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Quantization of non-abelian Einstein-Rosen waves

Einstein-Rosen cylindrically symmetric waves, when the metric tensor is assumed to be diagonal, an example of explicitly solvable model where the Einstein equations essentially linearize. Quantization of this linear model (summarized in 1996 Ashtekar-Peirri paper) allows to shed some light on general features of quantum gravity.

There is a natural non-abelian generalization of ER waves where the metric is non-diagonal any more and the equations of motion become non-linear but integrable in the sense of the theory of solitons. Algebraic quantization of this model using the theory of quadratic quantum algebras of Yangian type was completed in 1990's in the works of H.Nicolai, H.Samtleben, M.Niedermeier and the speaker. However, at that time no unitary representations of these algebras were found. More recently, it was discovered by M.Reisenberger that identical algebras naturally appear (both at the Poisson and quantum level) as building blocks of the light-front approach to the full 4d gravity. Motivated by this result, in our recent work with J.Peraza and M.Reisenberger we established an isomorphism between the quadratic algebra appearing in the non-abelian quantum ER waves and the S-matrix quadratic algebra arising in the Gross-Neveu model. This opens the way to construction of unitary representations of quantum ER algebra, analysis of the energy and metric spectrum with the ultimate goal to apply this machinery to the full 4d quantum gravity.

The talk is based on earlier works with H.Nicolai (AEI Golm) and H.Samtleben (ENS Lyon), and recent work with J.Peraza (Perimeter) and M.Reisenberger (Montevideo).