Fachverband Gravitation und Relativitätstheorie (GR) gemeinsam mit der Astronomischen Gesellschaft e.V.

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Übersicht der Hauptvorträge und Fachsitzungen

(Hörsaal JUR K)

Plenarvorträge

PV I	Mo	11:30–12:15	HG X und HG Aula	**From Disks to Planets: The Formation of Planetary Systems** — •Thomas Henning
PV II	Di	11:00–11:45	HG X und HG Aula	**The renormalization group - from peV to TeV, and from physics to mathematics** — •Manfred Salmhofer
PV III	Di	11:45–12:30	HG X und HG Aula	**Why go beyond the Standard Model?** — •Hitoshi Murayama
PV IV	Di	20:00–21:00	HG X und HG Aula	**Max-von-Laue-Lecture: Working Toward a World Without Nuclear Weapons** — •Sidney Drell
PV V	Mi	12:10–12:50	Oper	**Dark Matters** — •Simon White
PV VI	Mi	20:00–21:00	HG X und HG Aula	**Mikro- trifft Makrokosmos – mit dem Large Hadron Collider auf der Suche nach Antworten auf fundamentale Fragen** — •Norbert Wermes
PV VII	Do	11:00–11:45	HG X und HG Aula	**Präzisionsexperimente in Teilchen- und Astrophysik mit kalten und ultrakalten Neutronen** — •Stephan Paul
PV VIII	Do	11:45–12:30	HG X und HG Aula	**Hochenergiekosmos: Experimente, Ergebnisse, Perspektiven** — •Karl-Heinz Kampert
PV IX	Fr	11:00–11:45	HG X und HG Aula	**Going to extremes: Fundamental physics and radio astronomy** — •Michael Kramer
PV X	Fr	11:45–12:30	HG X und HG Aula	**What is wrong with the Sun? The Present and Future of Solar Physics** — •Sami K. Solanki

Hauptvorträge

GR 1.1	Mo	9:10– 9:55	JUR K	**Thermodynamics and Brownian motion in special relativity** — •Jörn Dunkel, Peter Hänggi, Stefan Hilbert
GR 1.2	Mo	9:55–10:40	JUR K	**Nonlocal Gravity Simulates Dark Matter** — •Friedrich W. Hehl, Bahram Mashhoon
GR 5.1	Di	8:30– 9:10	JUR K	**Orbitalsysteme als Plattformen für grundlegende physikalische Experimente** — •Hansjörg Dittus
GR 5.2	Di	9:10– 9:50	JUR K	**LISA and LISA Pathfinder: Gravitational wave astronomy from space** — •Karsten Danzmann
GR 5.3	Di	9:50–10:30	JUR K	**Towards a One Percent Measurement of Frame Dragging by Spin with Satellite Laser Ranging to LAGEOS, LAGEOS 2 and LARES and GRACE Gravity Models** — •Ignazio Ciufolini, Antonio Paolozzi, Erricos Pavlis, John Ries, Rolf Koenig, Richard Matzner, Giampiero Sindoni, Hans Neumayer
GR 10.1	Mi	8:30– 9:15	JUR K	**Supermassive black holes in galaxies: Correlations, coincidences and coevolution** — •Knud Jahnke
GR 10.2	Mi	9:15–10:00	JUR K	**Galactic Archaeology** — •Eva K. Grebel
GR 14.1	Do	14:00–14:45	JUR K	**Motion of extended bodies in General Relativity** — •Dirk Pützfeld
GR 14.2	Do	14:45–15:30	JUR K	**Spinning test particles in black-hole space-times** — •Oldřich Semerák

GR 14.3	Do	15:30–16:15	JUR K	**Black holes with spin in numerical general relativity** — •Bernd Brügmann
GR 17.1	Fr	8:30– 9:10	JUR K	**Canonical formulation of spinning objects in General Relativity** — •Jan Steinhoff
GR 17.2	Fr	9:10– 9:50	JUR K	**Effective one body description of tidal effects in inspiralling compact binaries** — •Alessandro Nagar, Thibault Damour
GR 17.3	Fr	9:50–10:30	JUR K	**Self-gravitating elastic bodies** — •Lars Anderson

Gemeinsamer Hauptvortrag von EP und GR

EP 12.1	Do	8:30– 9:00	AKM	**Herschel, a new Window to the Infrared Universe** — Franz Kerschbaum, •Roland Ottensamer

Fachsitzungen

GR 1.1–1.2	Mo	9:10–10:40	JUR K	**Hauptvorträge Montag: Moderne Aspekte der Relativitätstheorie (gemeinsam mit der jDPG)**
GR 2.1–2.1	Mo	10:40–11:00	JUR K	**Schwarze Löcher 1**
GR 3.1–3.4	Mo	16:45–18:05	JUR K	**Schwarze Löcher 2**
GR 4.1–4.3	Mo	18:05–19:05	JUR K	**Experimente zur Gravitation 1**
GR 5.1–5.3	Di	8:30–10:30	JUR K	**Hauptvorträge Dienstag: Weltraummissionen**
GR 6.1–6.6	Di	14:00–16:00	JUR K	**Experimente zur Gravitation 2**
GR 7.1–7.1	Di	16:00–16:20	JUR K	**Gravitationswellen 1**
GR 8.1–8.2	Di	16:45–17:25	JUR K	**Gravitationswellen 2**
GR 9.1–9.5	Di	17:25–19:05	JUR K	**Kosmologie 1**
GR 10.1–10.2	Mi	8:30–10:00	JUR K	**Hauptvorträge Mittwoch: Astrophysik**
GR 11.1–11.4	Mi	14:00–15:20	JUR K	**Kosmologie 2**
GR 12.1–12.3	Mi	15:20–16:20	JUR K	**Astrophysik**
GR 13.1–13.4	Do	9:10–10:30	JUR K	**Klassische Allgemeine Relativitätstheorie 1**
GR 14.1–14.3	Do	14:00–16:15	JUR K	**Hauptvorträge Donnerstag: Dynamik ausgedehnter Körper 1**
GR 15.1–15.2	Do	16:45–17:25	JUR K	**Klassische Allgemeine Relativitätstheorie 2**
GR 16.1–16.3	Do	17:25–18:25	JUR K	**Numerische Relativitätstheorie**
GR 17.1–17.3	Fr	8:30–10:30	JUR K	**Hauptvorträge Freitag: Dynamik ausgedehnter Körper 2**
GR 18.1–18.3	Fr	14:00–15:00	JUR K	**Grundlegende Probleme**
GR 19.1–19.3	Fr	15:00–16:00	JUR K	**Quantengravitation und Quantenkosmologie**
GR 20.1–20.1	Fr	16:00–16:20	JUR K	**Alternative Ansätze**
GR 21.1–21.2	Mo-Fr	ganztags	JUR K	**Poster**

Plenarvorträge des Symposiums Black Holes

Das vollständige Programm dieses Symposiums ist unter SYBH aufgeführt.

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

Symposium GHT Dissertationspreis

Das Symposium findet am Montag, 14:00–16:15 Uhr, im Hörsaal HG X statt. Details zu den Vorträgen werden einige Wochen vor der Tagung auf www.dpg-verhandlungen.de veröffentlicht.

Plenarvorträge des Symposiums Extrasolare Welten

Das vollständige Programm dieses Symposiums ist unter SYEW aufgeführt.

SYEW 1.1	Mi	16:45–17:15	HG I	**Extrasolar Planets** — •Artie Hatzes
SYEW 1.2	Mi	17:15–17:45	HG I	**Gravitational Microlensing: A powerful method for the detection of extrasolar planets** — •Joachim Wambsganss
SYEW 1.3	Mi	17:45–18:15	HG I	**The Formation of Planets** — •Wilhelm Kley
SYEW 1.4	Mi	18:15–18:45	HG I	**Von der Habitabilität zur Entstehung und Evolution des Lebens** — Gerda Horneck, •Petra Rettberg

Begrüßungsabend

Am Montag ab 19:30 Uhr findet ein Begrüßungsabend mit Imbiss und Getränken in der Mensa der Universität (Bonn-Poppelsdorf, Endenicher Allee 17) statt.

Mitgliederversammlung Fachverband Gravitation und Relativitätstheorie

Donnerstag 18:30–19:30 JUR K

- Eröffnung und Festsetzung der endgültigen Tagesordnung
- Genehmigung des Protokolls der letzten Mitgliederversammlung
- Bericht des Vorsitzenden
- Wahl des Vorsitzenden des FV
- Wahl des Beirats des FV
- Vergangene Aktivitäten
- Zukünftige Aktivitäten
- Dissertationspreis
- Denkschrift ART
- Büchertisch
- Verschiedenes

GR 1: Hauptvorträge Montag: Moderne Aspekte der Relativitätstheorie (gemeinsam mit der jDPG)

Zeit: Montag 9:10–10:40 Raum: JUR K

Hauptvortrag GR 1.1 Mo 9:10 JUR K

Thermodynamics and Brownian motion in special relativity — •Jörn Dunkel[1], Peter Hänggi[2], and Stefan Hilbert[3] — [1]Rudolf Peierls Centre for Theoretical Physics, University of Oxford, 1 Keble Road, Oxford OX1 3NP, United Kingdom — [2]Institut für Physik, Universität Augsburg, Universitätsstrasse 1, D-86135 Augsburg, Germany — [3]Argelander-Institut für Astronomie, Universität Bonn, Auf dem Hügel 71, D-53121 Bonn, Germany

The unification of relativity and thermodynamics has been a subject of considerable debate over the last 100 years. The reasons for this are twofold: (i) Thermodynamic variables are nonlocal quantities and, thus, single out a preferred class of hyperplanes in spacetime. (ii) There exist different, seemingly equally plausible ways of defining heat and work in relativistic systems. These ambiguities led, for example, to various proposals for the Lorentz transformation law of temperature. Traditional isochronous formulations of relativistic thermodynamics are neither theoretically satisfactory nor experimentally feasible. We will discuss how these deficiencies can be resolved by defining thermodynamic quantities with respect to the backward-lightcone of an observation event [1]. The second part of the talk concerns the question how Brownian motion processes can be generalized within the framework of special relativity [2].

[1] J. Dunkel, P. Hänggi and S. Hilbert, Nature Physics 5:741, 2009
[2] J. Dunkel and P. Hänggi, Physics Reports 471(1): 1, 2009.

Hauptvortrag GR 1.2 Mo 9:55 JUR K

Nonlocal Gravity Simulates Dark Matter — •Friedrich W. Hehl[1] and Bahram Mashhoon[2] — [1]University of Cologne and University of Missouri, Columbia, MO — [2]University of Missouri, Columbia, MO

A nonlocal generalization of Einstein's theory of gravitation is constructed within the framework of the translational gauge theory of gravity. In the linear approximation, the nonlocal theory can be interpreted as linearized general relativity but in the presence of "dark matter" that can be simply expressed as an integral transform of matter. It is shown that this approach can accommodate the Tohline-Kuhn treatment of the astrophysical evidence for dark matter.—

F.W.Hehl and B.Mashhoon, Phys.Rev.D79 (2009) 064028.

GR 2: Schwarze Löcher 1

Zeit: Montag 10:40–11:00 Raum: JUR K

GR 2.1 Mo 10:40 JUR K

Generalized Weyl solutions in five-dimensional Einstein-Gauss-Bonnet theory: the static black ring — •Burkhard Kleihaus, Jutta Kunz, and Eugen Radu — Universität Oldenburg

We argue that the Weyl coordinates and the rod-structure employed to construct static axisymmetric solutions in higher dimensional Einstein gravity can be generalized to the Einstein-Gauss-Bonnet theory. As a concrete application of the general formalism, we present numerical evidence for the existence of static black ring solutions in Einstein-Gauss-Bonnet theory in five spacetime dimensions. They approach asymptotically the Minkowski background and are supported against collapse by a conical singularity in the form of a disk. An interesting feature of these solutions is that the Gauss-Bonnet term reduces the conical excess of the static black rings. Analogous to the Einstein-Gauss-Bonnet black strings, for a given mass the static black rings exist up to a maximal value of the Gauss-Bonnet coupling constant α'. Moreover, in the limit of large ring radius, the suitably rescaled black ring maximal value of α' and the black string maximal value of α' agree.

GR 3: Schwarze Löcher 2

Zeit: Montag 16:45–18:05 Raum: JUR K

GR 3.1 Mo 16:45 JUR K

$d \geq 5$ static black holes with nonspherical horizon topology — Burkhard Kleihaus, Jutta Kunz, and •Eugen Radu — Institut für Physik, Universität Oldenburg, Postfach 2503 D-26111 Oldenburg, Germany

We discuss the properties of a class of $d \geq 5$ black holes with an event horizon topology $S^2 \times S^{d-4}$. These asymptotically flat solutions are static and present a conical singularity in the bulk. For $d = 5$ they reduce to the Emparan-Reall static black ring. Asymptotically anti-de Sitter black holes with an $S^2 \times S^1$ topology of the horizon are also discussed.

GR 3.2 Mo 17:05 JUR K

Asymptotically flat charged rotating dilaton black holes in higher dimensions — Ahmad Sheykhi[1], •Masoud Allahverdizadeh[2], Yosof Bahrampour[3], and Majid Rahnama[4] — [1]Department of Physics, Shahid Bahonar University, PO Box 76175, Kerman, Iran — [2]Institut fur Physik, Universitat Oldenburg, D-26111 Oldenburg, Germany — [3]Department of Mathematics, Shahid Bahonar University, Kerman, Iran — [4]Department of Physics, Shahid Bahonar University, PO Box 76175, Kerman, Iran

we find a class of asymptotically flat slowly rotating charged black hole solutions of Einstein*Maxwelldilaton theory with arbitrary dilaton coupling constant in higher dimensions. Our solution is the correct one generalizing the four-dimensional case. In the absence of a dilaton field, our solution reduces to the higher-dimensional slowly rotating Kerr*Newman black hole solution. The angular momentum and the gyromagnetic ratio of these rotating dilaton black holes are computed. It is shown that the dilaton field modifies the gyromagnetic ratio of the black holes.

GR 3.3 Mo 17:25 JUR K

Theoretical survey of tidal-charged black holes at the LHC — Benjamin Harms[1], Roberto Casadio[2], Sergio Fabi[1], and •Octavian Micu[3] — [1]University of Alabama, Tuscaloosa, Al, USA — [2]Bologna University and INFN, Italy — [3]TU Dortmund, Germany

A family of brane-world black holes which solve the effective four-dimensional Einstein equations for a wide range of parameters related to the unknown bulk/brane physics is analysed. The study is aimed at predicting the typical behavior one can expect if such black holes were produced at the LHC. It is found that, under no circumstances, the black holes would reach the (hazardous) regime of Bondi accretion. Nonetheless, the possibility remains that black holes live long enough to escape from the accelerator (and even from the Earth's gravitational field) and result in missing energy from the detectors.

GR 3.4 Mo 17:45 JUR K

Charged Boson Stars and Black Holes — •Meike List[1], Jutta Kunz[2], Burkhard Kleihaus[2], and Claus Lämmerzahl[1] — [1]ZARM - Universität Bremen, Am Fallturm, 28359 Bremen — [2]Carl-von-Ossietzky-Universität Oldenburg, Carl-von-Ossietzky-Straße 9-11, 26129 Oldenburg

We consider boson stars and black holes in scalar electrodynamics with a V-shaped scalar potential. The boson stars come in two types, having either ball-like or shell-like charge density. We analyze the properties of these solutions and determine their domains of existence. When mass and charge become equal, the space-times develop a throat. The shell-like solutions need not be globally regular, but may possess a horizon. The space-times then consist of a Schwarzschild-type black hole in the interior, surrounded by a shell of charged matter, and thus a Reissner-Nordstrøm-type space-time in the exterior. These solutions violate black hole uniqueness. The mass of the black hole solutions is related to the mass of the regular shell-like solutions by a mass formula of the type first obtained within the isolated horizon framework.

GR 4: Experimente zur Gravitation 1

Zeit: Montag 18:05–19:05 Raum: JUR K

GR 4.1 Mo 18:05 JUR K

Adaption of HPS to the MICROSCOPE Mission — •Stefanie Bremer, Meike List, Hanns Selig, and Claus Lämmerzahl — ZARM - Universität Bremen, Am Fallturm, 28359 Bremen

The French space mission MICROSCOPE aims at testing the Equivalence Principle (EP) up to an accuracy of 10^{-15}. The experiment will be carried out on a satellite which is developed and produced within the CNES Myriade series. The measuring accuracy will be achieved by means of two high-precision capacitive differential accelerometers, that are built by the French institute ONERA.

Currently, the HPS (High Performance satellite dynamics Simulator), a tool to support mission modeling, is adapted to the MICROSCOPE mission for the simulation of test mass and satellite dynamics. This tool is developed in cooperation with the DLR Institute of Space Systems. It includes possibilities for modeling environmental disturbances like solar radiation pressure as well as mission specific design aspects (e.g. geometry, number of accelerometers).

At ZARM, which is member of the MICROSCOPE performance team, the upcoming data evaluation process is prepared using the HPS. Therefore a comprehensive simulation of the real system including the science signal and all error sources is built.

The talk will contain a description of the HPS structure as well as of the implementation of environment models. Secondly, the actual status of the mission modeling will be presented.

GR 4.2 Mo 18:25 JUR K

Elektronisches Positionierungssystem — •Andrea Sondag[1], Marcus Stadtlander[1], Claus Lämmerzahl[1] und Hansjörg Dittus[2] — [1]ZARM, Universität Bremen — [2]DLR Bremen

Im Rahmen des von der DFG geförderten Projekts „Verbesserter Freifalltest des schwachen Äquivalenzprinzips“ wurde im ZARM, Universität Bremen ein elektrostatisches Positionierungssystem (EPS) entwickelt. Es soll eine Testmasse möglichst genau in axialer Richtung positionieren und wurde dazu in einem Laborexperiment getestet. Der Vortrag gibt einen Überblick über den aktuellen Stand und die ersten Ergebnisse der Charakterisierung des Systems. Wichtige Eigenschaften sind die Positioniergenauigkeit, Positioniergeschwindigkeit, Restgeschwindigkeiten der Testmasse nach der Positionierung sowie die Wiederholgenauigkeit. Auch die Ergebnisse zur Untersuchung der Systemfrequenzen, der spektralen Leistungsdichten und des Rauschens werden dargestellt. Ein Ausblick soll zeigen, wie das System weiter verbessert werden kann.

GR 4.3 Mo 18:45 JUR K

Intensivieren von Feldlinienkrümmung durch präzessionsbedingtes Drehzahlerhöhen von Massenrotationen — •Peter Kümmel — Amselweg 15 c, 21256 Handeloh

Der ”Powergyro” / ”Dynabee” erhöht durch Taumelbewegungen seines Gehäuses mit Lagerung die Drehzahl. Dies geschieht ohne mechanischen oder elektrischen Antrieb der Kreiselachse oder Kreiselrotationsmasse. Bedingung hierfür ist eine zuvor bereits existierende Anfangsgeschwindigkeit. Die schwach abgelenkten Feldlinien werden durch Präzession stärker gekrümmt. Dies vergrößert die Schwerpunktversatzstrecke bei gegenläufiger Anordnung. Schwerpunktversatz bewirkt Bewegung und umgekehrt. Referenzliteratur: ISBNs 3 921 291-00-3, -01-1, -02-X, -03-8, -04-6 und -05-4

GR 5: Hauptvorträge Dienstag: Weltraummissionen

Zeit: Dienstag 8:30–10:30 Raum: JUR K

Hauptvortrag GR 5.1 Di 8:30 JUR K

Orbitalsysteme als Plattformen für grundlegende physikalische Experimente — •Hansjörg Dittus — Institut für Raumfahrtsysteme, Deutsches Zentrum f. Luft- und Raumfahrt, Robert-Hooke-Str. 7, D - 28359 Bremen

Seit den Anfängen der Raumfahrt werden auch die Möglichkeiten intensiv diskutiert, sie zur Durchführung neuartiger und hoch präziser Experimente in vielen Bereichen der Physik, insbesondere aber in der Gravitationsphysik, zu nutzen. Mittlerweile existieren aber auch eine Vielzahl an Vorschlägen und konkreten Projekten zu quantenphysikalischen Tests unter den speziellen Bedingungen der Schwerelosigkeit.

Die experimentellen Möglichkeiten auf Satelliten und Plattformen sollen beschrieben und erörtert werden. Laufende Projekte und neueste Projektvorschläge sollen zusammenfassend dargestellt werden. Dabei wird auf die jüngsten technologischen Entwicklungen eingegangen.

Hauptvortrag GR 5.2 Di 9:10 JUR K

LISA and LISA Pathfinder: Gravitational wave astronomy from space — •Karsten Danzmann — AEI Hannover, Max-Planck Institut für Gravitationsphysik und Universität Hannover, Callinstr. 38, 30167 Hannover

The low-frequency part of the gravitational wave spectrum, from 100 micro-Hertz up to 1 Hz, contains the most spectacular sources of gravitational waves. Really high precision measurements are possible here, making this frequency range very interesting for both Astronomy and Fundamental Physics.

LISA, the Laser Interferometer Space Antenna, will comprise three satellites at the corners of an equilateral triangle with 5 Million km armlength. The constellation is inclined against the ecliptic by 60 degrees, following behind the earth in a distance of 50 Million km. Each satellite contains free-flying test masses on almost perturbation-free geodesic lines. Changes in the distances between the test masses will be measured by heterodyne laser interferometry with picometer resolution to detect the spacetime curvature caused by passing gravitational waves. LISA as a collaborative ESA/NASA mission is the most promising candidate for the L1 slot in the Cosmic Visions program of ESA with a launch in 2020. The Beyond Einstein Program Assessment Committee of NASA has just recently recommended LISA as a flagship mission for NASA.

Key technologies for LISA will be demonstrated on the precursor mission LISA Pathfinder, to be launched by ESA in 2012. Flight hardware manufacture for LISA Pathfinder has begun.

Hauptvortrag GR 5.3 Di 9:50 JUR K

Towards a One Percent Measurement of Frame Dragging by Spin with Satellite Laser Ranging to LAGEOS, LAGEOS 2 and LARES and GRACE Gravity Models — •Ignazio Ciufolini[1], Antonio Paolozzi[2], Erricos Pavlis[3], John Ries[4], Rolf Koenig[5], Richard Matzner[6], Giampiero Sindoni[2], and Hans Neumayer[5] — [1]University of Salento and INFN, Lecce, Italy — [2]Sapienza University of Rome, Scuola di Ingegneria Aerospaziale, Rome, Italy — [3]University of Maryland, Baltimore County, Baltimore, USA — [4]University of Texas at Austin, Center for Space Research, Austin, USA — [5]GFZ German Research Centre for Geosciences, Potsdam, Germany — [6]University of Texas at Austin, Center for Relativity, Austin, USA

During the past century Einstein’s theory of General Relativity gave rise to an experimental triumph; however, there are still aspects of this theory to be measured or more accurately tested. Today one of the main challenges in experimental gravitation, together with the direct detection of gravitational waves, is the accurate measurement of the gravitomagnetic field generated by the angular momentum of a body. Here, after a brief introduction on frame-dragging and gravitomagnetism, we describe the measurements of frame-dragging by the Earth spin, with an accuracy of approximately 10%, using the satellites LAGEOS, LAGEOS 2 and the Earth's gravity models obtained by the GRACE project. We then present the LARES experiment to be launched in 2010 by the Italian Space Agency for a measurement of frame-dragging with an accuracy of a few percent.

GR 6: Experimente zur Gravitation 2

Zeit: Dienstag 14:00–16:00 Raum: JUR K

GR 6.1 Di 14:00 JUR K

STAR - Space Time Asymmetry Research — •Claus Braxmaier[1], Thilo Schuldt[1], Mohammed Allab[1], Tim van Zoest[2], Stephan Theil[2], Ivanka Pelivan[2], Sven Herrmann[3], Claus Lämmerzahl[3], Achim Peters[4], Katharina Möhle[4], Andreas Wicht[4], Moritz Nagel[4], Evgeny Kovalchuk[4], Klaus Döringshoff[4], and Hansjörg Dittus[2] — [1]Hochschule Konstanz (HTWG) — [2]DLR, Institut für Raumfahrtsysteme, Bremen — [3]ZARM Universität Bremen — [4]Institut für Physik, Humboldt-Universität zu Berlin

STAR is a proposed satellite mission that aims for significantly improved tests of fundamental space-time symmetry and the foundations of special and general relativity. In total STAR comprises a series of five subsequent missions. The STAR1 mission will measure the constancy of the speed of light to one part in 10^{19} and derive the Kennedy Thorndike (KT) coefficient of the Mansouri-Sexl test theory to $7 \cdot 10^{-10}$. The KT experiment will be performed by comparison of an iodine standard with a highly stable cavity made from ultra low expansion (ULE) ceramics. With an orbital velocity of 7 km/s the sensitivity to a boost dependent violation of Lorentz invariance as modeled by the KT term in the Mansouri Sexl test theory or a Lorentz violating extension of the standard model (SME) will be significantly enhanced as compared to Earth based experiments. The low noise space environment will additionally enhance the measurement precision such that an overall improvement by a factor of 400 over current Earth based experiments is expected.

GR 6.2 Di 14:20 JUR K

Mobile accelerometers and gravity gradiometers based on atom interferometry — •Malte Schmidt[1], Guglielmo Tino[2], Philippe Bouyer[3], Ernst M. Rasel[4], Wolfgang Ertmer[4], Klaus Sengstock[5], Arnaud Landragin[6], Massimo Inguscio[7], Wolfgang Schleich[8], Reinhold Walser[8], Claus Lämmerzahl[9], Kai Bongs[10], and Achim Peters[1] — [1]Humboldt-Universität zu Berlin — [2]Università di Firenze — [3]Institut d'Optique, Orsay — [4]Institut für Quantenoptik, Hannover — [5]Universität Hamburg — [6]SYRTE, Paris — [7]LENS, Firenze — [8]Universität Ulm — [9]ZARM, Bremen — [10]University of Birmingham

Since 1992, matter wave interferometry has been used in many laboratories for a variety of fundamental physics experiments, e.g. measurement of the fine-structure and gravity constants. However, due to the complexity of these experiments, they were confined to laboratory environments. In recent years, however, efforts have been undertaken to develop mobile atom interferometers. These new sensors open up the possibility to perform on-site high-precision measurements of rotations, gravity gradients as well as absolute accelerations.

After briefly reviewing the basic principles underlying atom interferometers, we report on the status of different projects that are currently investigating and testing possible applications of mobile interferometers. These possibilities include earthbound mobile gravimeters as well as future employment of this technology in satellite missions (ESA Space Atom Interferometer project SAI). For both of these aspects, efforts are currently underway to construct prototype sensors. We give an overview of these sensors' designs and elaborate on their potential usefulness for earth observation missions. We acknowledge funding by ESA under contracts 20578/07/NL/VJ (SAI) and 21583/08/NL/HE (APPIA).

GR 6.3 Di 14:40 JUR K

Applications of Bose-Einstein-Condensates in microgravity — •Hauke Müntinga[1], Claus Lämmerzahl[1], Sven Herrmann[1] und das QUANTUS Team[1,2,3,4,5,6] — [1]ZARM, Universität Bremen — [2]Institut für Quantenoptik, LU Hannover — [3]Institut für Physik, HU Berlin — [4]Institut für Laserphysik, Universität Hamburg — [5]Institut für Quantenphysik, Universität Ulm — [6]MPQ, München

We report on the current status of the QUANTUS free fall BEC experiment at the ZARM drop tower in Bremen.

After the first realization of a BEC in microgravity in 2007, we were able to observe condensates after 1 s of free evolution. The extremely shallow traps possible in microgravity and resulting ultralow temperatures of a few nK allow for further studies ranging from coherence properties of condensates to inertial sensors based on matter waves.

In our talk we will focus on the implementation of a matter wave interferometer into our apparatus, which aims to extend measurement times to unprecedented durations and sensitivities. This leads the way to high precision measurements of gravitational forces and eventually a quantum test of Einstein's weak equivalence principle. Phenomena like quantum reflection and Anderson localization can also be examined with our apparatus. These goals are worked on in close cooperation with QUEST and the project PRIMUS.

The QUANTUS project is supported by the German Space Agency DLR with funds provided by the Federal Ministry of Economics and Technology (BMWi) under grant number DLR 50WM0836.

GR 6.4 Di 15:00 JUR K

High-Precision Atom Interferometry — •Naceur Gaaloul[1], Ernst M. Rasel[1], and das QUANTUS Team[1,2,3,4,5,6,7,8,9] — [1]Institut für Quantenoptik, LU Hannover — [2]ZARM, Uni Bremen — [3]Institut für Physik, HU Berlin — [4]Institut für Laserphysik, Uni Hamburg — [5]Institut für Quantenphysik, Uni Ulm — [6]MPQ, München — [7]Institut für angewandte Physik, TU Darmstadt — [8]Midlands Ultracold Atom Research Centre, University of Birmingham, UK — [9]FBH, Berlin

The recent developments in quantum optics transformed atom interferometry from pure fundamental research to a powerful technique giving birth to a multitude of tools for metrology, gravimetry and fundamental physics. Besides the measurement of fundamental constants (Fine structure constant, gravitational constants) or the tests of fundamental laws (Equivalence principle), the application of atom interferometers for gravimetry or generally for the measurement of inertial forces (Earth rotation, acceleration) became a central focus of research. Indeed, atom interferometers show not only a high sensitivity compared to other techniques but also an intrinsically high accuracy comparable to atomic clocks. Our efforts to advance the field of atom interferometry by carrying out challenging experiments, building networks and identifying the physical limitations as well as the potential applications will be reported in this contribution.

The QUANTUS project is supported by the German Space Agency DLR with funds provided by the Federal Ministry of Economics and Technology (BMWi) under grant number DLR 50WM0835-0839.

GR 6.5 Di 15:20 JUR K

GAP on Odyssey — •Tim van Zoest[1], Hansjörg Dittus[1], Claus Lämmerzahl[2], Hanns Selig[2], Bruno Christophe[3], and the Odyssey Science Team[3] — [1]DLR, Inst. f. Raumfahrtsysteme, Bremen — [2]ZARM, Universität Bremen — [3]ONERA, France

The objective of Odyssey is a set of gravitational tests in the solar system. Specifically, this mission is going to achieve four major scientific objectives, the test of the deep space gravity, the investigation of flybys, tests of the general relativity at solar conjunctions and planetary observations at Neptune and Triton. The tests will be performed by the "Gravity Advanced Package" (GAP). Since the instrument is only sensitive to non-gravitational forces, it tells whether or not the spacecraft follows a pure geodesic trajectory. This allows to obtain a much more precise orbit determination trajectory. As a consequence, the dependence of the gravitational force versus the distance to the sun is measured with a largely improved accuracy, opening new perspectives for the test of hypothetical deviations from the $1/r^2$ law predicted by higher dimensional models with large extra dimensions. During its trip from 1 up to 50 AU, the mission would search for dynamical anomalies in the motion of the spacecraft with an accuracy at the level of 4×10^{-11} m/s^2. The GAP instrument consists of an electrostatic accelerometer (ONERA design) and a bias rejection subsystem, where the rejection is obtained by modulating, at a frequency between 1 and 10 mHz, the non-gravitational acceleration delivered by the accelerometer. The total mass of the instrument is less than 3 kg, with a power consumption less than 3 W and a volume of less than 3 liters.

GR 6.6 Di 15:40 JUR K

Modelling and evaluation of Pioneer 10/11 thermal recoil: Work status and first results — •Benny Rievers and Claus Lämmerzahl — Zentrum für angewandte Raumfahrttechnologie und Mikrogravitation (ZARM), Universität Bremen, Am Fallturm, 28359 Bremen

The origin of the anomalous constant deceleration of the Pioneer 10/11 spacecrafts, first identified by Anderson et al in 1998, has been subject of several scientific investigations and speculations. Many systematic effects have been ruled out as the cause, however, the anisotropic radiation emitted by the crafts is supposed to explain at least a non-negligible part of the observed anomaly. In order to evaluate the exact magnitude and the dynamics of thermal recoils a method based on ray tracing and finite element (FE) modeling has been developed at the Center of Applied Space Technology and Microgravity (ZARM). Preliminary results show that a significant amount of the observed effect can be credited to thermal effects. A complete FE model of Pioneer 10 including detailed outer shape, internal payloads and temperature measurements of the radioisotopic thermal generators is developed at ZARM and will enable the exact evaluation of thermal disturbance accelerations. An overview of the current work status and a detailed insight in the used method will be given. Besides the evaluation of thermal effects with respect to Pioneer anomaly investigations the elaborated method can also benefit the upcoming high-precision missions (LISA, LISA pathfinder, MICROSCOPE ...) where the high scientific requirements demand precise modeling of thermal perturbations.

GR 7: Gravitationswellen 1

Zeit: Dienstag 16:00–16:20 Raum: JUR K

GR 7.1 Di 16:00 JUR K

Uhrenrauschen bei LISA — •Markus Otto, Gerhard Heinzel und Karsten Danzmann — AEI Hannover (Max-Planck-Institut für Gravitationsphysik), Leibniz Universität Hannover

Bei der Detektion von Gravitationswellen mit Hilfe der Satellitenmission Laser Interferometer Space Antenna (LISA) ist im Beobachtungsband 0.1 mHz - 1 Hz das Laserrauschen die wesentliche Störgröße. Durch Time Delay Interferometry (TDI) kann diese Rauschquelle synthetisch entfernt werden, während das Gravitationswellensignal erhalten bleibt. Hierzu kombiniert man auf geschickte Art zeitverzögerte Interferometersignale.

Um diese synthetisierten Datenstromkombinationen überhaupt erzeugen zu können, muss das analoge Interferometersignal in ein digitales Signal mit Hilfe eines Analog-Digital-Konverters (ADC) umgeformt werden. Der ADC wird von einer extrem genauen Uhr gesteuert (USO). Diese Uhr wiederum unterliegt Schwankungen, wodurch Uhrenrauschen (clock noise) in die Datenströme einkoppelt. Wir werden in diesem Vortrag einen kurzen Überblick der Problematik geben und Lösungsansätze zum Herausrechnen des Uhrenrauschens diskutieren.

GR 8: Gravitationswellen 2

Zeit: Dienstag 16:45–17:25 Raum: JUR K

GR 8.1 Di 16:45 JUR K

Gravitationswellenforschung: Aussagen und Aussichten — •Peter Aufmuth — Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut), Callinstr. 38, 30167 Hannover

Die interferometrischen Gravitationswellendetektoren haben die für die erste Generation geplante Empfindlichkeit erreicht. Die Reichweite ist leider immer noch zu gering für den regelmäßigen Nachweis von Signalen. Auch aus deren Ausbleiben lassen sich aber heute schon Aussagen über die Gestalt von Neutronensternen oder über den Ursprung der stochastischen Hintergrundstrahlung machen. Das Restrauschen der Detektoren könnte bereits Hinweise auf die Quantennatur der Raumzeit enthalten und so Beiträge zu einer Quantengravitationstheorie liefern. Bis 2014 soll die Empfindlichkeit der Detektoren um das Zehnfache gesteigert werden. Dies bedeutet ein tausendmal größeres Beobachtungsvolumen und eine entsprechend höhere Nachweisrate.

GR 8.2 Di 17:05 JUR K

Orbital motion of spinning compact binaries — •Manuel Tessmer, Johannes Hartung, and Gerhard Schäfer — TPI, Physikalisch-Astronomische Fakultät, Friedrich-Schiller-Universität Jena

A Keplerian-type parameterization for the solutions to post-Newtonian accurate equations of motion for spinning compact binaries is obtained including both spin-orbit and spin-spin interactions. For arbitrary mass ratios the spin orientations are taken to be parallel or antiparallel to the orbital angular momentum vector, for nearly equal masses no assumptions about the spin orientations are made but quasi circularity of the orbits is chosen.

GR 9: Kosmologie 1

Zeit: Dienstag 17:25–19:05 Raum: JUR K

GR 9.1 Di 17:25 JUR K

Quartessence Models in Cosmology — •Hermano Velten — Fakultät für Physik, Universität Bielefeld, Bielefeld, Deutschland — Departamento de Física, Universidade Federal do Espírito Santo, Brasil

Two of the major puzzles of modern comsology are the nature of dark energy and dark matter. In this contribution we consider the hypothesis that dark energy and dark matter could be different manifestations, observed at different scales, of the same substance, the unifying dark matter or quartessence. We shall show some recent results of this class of models in the context of structure formation process in the universe.

GR 9.2 Di 17:45 JUR K

Stochastic Inflation and Replica Field Theory — •Florian Kühnel — Bielefeld University

In this talk, I discuss the application of replica field theory to stochastic inflation. After a review of the latter and a basic introduction to the former, I present recent results for the power spectrum. This is done for a minimally-coupled test field in de Sitter space-time. I will comment on the choice of filter functions and discuss the infra-red suppression of the power spectrum as an outcome of this new approach. In particular, I will show how this damping might explain the observed lack of large-angle correlation on the non-Galactic microwave sky.

GR 9.3 Di 18:05 JUR K

Optics in curved space — •Vincent Schultheiss[1,2], Sascha Batz[1,2], and Ulf Peschel[2] — [1]MPI für die Physik des Lichts, Erlangen, Germany — [2]Institut für Optik, Information und Photonik, Universität Erlangen-Nürnberg, Germany

The conventional way of manipulating light propagation is to introduce specific optical elements, which break the homogeneity of the transmitting medium by modulating the refractive index. In this context the underlying space is assumed to be flat. However, Maxwell's equations are not limited to the specific case of Euclidean space, but can be generalized to a covariant form holding also in curved space. It turns out that indeed space influences the evolution of light beyond the ray-optical approximation even without the need of modulating the refractive index. Here we present the very first experimental study of the impact of intrinsic curvature on the evolution of optical waves. While so-called transformation optics proposes the use of metamaterials to mimic non flat space-time, we choose a more direct approach and abandon one spatial dimension to investigate light propagation on specifically shaped two-dimensional curved surfaces embedded in three dimensional space. For positive intrinsic (or Gaussian) curvature as it is modeled by the surface of a sphere we observe periodic refocusing, self-imaging and diffractionless propagation. In contrast light spreads exponentially on hyperbolic surfaces with constant negative Gaussian curvature. The proposed ideas open up new approaches to manipulate light in integrated optical circuits and investigate analogous models of general relativity.

GR 9.4 Di 18:25 JUR K

Variable Speed of Light and its Cosmological Implications — •Alexander Unzicker — Pestalozzi-Gymnasium München

Variable speed of light (VSL) formulations of general relativity have been shown to be in accordance with the four classical tests. The approach presented here combines Dicke's (1953) theory (different from Brans-Dicke) with de Broglies phase velocity formula $c^2 = vV$ in order to obtain equations of motion from a variational principle of minimum phase. This realizes Mach's principle with variable time and lenght scales. The cosmological consequences would explain Dirac's observation on the total number of particles in the universe known as Large Number Hypothesis. Furthermore, it is discussed how small accelerations on the cosmological scale $10^{-10}\frac{m}{s^2}$ can appear.

GR 9.5 Di 18:45 JUR K

Physical applications of a natural interpretation of the constant of gravity — •Reinhold Zwickler — Am Trautheim 14, D-64367 Mühltal, Germany

According to Heisenberg and J.D.Barrow progress in physics may require a new system of concepts and/or a revision of constants of nature. In this paper a complete solution of the "cosmologic problem" is presented, based on a generalization of the Newtonian system of concepts and a natural interpretation of the constant of gravity G.The solution unifies two generalized laws of classical physics into one space-time-equation, in which the constant of gravity arises as an initial condition and determines the accelerated expansion of the universe once and for all.The mean density of matter of today is predicted correctly. The new interpretation of G as "specific expansion acceleration" is a necessary completion to the phenomen of attraction in order to avoid a collaps of the galaxies and to provide a state of equilibrium of the universe. It is shown that the cosmic balance can be compared with the phase equilibrium between liquid and gas for water even above the critical point, where the theory of the cosmos can be used as an analoguous solution for the inconsistent definition of "liquid" and "gas" as formulated by Planck with a conceptual paradox in 1897. The principle of equi-librium seems the be a general order principle in nature. A discussion of some rash conclusions about classical physics and of doubtful opinions in today physics is necessary in the interest of progress in science and education.

GR 10: Hauptvorträge Mittwoch: Astrophysik

Zeit: Mittwoch 8:30–10:00 Raum: JUR K

Hauptvortrag GR 10.1 Mi 8:30 JUR K

Supermassive black holes in galaxies: Correlations, coincidences and coevolution — •Knud Jahnke — Max Planck Institute for Astronomy, Heidelberg

It has been known for about a decade that supermassive black holes exist in the centers of at least most massive galaxies. This moved the previously deemed exotic class of galaxies with an "active nucleus" e.g. knows as "quasars" in their most extreme form, into the focus of galaxy evolution research. Black holes grow and evolve in galaxies, no doubt about this. But do galaxy and black hole growth influence each other? The existence of scaling relations between black hole and galaxy suggests this, e.g. through a potential mechanism of energetic feedback from the black hole into the galaxy and a resulting self regulating loop of black hole and stellar mass growth.

I will review the observational evidence and mechanisms that are seen or proposed to be effective in the apparent coevolution of galaxies and black holes and show the current state of empirical constraints. And I will ask the question whether there are alternatives to an interpretation of the galaxy black hole scaling relations other than a causal connection of the two.

Hauptvortrag GR 10.2 Mi 9:15 JUR K

Galactic Archaeology — •Eva K. Grebel — Astronomisches Rechen-Institut, Zentrum für Astronomie der Universität Heidelberg, Mönchhofstr. 12-14, 69120 Heidelberg

Our Milky Way is part of a small group of galaxies, the so-called Local Group. The Local Group contains a variety of galaxies of different types, morphologies, luminosities, and masses. Owing to the proximity of these galaxies we can study them in great detail and can even resolve them into individual stars. These stars are essentially fossil witnesses of past epochs, permitting us to unravel the evolutionary history of these galaxies over billions of years doing true "galactic archaeology". The most frequent type of galaxy is of particular interest: Small, low-mass dwarf galaxies of very low luminosity. Many of these objects were only discovered in recent years. Often they are considered as remnants of the building blocks of large galaxies. They appear to be dark-matter-dominated and play a key role in testing predictions of cosmological models for galaxy formation.

GR 11: Kosmologie 2

Zeit: Mittwoch 14:00–15:20 Raum: JUR K

GR 11.1 Mi 14:00 JUR K

divide et impera: Partitioning the average universe — •Alexander Wiegand[1] and Thomas Buchert[2] — [1]Fakultät für Physik, Universität Bielefeld, Universitätsstraße 25, D-33615 Bielefeld — [2]Université Lyon 1, CRAL, 9 avenue Charles André, F-69230 Saint-Genis-Laval

Cosmological backreaction suggests a link between structure formation and the expansion history of the Universe. In order to quantitatively examine this connection we dynamically investigate a volume partition of the Universe into over– and underdense regions. This allows to trace structure formation using the volume fraction of the overdense regions $\lambda_{\mathcal{M}}$ as its characterizing parameter. Employing results from cosmological perturbation theory, and under the assumption of an initial near to homogeneous Gaussian density field, we construct a three–parameter model for the effective cosmic expansion history, involving $\lambda_{\mathcal{M}_0}$, the matter density and the Hubble rate of today's Universe.

The talk presents the resulting model and first tests of its capability to explain what we know about the evolution of the Universe, in the backreaction context. Furthermore, the possible benefits of an application of the partitioning approach to more general cases will be discussed.

GR 11.2 Mi 14:20 JUR K

Probing Backreaction Effects with Supernova Data — •Marina Seikel and Dominik J. Schwarz — Universität Bielefeld

As the Einstein equations are non-linear, spatial averaging and temporal evolution do not commute. Therefore, the evolution of the averaged universe is affected by inhomogeneities. It is, however, highly controversial how large these cosmological backreaction effects are. We use the supernova data of the Constitution set up to a redshift of 0.1 in order to analyse to what extent the measurement of the Hubble constant is affected. The size of the effect depends on the size of the volume that is averaged over. The observational results are then compared to the theory of the backreaction mechanism.

GR 11.3 Mi 14:40 JUR K

Propagation of vacuum bubbles on dynamical backgrounds — •Dennis Simon[1], Julian Adamek[1], Aleksandar Rakic[1], and Jens Niemeyer[1,2] — [1]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany — [2]Institut für Astrophysik, Universität Göttingen, Friedrich-Hund-Platz 1, D-37077 Göttingen, Germany

In the context of nucleation of vacuum bubbles by Coleman-De Luccia tunneling we focus on the propagation of such bubbles in matter dominated FLRW and LT backgrounds. Using a thin wall approximation and the Israel junction method we solve the equations of motion and show that, in contrast to the standard de Sitter scenario, bubbles in dust dominated backgrounds can not expand. Furthermore the presence of dust and curvature inhomogeneities hardly affects the trajectory of the domain wall and therefore has no influence on the cosmology inside the bubble. However, a sudden phase transition in the matter background changes the motion of the bubble and raises the question whether this leads to potentially observable effects, e.g. in the CMB.

GR 11.4 Mi 15:00 JUR K

Dark strings interacting with cosmic strings — •Betti Hartmann[1], Yves Brihaye[2], and Farhad Arbabzadah[1] — [1]Jacobs University Bremen, Germany — [2]Universite de Mons, Belgium

Dark strings are a prediction of new dark matter models that try to explain the excess electronic production in the galaxy. In this talk, I will discuss the interaction of these dark strings with cosmic strings. The main result is that cosmic strings can lower their energy when interacting with dark strings, which might have consequences for the evolution of cosmic string networks.

GR 12: Astrophysik

Zeit: Mittwoch 15:20–16:20 Raum: JUR K

GR 12.1 Mi 15:20 JUR K

Bestimmung der Dunkle-Materie-Verteilung der Milchstraße — •Markus Weber und Wim de Boer — Karlsruher Institut für Technologie (KIT), Germany

Das Dichtemodell der Milchstraße ist hauptsächlich durch die lokale Materiedichte (Oort-Limit), die Rotationsgeschwindigkeit am Ort der Sonne und die Gesamtmasse der Galaxie bestimmt. Die χ^2-Anpassung aller Daten zeigt, dass die lokale Dunkle-Materie-Dichte stark positiv mit dem Skalenradius des Haloprofils und stark negativ mit dem Skalenradius der Dichteverteilung der Galaktischen Scheibe korreliert ist. Da diese Skalenlängen nur ungenau bekannt sind kann die lokale Dichte von 0.2 bis 0.4 GeV cm^{-3} (0.005 - 0.01 $M_\odot$ pc^{-3}) variieren, wenn man ein sphärisches Haloprofil annimmt und eine Gesamtmasse bis zu $2 \cdot 10^{12}$ $M_\odot$ zulässt. Für abgeplattete Haloprofile und Scheiben aus Dunkler Materie, die von N-body-Simulationen vorhergesagt werden, kann sich die lokale Dunkle-Materie-Dichte weiter erhöhen. Die Rotationskurve innerhalb der Galaktischen Scheibe, die ein Minimum bei etwa 9 kpc aufweist, kann durch ein einfaches Haloprofil nicht beschrieben werden. Eine Substruktur des Halos, bestehend aus zwei Dunkle-Materie-Ringen, kann die Rotationskurve innerhalb der Galaktischen Scheibe, die Rotationsgeschwindigkeit von Halosternen und die lokale Oberflächendichte beschreiben.

GR 12.2 Mi 15:40 JUR K

Dark matter in galactic disks — •Peter M.W. Kalberla — Argelander-Institut für Astronomie

Dark matter (DM) is needed to explain the rotation of galaxies but details about the shape of the DM distribution are controversial, in particular for the Milky Way.

There is growing evidence that a significant fraction of the DM around galaxies is associated with the baryonic disks. We discuss observations and simulations that give evidence for such a distribution and constrain the properties of DM disks.

The gas distribution in the Milky Way disk and its halo is well known from high precision observations. The gas extends far beyond the stellar population and is therefore a perfect tracer of the gravitational potential. For the Milky Way we solve the combined Poisson-Boltzmann equations in a self-consistent way. Our results suggest a DM disk, in good agreement with mass models derived from the observed excess of diffuse gamma rays from EGRET. Dwarf galaxies recycled from the collisional debris of massive galaxies give additional evidence.

We compare observational constraints for the mass distribution in the Milky Way with results from recent n-body simulations of merger events. Alternative explanations from modified Newtonian dynamics are discussed. We comment on speculations about the origin of the DM disk.

GR 12.3 Mi 16:00 JUR K

On the frequency band of the f-mode CFS instability — •Burkhard Zink[1], Oleg Korobkin[2], Erik Schnetter[2], and Nikolaos Stergioulas[3] — [1]Theoretische Astrophysik, Eberhard-Karls-Universität Tübingen — [2]Center for Computation and Technology, Louisiana State University, Baton Rouge, LA, USA — [3]Department of Physics, Section of Astrophysics, Astronomy and Mechanics Aristotle University of Thessaloniki, Thessaloniki, Greece

Rapidly rotating neutron stars can be unstable to the CFS mechanism if they have a neutral point in the spectrum of nonaxisymmetric f-modes. We investigate the frequencies of these modes in two sequences of uniformly rotating polytropes using nonlinear simulations in full general relativity, determine the approximate locations of the neutral points, and derive limits on the observable frequency band available to the instability in these sequences.

GR 13: Klassische Allgemeine Relativitätstheorie 1

Zeit: Donnerstag 9:10–10:30 Raum: JUR K

GR 13.1 Do 9:10 JUR K

Analytic solution of the geodesic equations in the Plebański-Demiański spacetimes of generalized Black Holes — Eva Hackmann[2], Valeria Kagramanova[1], Jutta Kunz[1], and •Claus Lämmerzahl[2] — [1]Universität Oldenburg — [2]ZARM, Universität Bremen

The Plebański–Demiański metric represents the complete family of Petrov type D solutions of the Einstein-Maxwell equations in 4 dimensions with an aligned electromagnetic field and non-zero cosmological constant. It includes e.g. Kerr-de Sitter, NUT-de Sitter and Kerr–NUT–de Sitter spacetimes. These spacetimes are characterized by 7 parameters: mass, nut parameter, rotation parameter, electric and magnetic charges, cosmological constant and the acceleration. We show that the separable Hamilton–Jacobi equations in the spacetimes without acceleration are analytically integrable and present the complete sets of analytic solutions of the equation of motion for a charged particle. The solutions are given in terms of the Kleinian sigma functions and are based on the theory of hyperelliptic integrals and functions.

GR 13.2 Do 9:30 JUR K

Discussion of geodesics in Kerr-de Sitter space-time — •Eva Hackmann and Claus Lämmerzahl — ZARM, Universität Bremen

Recently, the geodesic equation in Kerr-de Sitter space-time has been solved analytically (arXiv:0911.1634v1). Using this solution, we discuss chosen geodesics in this space-time. This includes orbits which highlight the influence of the cosmological constant as well as the last stable spherical orbit and the innermost stable circular orbit. In addition, the analytical expressions for the perihelion shift and the Lense-Thirring effect will be discussed and corresponding orbits will be shown.

GR 13.3 Do 9:50 JUR K

Analytical solution of the geodesic equations in the NUT–(de Sitter) spacetime. — •Valeria Kagramanova[1], Jutta Kunz[1], Eva Hackmann[2], and Claus Lämmerzahl[2] — [1]Universität Oldenburg — [2]ZARM, Universität Bremen

We analytically solve the geodesic equations in the NUT–de Sitter spacetime which belongs to the Petrov type D spacetimes of generalized Black Holes and is characterized by the (gravielectric) mass and the gravimagnetic mass. The analytical solution of the geodesic equations, given in terms of Weierstrass elliptic functions (NUT) and hyperelliptic theta and sigma functions (NUT–de Sitter), allows us to systematically study the motion of test particles and to derive analytic expressions for the observables. In particular, we discuss the incomplete geodesics in these spacetimes.

GR 13.4 Do 10:10 JUR K

Analytische Berechnung der Bahnen und deren Observablen in der Kerr-Raumzeit — •Claus Gebhardt, Eva Hackmann und Claus Lämmerzahl — ZARM, Uni Bremen

Die analytische Lösung der Geodätengleichung in der Kerr-Raumzeit lässt sich mit Hilfe elliptischer Funktionen finden. Dieser Formalismus führt weiterhin auf die analytische Darstellung von Observablen in dieser Raumzeit. In unserem Vortrag werden wir die analytische Lösung darlegen und anschließend Phänomene wie die Lichtablenkung, den fly-by von Teilchen, die Periheldrehung sowie den Lense-Thirring-Effekt diskutieren. Außerdem geben wir einen Ausblick auf spezielle Orbits, wie z. B. die innerste stabile Kreisbahn.

GR 14: Hauptvorträge Donnerstag: Dynamik ausgedehnter Körper 1

Zeit: Donnerstag 14:00–16:15 Raum: JUR K

Hauptvortrag GR 14.1 Do 14:00 JUR K

Motion of extended bodies in General Relativity — •Dirk Pützfeld — Albert-Einstein-Institut, Golm

The description of the motion of extended bodies represents a long-standing problem in the context of Einstein's theory of gravity.

In general, the study of extended self-gravitating objects in General Relativity requires the use of different approximation techniques. Many applications in gravitational physics, e.g. the detection of gravitational waves, crucially depend on our theoretical understanding and mastery of such approximation techniques.

In this talk we provide a brief review of the so-called 'problem of motion' in General Relativity. In particular, we focus on multipolar approximation methods and their use in the description of the motion of extended test bodies.

Hauptvortrag GR 14.2 Do 14:45 JUR K

Spinning test particles in black-hole space-times — •Oldřich Semerák — Institute of Theoretical Physics, Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic

In general relativity, the behaviour of spinning test particles is usually treated within 'pole-dipole' approximation, represented by Mathisson-Papapetrou equations. The system has to be closed by a 'spin supplementary condition' whose role is to select a representative worldline with respect to which the test body's mass and spin are determined. We illustrate the effect of spin-curvature coupling and of the supplementary condition on numerical trajectories obtained in black-hole space-times. We also mention that non-zero spin turns the particle dynamics chaotic. What remains to be clarified is the validity of pole-dipole approximation and the relevance of spin in astrophysical situations.

Hauptvortrag GR 14.3 Do 15:30 JUR K

Black holes with spin in numerical general relativity — •Bernd Brügmann — TPI, Uni Jena, Germany

Solving the Einstein equations of general relativity for black hole binary systems is of particular interest for gravitational wave astronomy. Numerical simulations are now possible that cover the highly non-linear, dynamical phase of the last few orbits and the merger. Binary mergers involving spinning black holes pose additional challenges, in particular for precessing spins. We discuss results for gravitational wave predictions as well as surprises regarding black hole recoil due to spin effects.

GR 15: Klassische Allgemeine Relativitätstheorie 2

Zeit: Donnerstag 16:45–17:25 Raum: JUR K

GR 15.1 Do 16:45 JUR K

Geodesics in black hole space-times with cosmic strings — •Parinya Sirimachan[1], Eva Hackmann[2], Betti Hartmann[1], and Claus Lämmerzahl[2] — [1]Jacobs University Bremen, Germany — [2]ZARM, University Bremen, Germany

We investigate the solutions of the geodesic equations in the space-time of a Schwarzschild, respectively Kerr black hole pierced by an infinitely long cosmic string in the thin string limit. In this work the full set of analytical solutions of the geodesic equations are given in terms of elliptic functions. The perihelion shift and the light deflection have been calculated in order to compare the results with the observational data from the solar system.

GR 15.2 Do 17:05 JUR K

Orbits of spinning particles in Schwarzschild- and Kerr-de Sitter space-times — •Isabell Schaffer und Claus Lämmerzahl — ZARM, Universität Bremen, Am Fallturm, D-28359 Bremen

Spinning particles are described within the Mathisson–Papapetrou–Dixon–formalism. We calculate the orbits of particles with spin and the corresponding spin motion in Schwarzschild-de Sitter and Kerr-de Sitter space-times, determine the influence of the spin on the orbit, and evaluate the influence of the cosmological constant.

GR 16: Numerische Relativitätstheorie

Zeit: Donnerstag 17:25–18:25 Raum: JUR K

GR 16.1 Do 17:25 JUR K

Toward a dynamical shift condition for unequal mass black hole binary simulations — •Doreen Müller, Jason Grigsby, and Bernd Brügmann — Theoretisch-Physikalisches Institut, FSU Jena

Moving puncture simulations of black hole binaries rely on a specific gauge choice that leads to approximately stationary coordinates near each black hole. Part of the shift condition is a damping parameter, which has to be properly chosen for stable evolutions. However, a constant damping parameter does not account for the difference in mass in unequal mass binaries. We introduce a position dependent shift damping that addresses this problem. Although the coordinates change, the changes in the extracted gravitational waves are small.

GR 16.2 Do 17:45 JUR K

3D matter evolution with the Z4 formulation — •Marcus Thierfelder[1], Wolfgang Tichy[2], Sebastiano Bernuzzi[1], Roman Gold[1], David Hilditch[1], and Bernd Brügmann[1] — [1]Theoretisch-Physikalisches Institut, FSU Jena, Germany — [2]Department of Physics, Florida Atlantic University, USA

Several promising tests in spherical symmetry have shown that the evolution with a conformal decomposition of a Z4-like formulation (Z4c) of General Relativity shows advantages in comparison with the BSSNOK formalism. We compare evolutions of both systems in full 3D for puncture and neutron star initial data.

GR 16.3 Do 18:05 JUR K

Phase space of eccentric black hole binaries — •Roman Gold and Bernd Brügmann — Theoretisch Physikalisches Institut, FSU Jena, Germany

The possibility of gravitational wave detections within the near future relies on our understanding of the corresponding sources. Apart from the mere detection there is the additional challenge of how to derive the dynamics of the source from it's observed radiation properties. In terms of a black hole binary it is well-known that parameter estimation becomes much more accurate when the orbits are eccentric. I show recent results on the phase space trajectories as well as radiation properties of two black holes on eccentric orbits computed from fully general relativistic simulations. The data set involves so-called zoom-whirl orbits and hyperbolic encounters. I demonstrate new results on a phase space approach that allows one to qualitatively understand on physical grounds why certain eccentric orbital configurations radiate more intense than others.

GR 17: Hauptvorträge Freitag: Dynamik ausgedehnter Körper 2

Zeit: Freitag 8:30–10:30 Raum: JUR K

Hauptvortrag GR 17.1 Fr 8:30 JUR K

Canonical formulation of spinning objects in General Relativity — •Jan Steinhoff — Theoretisch-Physikalisches Institut, FSU Jena

The extension of the canonical formalism of Arnowitt, Deser and Misner from point-masses to spinning objects is a long standing problem in General Relativity. Two independent approaches to a solution of this problem are given in this talk. The first is based on an explicit order-by-order construction of the canonical formalism within the post-Newtonian approximation scheme, using the pole-dipole stress-energy tensor of spinning objects. Here the global Poincaré algebra is the important consistency condition. The second approach is based on an action functional and is similar to the original derivation of Arnowitt, Deser and Misner for non-spinning objects. A comparison to the canonical formulation of the Dirac field coupled to gravity is made. As an application, spin and quadrupole contributions to next-to-leading order in the post-Newtonian approximation scheme are presented.

Hauptvortrag GR 17.2 Fr 9:10 JUR K

Effective one body description of tidal effects in inspiralling compact binaries — •Alessandro Nagar and Thibault Damour — Institut des Hautes Etudes Scientifiques, Bures sur Yvette, France

The late part of the gravitational wave signal of binary neutron star inspirals can in principle yield crucial information on the nuclear equation of state via its dependence on relativistic tidal parameters (relativistic Love numbers). In the hope of analytically describing the gravitational wave phasing during the late inspiral (essentially up to contact) we discuss an extension of the effective one body (EOB) formalism which includes tidal effects. We compare the prediction of this tidal-EOB formalism to i) recently computed nonconformally flat quasi-equilibrium circular sequences of binary neutron star systems and ii) complete numerical relativity binary neutron star inspiral waveforms. Our analysis suggests the importance of higher-order (post-Newtonian) corrections to tidal effects, even beyond the first post-Newtonian order, and their tendency to *significantly* increase the "effective tidal polarizability" of neutron stars. The comparison shows the strong sensitivity of the late-inspiral phasing to the choice of the analytical model, but raises the hope that a sufficiently accurate numerical–relativity–"calibrated" EOB model might give us a reliable handle on the nuclear equation of state

Hauptvortrag GR 17.3 Fr 9:50 JUR K

Self-gravitating elastic bodies — •Lars Anderson — Albert Einstein Institute

I will discuss some recent results and open problems concerning self-gravitating elastic bodies in Einstein gravity. Among the topics are constructions of static and rotating bodies, multi-body configurations as well as the dynamics of self-gravitating elastic bodies.

GR 18: Grundlegende Probleme

Zeit: Freitag 14:00–15:00 Raum: JUR K

GR 18.1 Fr 14:00 JUR K

On the reduced Next-to-Leading Order Spin-Squared Hamiltonian for Binary Systems — •Steven Hergt — Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universität, Max-Wien-Platz 1, 07743 Jena, Germany, EU

It is presented the fully reduced (to the physical degrees of freedom) next-to-leading-order Spin-Squared Hamiltonian for arbitrary binaries like black holes or neutron stars modeled by a quadrupole constant, which takes into account self-spin interaction or spin deformation effects at 2nd post-Newtonian order in perturbation theory of Einstein's field equations. The Hamiltonian is calculated in standard canonical variables. Equivalence of different approaches attaining this Hamiltonian (with different spin supplementary condition or coordinates) is also shown.

GR 18.2 Fr 14:20 JUR K

On the equations of motion for a charged dust — •Volker Perlick and Anthony Carr — Physics Department, Lancaster University, Lancaster LA1 4YB, UK

We consider the equations of motion for a charged dust coupled to Maxwell's equations on a general-relativistic spacetime (Maxwell-Lorentz equations). These equations of motion provide a mathematical model, e.g., for the electron component of a (cold) plasma in applications to astrophysics, but also for a beam of charged particles in an accelerator. After establishing some general features of the Maxwell-Lorentz equations, spherically symmetric solutions on Minkowski spacetime are discussed in greater detail. Some unexpected and counter-intuitive properties are found.

GR 18.3 Fr 14:40 JUR K

General Relativity Based on Physical Phenomena — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Whereas Newton's gravity only covers the static cases, it is the merit of Einstein that he extended gravity to the phenomena occurring at (fast) motion. But Einstein paid an enormous price for his result by changing our understanding of space and time. The resulting theory (GR) is so complex that in the opinion of Steven Weinberg not even 10 physicists may have understood it.

Historically Einstein fell into a trap when he assumed that the speed of light is always constant, even as a 1-way-speed in a moving system. The philosopher Hans Reichenbach, who otherwise supported Einstein, pointed out that this assumption is not compelling, and that Einstein's theory is not the only possible way.

We can, on the other hand, stay with the classical understanding of space, time, and speed addition. We can explain relativity by the behaviour of fields (Heaviside / Lorentz) and of particles (de Broglie / Dirac) and we should accept a variable speed of light in a gravitational field. We then achieve the same results of GR as with Einstein at least up to the Schwarzschild solution. And this way is so easy to follow that it can be taught at school.

In contrast to this, Einstein has with his complex way to relativity impeded the further development of physics for almost a century.

Further info at: www.ag-physics.org/gravity

GR 19: Quantengravitation und Quantenkosmologie

Zeit: Freitag 15:00–16:00 Raum: JUR K

GR 19.1 Fr 15:00 JUR K

Effects of spacetime fluctuations on quantum systems — •Ertan Göklü and Claus Lämmerzahl — ZARM - Universität Bremen

Spacetime can be understood as some kind of spacetime foam of fluctuating bubbles or loops which is expected to be an outcome of a theory of quantum gravity. This should lead to a fluctuating spacetime. In our approach we assume that spacetime fluctuations manifest as classical stochastic fluctuations of the metric. It will be shown how quantum dynamics is affected and we discuss the following effects: (i) an apparent violation of the weak equivalence principle, (ii) a modification of the spreading of wavepackets, and (iii) a loss of quantum coherence.

GR 19.2 Fr 15:20 JUR K

Die Gravitation und die Dunkle Materie des Universums — •Norbert Sadler — 85540 Haar ; Wasserburger Str. 25a

Die Gravitat. resultiert aus der beschl. Expansion des Univ. ,wobei der dunkle Mat.Ant.(23,9%) mit dem Expansionsfeld in Wechselw.tritt u.das Gravitationsfeld g(Univ) entspeichert. (4/9*0,239)*1kg*b(exp.Univ)=1kg*g(Univ)=1kg/1m*(G)*1kg/1m

mit: b(exp.Univ)=Ho*c=2Pi*10**-10;g(Univ)=6,674*10**-11

In der Quantenth.Darst. mit Prot.Wirkrad.=1,27*10**-15m: (0,239) * (alfaQCD/alfaQED) * (h-quer*c)/(Prot.Wirkrad.*1m) = 1kg * g(Univ) / (4Pi/3)

Die gemessene Pioneer Anomalität kann als Experim.zum Nachweis der dunkl.Mat. u. d. Garvitationfeldst.angesehen werden 1kg*g(Univ)=2*((0,045/0,283)*0,239)*1kg*a(Pion.=8,78*10**-11) mit:0,045 baryon.Mat.;0.283 ges.Mat.;3*0,239 Dunkl.Energie.

Aus obigen Erkenntnissen kann die Protonenmasse best.werden: Die lokale Prot.Masse ist als der über den Univ.Rad. gleich verteilte dunkl.Mat.Anteil der lokalen 1kg Masse zu verst. m(Proton;kg)=(0,239*1kg)/(Betrag Univ.Rad.=1,43*10**26m).

Der dunkle Mat.Ant. des Higgs-Bosons(154,6 GeV)lokalisiert die mittl.lineare Materiedichte(4/9 Prot./1m) des Univ. in Wechselw. mit d. Wahrsch.Dichte des dunkl.Mat.Ant.d. Univ.

(0,239)*(Hi.-B=154,6GeV)=(4/9p/1m=0,417GeV)/(4/9*0.239)**2

GR 19.3 Fr 15:40 JUR K

Quantengravitation als elektromagnetische und thermodynamische Nahwirkung — •Manfred Böhm — Solitudestr. 389, 70499 Stuttgart

Gravitation gilt derzeit nicht als elektromagnetische Kraft. Man kann jedoch zeigen, daß es einerseits viel kleinere Ladungen geben muß als das Elektron und daß andererseits Quantengravitation nicht nur auf elektromagnetischen Wirkungen beruht, sondern auch auf thermodynamischen, die als Nahwirkungen zum "Schweredruck" führen. Massen auf der Erde werden also nicht von der Erde angezogen,sondern von deren Quantenhülle auf sie gedrückt. Die thermodynamische Basis der Quantengravitation ergibt sich aus $G=h\omega/kT$. Quantengravitation wird beschrieben als elektromagnetische und thermodynamische Nahwirkung winziger Teilchen $h\omega$ des Quantengases der Erde.

GR 20: Alternative Ansätze

Zeit: Freitag 16:00–16:20 Raum: JUR K

GR 20.1 Fr 16:00 JUR K

The right explanation of Michelson's experiment — •Shukri Klinaku — Universität von Prishtina, Prishtina, Kosovo

The Lorentz transformation and the special theory of relativity (STR) are built upon the explanation of the results on Michelson's experiment. Even today there are dilemmas on this experiment. A very simple explanation for this experiment will be given in this paper. Be doing so we will try to prove that the explanations that lasted up to present are wrong, because the expectation (the idea of Michelson) was wrong. According to this even STR is incorrect.

GR 21: Poster

Zeit: Montag bis Freitag ganztags Raum: JUR K

GR 21.1 Mo-Fr 0:00 JUR K

Special Relativity Derived from the Structure of Matter — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

When Einstein developed Special Relativity, he got caught in a trap. He assumed that the 1-way speed of light is always a constant. - This was a rash conclusion from the Michelson-Morley experiment, which is logically in no way compelling. - From that point on, there was no way out of an unnecessary complex theory based on weird assumptions about space-time.

In using the other way:

- We replace the dilation of time by the inevitable slow down of the basic oscillations within elementary particles at motion (de Broglie/Dirac/Schrödinger)

- We replace the contraction of space by a contraction of fields (Heaviside/Lorentz) with similar results of physical measurements

- We will then conclude that the apparent constancy of the speed of light 'c' is a pure measurement effect following from both abovementioned facts.

This approach avoids all of the logical conflicts and paradoxes which accompany the assumptions of Einstein about space and time, and yet it achieves similar results for special relativity.

And this approach is also an appropriate basis for developing a successful and easily understandable General Relativity.

For further information: www.ag-physics.org

GR 21.2 Mo-Fr 0:00 JUR K

Is the Speed of Light 'c' a True Constant? — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Einstein has - in his structure-based theory of relativity - stated that the speed of light 'c' is a true constant under all circumstances. He has concluded this from the Michelson-Morley experiment, not realizing that this experiment only demonstrates the 2-way speed of light.

Philosopher Hans Reichenbach, a prominent supporter of Einstein, has pointed out that Einstein's conclusion is logically not compelling. The 1-way speed of light is not proven to be constant, and relativity can be explained in different ways.

The poster presentation will point out that:

1. The apparent constancy of 'c' is a measuring effect caused by the contraction of rods and the slow down of clocks, which both can be physically explained

2. The curvature of space-time in a gravitational field can be replaced by the slow down of 'c' in the field and the resulting refraction of light-like objects

3. The change of 'c' during the development of the universe is a physically better replacement for the so called 'inflation'. Furthermore it avoids the necessity of a 'dark energy'. Additionally it allows for an adapting change of basic physical parameters and in this way makes the landscape of 10^{100} universes superfluous.

For further information: www.ag-physics.org/relat and /gravity