MP 16: Gravitation

Time: Thursday 11:20–12:20 Location: HFT-FT 101

MP 16.1 Thu 11:20 HFT-FT 101

Spacetime symmetries in the language of Cartan geometry — •Manuel Hohmann — Institut für Physik, Universität Tartu, Estland

I discuss how apparently different geometrical descriptions of spacetime geometry - in particular, affine geometry, metric geometry and Finsler geometry - can commonly be reformulated in terms of Cartan geometry. In the main part of my talk I show how this common Cartan geometric description can be used to formulate spacetime symmetries under the action of continuous diffeomorphism groups, represented by Killing-like vector fields. As an illustrative example I discuss the case of axial, spherical and cosmological symmetry. These calculations can be applied in the construction of symmetric solutions of gravity theories based on these different geometric descriptions.

MP 16.2 Thu 11:40 HFT-FT 101

Counting of Manifold Triangulations — •Benedikt Krüger and Klaus Mecke — Institut für Theoretische Physik, Staudtstr. 7, 91058 Erlangen

Each topological manifold in 2d and 3d permits a finite number of non-equivalent discretisations into combinatorial manifolds or triangulations with given number of vertices or maximal simplices. This number of distinct triangulations is important for questions arising in topology, geometry and physics. E.g., the scaling behaviour of this number determines whether the quantum gravity model of causal dynamical triangulations [1] is well-defined.

Until now the best method for counting of combinatorial manifolds was the isomorphism free enumeration of all possible triangulations for vertex numbers below 15 [2]. Here, we use Monte-Carlo algorithms for estimating the number of triangulations of two- and three-dimensional manifolds and show that the accessible regime of triangulation counts can be increased by several magnitudes. We give numerical evidence that the number of surface triangulations scales exponentially with the vertex number and that the rate of growth depends linearly on the genus of the surface. Additionally we address the question whether the number of triangulations of the 3-sphere scales exponentially with the number of tetrahedra, and whether these triangulations are computationally ergodic.

[1] J. Ambjörn, J. Jurkiewicz, and R. Loll, Phys. Rev. D 72, 064014 (2005); [2] T. Sulanke and F. H. Lutz, Eur. J. Comb. 30, 1965 (2009)

MP 16.3 Thu 12:00 HFT-FT 101

Defining equidistance in finite and discrete geometries — •Alexander Laska, Benedikt Krüger, and Klaus Mecke — Institut für Theoretische Physik, Staudtstr. 7, 91058 Erlangen

In order to replace the continuous smooth manifold of general relativity by a suitable discrete structure, we tried to practice physics within finite – affine and projective – geometries. They might be the discrete analog to tangential and cotangential spaces to the manifold. In order to implement a lightcone the notion of one quadric per point does not suffice to encode length (and thus causal relations) in all directions. But a pair of quadrics – a biquadric – has to be employed per point. The scope of this talk is to present how and to what extent these biquadrics might encode length, causal relations, and furthermore curvature for arbitrary dimensions and signatures in order to be able to retrieve back the general theory of relativity – or a close approximation – in terms of a continuum limit.