

Quantization of Constantly Curved Tetrahedron

Monday 6 May 2024 17:00 (15 minutes)

In this talk, we develop a quantum theory of homogeneously curved tetrahedron geometry, by applying the combinatorial quantization to the phase space of tetrahedron shapes defined in arXiv:1506.03053. Our method is based on the relation between this phase space and the moduli space of $SU(2)$ flat connections on a 4-punctured sphere. The quantization results in the physical Hilbert space as the solution of the quantum closure constraint, which quantizes the classical closure condition $M_4 M_3 M_2 M_1 = 1$, $M_i \in SU(2)$, for the homogeneously curved tetrahedron. The quantum group $U_q(\mathfrak{su}(2))$ emerges as the gauge symmetry of a quantum tetrahedron. The physical Hilbert space of the quantum tetrahedron coincides with the Hilbert space of 4-valent intertwiners of $U_q(\mathfrak{su}(2))$. In addition, we define the area operators quantizing the face areas of the tetrahedron and compute the spectrum. The resulting spectrum is consistent with the usual Loop-Quantum-Gravity area spectrum in the large spin regime but is different for small spins. This work closely relates to 3+1 dimensional Loop Quantum Gravity in presence of cosmological constant and provides a justification for the emergence of quantum group in the theory.

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