Symposium Black Holes (SYBH)

gemeinsam veranstaltet von
Arbeitsgruppe Philosophie (AP Phil)
Fachverband Gravitation(GR)
Fachverband Theoretische und Mathematische Grundlagen der Physik (MP)
Fachverband Extraterrestrische Physik (EP)
Astronomische Gesellschaft (AG)

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsaal HG Aula)

Hauptvorträge

SYBH 1.1	Mo	13:15–13:50	HG Aula	**From the Geometry of Spacetime to the Geometry of Numbers** — •Stefan Hollands
SYBH 1.2	Mo	13:50–14:25	HG Aula	**Black Holes in Four and Higher Dimensions** — •Jutta Kunz
SYBH 1.3	Mo	14:25–15:00	HG Aula	**Philosophical Aspects of Black Holes** — •Chris Smeenk
SYBH 1.4	Mo	15:20–15:55	HG Aula	**Super-Massive Black Holes at the Centers of Galaxies: The Case of Sagittarius A* at the Center of the Milky Way** — •Andreas Eckart
SYBH 1.5	Mo	15:55–16:30	HG Aula	**Classical and Relativistic Dynamics of Supermassive Black Holes and their Spin in Galactic Nuclei** — •Rainer Spurzem

Fachsitzungen

SYBH 1.1–1.5	Mo	13:15–16:30	HG Aula	**Symposium Black Holes (SYBH)**

SYBH 1: Symposium Black Holes (SYBH)

Zeit: Montag 13:15–16:30 Raum: HG Aula

Hauptvortrag SYBH 1.1 Mo 13:15 HG Aula

From the Geometry of Spacetime to the Geometry of Numbers — •Stefan Hollands — School of Mathematics, Cardiff University, Senghennydd Road CARDIFF, Wales, UK. CF24 4AG

The first aim of the talk is to give a general introduction to basic properties of black holes, including their thermodynamic properties ("Laws of Black Hole Mechanics") and their symmetry properties. I then report on recent progress on the problem how to classify (stationary) black hole solutions, not just in dimensions four, but more generally in higher dimensions. This is of current interest because higher dimensions occur naturally in various theories attempting a unification of the forces in Nature, and it is important to know to what extent the "No Hair-Theorems" for four-dimensions black holes continue to hold in such contexts. I finally explain some amusing connections of this problem to concepts in number theory such as to continued fractions, lattices, and to "Farey tees".

Hauptvortrag SYBH 1.2 Mo 13:50 HG Aula

Black Holes in Four and Higher Dimensions — •Jutta Kunz — Department of Physics, Carl von Ossietzky University Oldenburg, D 26111 Oldenburg

Black holes are a major prediction of Einstein's general relativity. Today there is strong observational evidence for the existence of astrophysical black holes. On the other hand string theory, a major candidate for the quantum theory of gravity and the unification of all interactions, predicts in its low energy limit additional fields and also requires higher dimensions for mathematical consistency. As a result, essential properties of black holes can change dramatically. Here we address the questions as to what the consequences for the properties of black holes are and how they are affected by the presence of extra dimensions.

Black holes in 4-dimensional Einstein-Maxwell theory have a number of important special properties: They are subject to the topological censorship theorem, stating that their horizons have the topology of a sphere; they satisfy a uniqueness theorem, stating they are uniquely characterized by their mass, their angular momentum, their electric charge, and their magnetic charge; they also obey the staticity theorem, stating that stationary black holes with static horizons must be static.

In recent years it has been realized that higher dimensions allow for more general types of black holes. In particular, black objects with different types of horizon topologies are present in higher dimensions, such as black rings, concentric black rings or black saturns. While these black objects are asymptotically flat, there are also black objects with compact dimensions such as locaized black holes, black strings and black branes. Here the properties of these various types of black objects will be discussed.

Hauptvortrag SYBH 1.3 Mo 14:25 HG Aula

Philosophical Aspects of Black Holes — •Chris Smeenk — University of Western Ontario, Department of Philosophy, Talbot College, London, Ontario N6A 3K7, Canada

Black holes have been a focus of intense research interest because their description draws on ideas from the three main branches of fundamental physics – general relativity, quantum physics, and thermodynamics. There are a number of intriguing puzzles regarding black holes: why do they seem to behave like thermal objects, and is information lost in black hole evaporation? Attempts to solve these puzzles have to face up to conflicts between the basic concepts of the different branches of fundamental physics. But the discussions have also invoked philosophical positions, in particular Bohr's idea of "complementarity." This talk will focus on assessing "black hole complementarity" from a philosophical point of view. I will argue that the crucial questions at issue in this debate are somewhat orthogonal to Bohr's original position, and instead involve questions regarding the applicability of different effective theories.

15 min. coffee break

Hauptvortrag SYBH 1.4 Mo 15:20 HG Aula

Super-Massive Black Holes at the Centers of Galaxies: The Case of Sagittarius A* at the Center of the Milky Way — •Andreas Eckart — I.Physikalisches Institut ; Zülpicher Str. 77; 50937 Koeln

The dynamics of stars and gas at the centers of galaxies show that in almost all cases they harbor super-massive black holes (SMBH) with masses between a few million and one-hundred million solar masses. The closest of these objects is Sagittarius˜A* (Sgr˜A*), the radio to X-ray source associated with the super-massive 4 million solar mass black hole at the center of the Milky Way. Here the central mass can undoubtedly be determined from a stellar orbits. In addition, violent flare emission allows us to probe the immediate environment of the central mass. Near-infrared polarimetry shows signatures of strong gravity that are statistically significant against randomly polarized red noise allowing to derive spin and inclination information of the SgrA* SMBH. A combined synchrotron self Compton (SSC) and adiabatic expansion model with source component spectra peaking at a few THz can fully account for the observed flare flux densities and delay times covering the spectral range from the X-ray to the mm-radio domain. The light curves of SgrA* suggest that the mm-wavelength flare emission follows the optically thin THz to near-infrared emission with a delay of 1.5 - 2 hours. Two cometary shaped stellar sources in the vicinity of SgrA* as well as the proper motions of thin dusty filaments in the mini-spiral may represent one of the best indicators for a >1000 km/s fast wind emerging from the center.

Hauptvortrag SYBH 1.5 Mo 15:55 HG Aula

Classical and Relativistic Dynamics of Supermassive Black Holes and their Spin in Galactic Nuclei — •Rainer Spurzem — Astronomisches Rechen-Institut, Mönchhofstraße 12-14, 69120 Heidelberg — National Astronomical Observatories, Chinese Academy of Sciences, Beijing, China

We study the dynamical evolution of supermassive single and binary black holes (SMBH) embedded in dense star clusters in galactic nuclei. First, the interaction of black holes with stars (tidal disruption, close gravitational encounters) can be modelled classically (Newtonian); but relativistic corrections to Newtonian gravity are taken into account when necessary. It is shown, mainly from N-body computer experiments, how relativistic interactions trigger the coalescence of SMBH and the detailed spectrum of gravitational wave emission is computed in the model. The physical nature of various relativistic corrections important for the model (e.g. periastron shifts, energy losses due to gravitational radiation, relatvistic spin-orbit interactions) is reviewed. The emerging field of gravitational wave astrophysics and ongoing and planned instruments (ground-based, space-based) and their sensitivity characteristics are presented. In a final part of the talk our new computational instruments are presented, special supercomputers using graphical processing units (GPU) as accelerators, our pathfinder systems using this technology in Germany and China. The new paradigm of green supercomputing is discussed and its use for black hole physics in galactic nuclei.