MP 5: Loop Quantum Gravity

Time: Tuesday 15:00–15:50 Location: H7

MP 5.1 Tue 15:00 H7

Super Cartan geometry, loop quantum supergravity and applications — •Konstantin Eder — FAU Erlangen-Nürnberg

This talk is devoted to the quantization of supergravity in a formulation in which (part of) supersymmetry manifests itself in terms of a gauge symmetry. Applications we have in mind are supersymmetric black holes and loop quantum cosmology.

We will derive the Holst variant of the MacDowell-Mansouri action for N=1 and N=2 supergravity in D=4 for arbitrary Barbero-Immirzi parameters. We will show that these actions provide unique boundary terms that ensure local supersymmetry invariance at boundaries. The chiral case is special. The action is invariant under an enlarged gauge symmetry, and the boundary theory is a super Chern-Simons theory. The action also implies boundary conditions that link the super electric flux through, and the super curvature on, the boundary.

We will also study chiral symmetry reduced models with local supersymmetry. The enlarged gauge symmetry of the chiral theory is essential as it allows for nontrivial fermionic degrees of freedom even if one imposes spatial isotropy.

MP 5.2 Tue 15:25 H7

Revisiting loop quantum gravity with selfdual variables — •Robert Seeger — Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)

Loop quantum gravity (LQG) in its current formulation is a the quantisation of the SU(2) gauge theory of gravity in Ashtekar-Barbero variables. It started out as an SL(2,C) gauge theory in Ashtekar's selfdual variables, but the quantisation program was never fully carried out in this formulation. The two main obstacles are the non-compactness of the gauge group SL(2,C) and the necessity to implement complicated reality conditions. The latter ensure reality of the spatial metric and its evolution.

We revisit the original formulation by considering the selfdual part of complexified general relativity in Ashtekar variables. These are a complex flux and an SL(2,C) connection. We show that one is lead to a classical theory that is holomorphic in the canonical variables, in order to have a non-degenerate symplectic structure. This does not allow to implement the reality conditions as additional constraints in the action, they have to be added by hand during the quantisation. We describe first steps to extend the holomorphic character also to the quantum theory, with SL(2,C) holonomies, holomorphic derivatives, and a notion of holomorphic spin networks. Thus, working in a holomorphic setup turns out to be natural, as anticipated by Ashtekar and others in early works on the selfdual theory. We will also comment on the implementation of the reality conditions.