General Relativity and Quantum Cosmology

Three-dimensional gravity and Drinfel'd doubles: spacetimes and symmetries from quantum deformations

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We show how the constant curvature spacetimes of 3d gravity and the associated symmetry algebras can be derived from a single quantum deformation of the 3d Lorentz algebra sl(2,R). We investigate the classical Drinfel'd double of a "hybrid" deformation of sl(2,R) that depends on two parameters (\eta,z). With an appropriate choice of basis and real structure, this Drinfel'd double agrees with the 3d anti-de Sitter algebra. The deformation parameter \eta is related to the cosmological constant, while z is identified with the inverse of the speed of light and defines the signature of the metric. We generalise this result to de Sitter space, the three-sphere and 3d hyperbolic space through analytic continuation in \eta and z; we also investigate the limits of vanishing \eta and z, which yield the flat spacetimes (Minkowski and Euclidean spaces) and Newtonian models, respectively.

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