Plebanski-Demianski space-time of generalized black holes. The solution is expressed in terms of the Weierstrass' elliptic or Abelian hyperelliptic functions. That depends on the degree of difficulty of the considered problem and on the number of parameters characterizing the black hole and the test particle. We integrate differentials of all three kind with arbitrary genus of the underlying polynomial curve. We also present the analytical expressions for the observable quantities such as perihelion shift for planetary orbits and light deflection for escape orbits of photons.

Hauptvortrag GR 11.3 Mi 17:45 ZHG 002

Black holes in su(N) Einstein-Yang-Mills theory: hair, fur and superconducting horizons — •Elizabeth Winstanley — Consortium for Fundamental Physics, School of Mathematics and Statistics, The University of Sheffield, Hicks Building, Hounsfield Road, Sheffield. S3 7RH United Kingdom

Black hole solutions of general relativity coupled to an su(N) Yang-Mills gauge field have been studied for over 20 years. In this talk we focus on black holes in Einstein-Yang-Mills theory in four-dimensional, asymptotically anti-de Sitter space, with a negative cosmological constant. We emphasize three aspects of these black holes:

(a) the existence of stable black holes in anti-de Sitter space with abundant Yang-Mills hair;

(b) how these hairy black holes may be characterized by non-Abelian charges at infinity;

(c) planar black holes with superconducting horizons.

Hauptvortrag GR 11.4 Mi 18:15 ZHG 002

Bidifferential calculus and integrable PDEs in General Relativity — •Folkert Müller-Hoissen — Max-Planck-Institute for Dynamics and Self-Organization, Bunsenstrasse 10, D-37073 Göttingen

The "bidifferential calculus approach" to integrable partial differential (and difference) equations allows to deduce substantial results, e.g. methods to generate exact solutions, on an abstract level. Once a "bidifferential calculus formulation" of some equation is at hand, these general results can be evaluated in the concrete case. A special result in this framework, with a surprisingly simple proof, has recently been shown (joint work with Aristophanes Dimakis and Nils Kanning) to reproduce in particular the multi-Kerr-NUT and multi-Demianski-Newman families of solutions of the Ernst equations, governing stationary axisymmetric vacuum and electrovacuum space-times in General Relativity. We present an introduction to the underlying structures and methods of bidifferential calculus, and delegate a more detailed discussion of the case of the Ernst equations to the talk by Nils Kanning at this meeting.