Quantum Big Bounce

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- **Loop Quantum Cosmology (LQC) := quantization method inspired by Loop Quantum Gravity, LQG, (field theory with infinitely many degrees of freedom) for quantization of simple models of the universe (with a few degrees of freedom).**

- **Both LQC and LQG are based on the holonomy-flux representation for the algebra of elementary variables, which is quite different from the Schroedinger representation.**

- **Classical Hamiltonian is expressed in terms of holonomy around loop with radius shrunk to zero.**

- **Quantum Hamiltonian includes quantum holonomy loop with finite value of length, determined from the energy gap of an area operator of LQG (not LQC).**

- **LQC calculations for flat FRW universes with scalar field strongly suggest that the evolution of these universes does not suffer from the classical singularity:**
  The initial big-bang singularity turns into quantum big-bounce owing to strong quantum effects.

- **Resolution of the cosmological singularity is due to the discreteness of quantum geometry.**

- **Physical justification for such procedure is doubtful:**

  1. **LQC is not the cosmological sector of LQG. These are two different models of two different quantum systems. Insertion by hand from LQG into LQC of the corresponding physical quantities does not make sense.**
  2. **Geometrical operators of length, area or volume has not been defined in the physical Hilbert space (satisfying constraints), but on the kinematical one so they are not observables because they are gauge dependent.**

- **Possible solution to the problem:**
  If cosmic projects like PiSky, SWIFT, HESS, MAGIC, GLAST or others detect the dispersion of photons, the assumption on discreteness of quantum geometry may get substantial support. Determination of some measure of `fundamental length' might be used to model a size of `fundamental loop' used in LQC to calculate within LQC the critical density of matter at which the Big-Bounce occurs. The energy scale of the quantum phase may turn out to be different from the Planck scale.