MP 12: Field Theory and Cosmology

Zeit: Donnerstag 14:00–15:50 Raum: SFG 2010

MP 12.1 Do 14:00 SFG 2010

NLS breathers, rogue waves, and solutions of the Lyapunov equations with Jordan blocks — •Folkert Müller-Hoissen and Oleksandr Chvartatskyi — MPI for Dynamics and Self-Organization, Göttingen

The infinite families of Peregrine, Akhmediev and Kuznetsov-Ma breather solutions of the focusing Nonlinear Schrödinger (NLS) equation are obtained via a matrix version of the Darboux transformation, with a spectral matrix of the form of a Jordan block. The structure of these solutions is essentially determined by the corresponding solution of the Lyapunov equation. In particular, regularity follows from properties of the Lyapunov equation.

MP 12.2 Do 14:20 SFG 2010

Gauged Baby Skyrme Model with and without Chern-Simons Term — •Yakov Shnir[1] and Albert Samoilenko[2] — [1]Joint Institute for Nuclear Research Bogoliubov Laboratory of Theoretical Physics — [2]Belarus State University

The properties of the multisoliton solutions of the U(1) gauged modification of the 2+1 dimensional planar Skyrme model with and without Chern-Simons term are investigated numerically. Coupling to the Chern-Simons term allows for existence of the electrically charged solitons which may also carry magnetic fluxes. Two particular choices of the potential term are considered: (i) the weakly bounded potential and (ii) the double vacuum potential. In the absence of the gauge interaction in the former case the individual constituents of the multisoliton configuration are well separated, while in the latter case the rotational invariance of the configuration remains unbroken. We analyze the dependency of the structure of the solutions, the energies, angular momenta, electric and magnetic fields of the configurations on the gauge coupling constant g, and the electric potential. It is found that, generically, the coupling to the Chern-Simons term strongly affects the usual pattern of interaction between the skyrmions, in particular the electric repulsion between the solitons may break the multisoliton configuration into partons. On the other hand, in the strong coupling limit the coupling to the gauge field results in effective recovering of the rotational invariance of the configuration and both the magnetic flux and the electric charge of the solutions become quantized, although they are not topological numbers.

MP 12.3 Do 14:40 SFG 2010

On particle interpretation in homogeneous cosmology — •Zhirayr Avetisyan — Department of Mathematics, UCL

We work in the framework of quantum field theory in curved spacetimes. In absence of gravity - in Minkowski spacetime - the notion of an elementary particle is well-understood. Several different interpretations are possible that are naturally equivalent. In a curved spacetime, however, these interpretations become less intuitive and their equivalence on a mathematical level is not clear yet. In homogeneous cosmology the spacetime is assumed spatially homogeneous. This allows one to consider somewhat obscure generalizations of particle interpretations known to work in the flat case. One such interpretation comes from mode decomposition of a hyperbolic field equation, each mode roughly representing an elementary particle state with fixed evolution. Another particle interpretation is a reminiscent of Wigner's classification: every unitary irreducible representation of the isometry group corresponds to an elementary particle state with fixed momentum but unclear energy. We will discuss Peter-Weyl theorem from harmonic analysis and see how it may help us to achieve a mathematical identification of these two interpretations on general grounds.

10 min. break

MP 12.4 Do 15:10 SFG 2010

Geodesic motion and the magnitude-redshift relation on cosmologically symmetric Finsler spacetimes — •Manuel Hohmann[1] and Christian Pfeifer[1,2,3] — [1]Physikalisches Institut, Universität Tartu, Estland — [2]Institut für theoretische Physik, Universität Hannover — [3]Zentrum für angewandte Raumfahrttechnologie und Mikrogravitation (ZARM), Universität Bremen

We consider the most general Finsler spacetime geometry with cosmological symmetry, i.e., six Killing vector fields for homogeneity and isotropy. Within this background, we discuss the geodesic motion of both massive test bodies and light. Using adapted coordinates on the tangent bundle, we derive the geodesic equation and a full set of constants of motion, which allow us to characterize geodesics. As an application, we derive the magnitude-redshift relation for Finsler cosmology. We apply our findings to several kinematic models of Finsler spacetimes.

MP 12.5 Do 15:30 SFG 2010

Light propagation in local and linear media: Fresnel-Kummer wave surfaces with 16 singular points — Alberto Favaro[1] and •Friedrich W. Hehl[2] — [1]Dept. Physics, Imperial College, London and ASI Data Science, London — [2]Universität zu Köln and University of Missouri, Columbia

The Fresnel wave surfaces of transparent biaxial media have 4 singular points. In more general media, the number of singularities can exceed 4. In fact, a highly symmetric linear material is proposed whose Fresnel surface exhibits 16 singular points. For every linear material, the dispersion equation is quartic. Thus, 16 is the maximum number of isolated singularities. The identity of Fresnel and *Kummer surfaces,* which holds true for media with a certain symmetry (zero skewon piece), provides an elegant interpretation of the results. We describe a metamaterial for our linear medium with 16 singular points. It is found that an appropriate combination of metal bars, split-ring resonators, and magnetized particles can generate the correct permittivity, permeability, and magnetoelectric moduli. [1] H. Knörrer, Die Fresnelsche Wellenfläche, in: Math. Miniaturen, Vol. 3, p. 115 (Birkhäuser, Basel, 1986). [2] A. Favaro, F. W. Hehl, Phys. Rev. A 93, 013844 (2016).