GR 15: Quantengravitation und Quantenkosmologie II

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

GR 15.1 Do 16:45 ZHG 002

SUSY Q-Balls and Boson Stars in Anti-de Sitter space-time
— •Jürgen Riedel — School of Engineering and Science Jacobs University Bremen 28759 Bremen, Germany

Q-balls and boson stars are non-topological solitons that have been intensively studied and their properties are well established for a variety of scalar potentials. More recently a supersymmetric (SUSY) potential has been considered for Q-ball and boson star models in the context of the supersymmetric extension of the Standard Model [1,2]. Moreover, it has been proposed that such soliton models can be interpreted as Bose-Einstein condensates of glueballs within the context of the Anti-de Sitter/Conformal Field Theory (AdS/CFT) correspondence [3].

We solve the Klein-Gordon equation for the SUSY Q-balls in AdS background numerically and study the solutions in detail. In particular the mass M and charge Q of the Q-balls in AdS background are calculated.

[1] E. Copeland and M. Tsumagari, Phys.Rev. D 80 025016 (2009) [2] L. Campanelli and M. Ruggieri, Phys. Rev. D 77 (2008), 043504; L. Campanelli and M. Ruggieri, Phys. Rev. D 80 (2009) 036006 [3] G.T. Horowitz and B. Way, Complete phase diagrams for holographic superconductor/insulator systems, JHEP 1011:011, 2010 [arXiv:1007.3714v2]

GR 15.2 Do 17:05 ZHG 002

Decoherence in loop quantum cosmology with fermions — Claus Kiefer and •Christian Schell — Institut für Theoretische Physik, Universität zu Köln

Loop quantum cosmology employs triads of two different orientations. The theory allows them to occur in an arbitrary superposition. Here we show how such a superposition is rendered unobservable by decoherence - the irreversible interaction with an “environment”. Since a suitable environment must be able to distinguish between the two orientations, we introduce fermions for its description. Solving the total difference equation numerically and integrating out the fermions, we obtain the reduced density matrix for the triads. We discuss the degree of decoherence described by it and focus on the relevance of our results for interpretational issues in loop quantum cosmology.

GR 15.3 Do 17:25 ZHG 002

Quantum gravitational effects for cosmological perturbations
— •Manuel Krämer and Claus Kiefer — Institut für Theoretische Physik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln, Germany

We discuss cosmological perturbations in the framework of canonical quantum gravity. We use a model for an inflationary universe with a perturbed scalar field and obtain the power spectrum for these perturbations by means of a semiclassical approximation to the Wheeler-DeWitt equation. We calculate quantum gravitational corrections to the power spectrum and discuss the appearance of unitarity-violating correction terms.

GR 15.4 Do 17:45 ZHG 002

Spontaneous breaking of Lorentz symmetry for canonical gravity — •Steffen Gielen[1,3] and Derek Wise[2] — [1]Max-Planck-Institut für Gravitationsphysik (Albert-Einstein-Institut), Am Mühlenberg 1, 14476 Golm — [2]Institut für Theoretische Physik III, Universität Erlangen-Nürnberg, Staudtstr. 7/B2, 91054 Erlangen — [3]Perimeter Institute for Theoretical Physics, 31 Caroline St. N., Waterloo, Ontario, Canada N2L 2Y5

In Hamiltonian formulations of general relativity, in particular Ashtekar variables which serve as the classical starting point for loop quantum gravity, Lorentz covariance is a subtle issue which has been the focus of some debate, while at the same time being crucial with regard to possible experimental tests. After reviewing the sources of difficulty, we present a Lorentz covariant formulation in which which we generalise the notion of a foliation of spacetime usually used in the Hamiltonian formalism to a field of ”local observers” which specify a time direction only locally. This field spontaneously breaks the local SO(3,1) symmetry down to a subgroup SO(3), in a way similar to systems in condensed matter and particle physics. The formalism is analogous to that in MacDowell-Mansouri gravity, where SO(4,1) is spontaneously broken to SO(3,1). We show that the apparent breaking of SO(3,1) to SO(3) is not in conflict with Lorentz covariance. We close by outlining other possible applications of the formalism of local observer, especially with regard to phenomenology of quantum gravity.

GR 15.5 Do 18:05 ZHG 002

Fluctuations of spacetime and hyperfine structure of the hydrogen atom — •Ertan Göklü[1], Juan Israel Rivas[2], and Abel Camacho[2] — [1]ZARM-Universität Bremen, Am Fallturm, 28359 Bremen — [2]Universidad Autónoma Metropolitana–Iztapalapa, Apartado Postal 55–534, C.P. 09340, México, D.F., México

We consider the consequences of the presence of metric fluctuations upon the properties of a hydrogen atom. Particularly, we introduce these metric fluctuations in the corresponding effective Schrödinger equation and deduce the modifications that they entail upon the hyperfine structure related to a hydrogen atom. We will find the change that these effects imply for the ground state energy of the system and obtain a bound for its size comparing our theoretical predictions against the experimental uncertainty reported in the literature.

GR 15.6 Do 18:25 ZHG 002

What happens inside a black hole? — •Thomas Görnitz — Goethe-Univ. Frankfurt/M

The interior solution for a black hole is normally understood as a problem of classical general relativity. Such a view is carried by the questionable notion that quantum theory is necessary only for very small space regions. Therefore it is often argued that for real black holes, which are much larger than the atoms, the use of quantum theory is superfluous for its description. A simple argument from quantum theory shows that such a concept may be incorrect, because a restriction of the spatial extent of a system - putting it into a box - results in a change of its ground state. The only really impenetrable boxes in the universe are the horizons of the black holes. Therefore it is unphysical to postulate inside of a black hole the same vacuum as outside. By avoiding this, the unphysical singularity in the centre of the black hole disappears, and the interior solution goes over into a Friedman-Robertson-Walker-cosmos. To show that, one has to work with the protyposis, abstract and absolute quantum bits, as the elementary entities of the universe. Doing this, also the entropy of the black holes does follow in a simple and straightforward way.