SU(infinity) Quantum Gravity and Cosmology: Everything emerges from nothing

SU(infinity)-QGR is a model for a quantum Universe with an infinite number of mutually commuting observables[1,2]. The Hilbert space of this Universe represents SU(infinity) symmetry, and in absence of a pointer basis it is static and topological. Nonetheless, a universal interaction similar to gravity emerges after (approximate) fragmentation of the Hilbert space due to random quantum fluctuations. Fragments - subsystems/particles - represent a generic finite rank local symmetry group G and SU(\infinity) symmetry of their infinite dimensional environment[3], to which they are entangled. The ensemble of SU(\infinity) representations break the U(1) symmetry[4] of the algebra of single representations and states of subsystems become dependent on 3 continuous parameters. Moreover, a relative time and dynamics[5] emerges after selection of an arbitrary subsystem as a quantum clock. At lowest quantum order it has the structure of Yang-Mills QFT for both G and SU(infinity) symmetries. This is a distinctive prediction of the model and can be tested in future QGR experiments. However, the (3+1)D parameter space cannot be identified with the classical spacetime, because its geometry is arbitrary and irrelevant. This attribute leads to a constraint analogous to the Einstein equation[6]. On the other hand, quantum uncertainty relations in the form of quantum speed limit inequalities[7 (review)] is used to relate the variation of quantum state of subsystems to the affine parameter of the average trajectory of state in the parameter space. Variation of the affine parameter can be expanded as a pseudo-Riemannian - Lorentzian - metric with respect to the average values of the (3+1)D parameters. This effective metric is interpreted as the perceived classical spacetime. When the quantumness of SU(infinity) - gravity - sector is not detectable, its effect is perceived as curvature of the effective spacetime[8] and classical Einstein gravity is recovered. If time allows I will outline a test of the quantumness of gravity based on the observation of strongly lensed astronomical masers[3].

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