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From 4-point space to ∞-point space?

I. Carlo Rovelli: Zakopane lectures on loop gravity (2011):

This is a mathematical paper. There are only weak relations to physics. Rovelli: “The theory is far from being complete. We do not know if it really works.” Nontheless the theory has some promissing aspects.

1. Gravitational fields form themselves spacetime. The quanta of gravity are also the “quanta of space”. They do not live in space, but give rise to space by themselves.
2. The theory is based on the spin network theory of Roger Penrose. Spin networks are mathematical models consisting of points (“nodes”) and oriented connections (lines, “links”) between these points. This way a network (“spacetime foam”) with volumes (“grains”) and surfaces (“areas”) is constructed. The size of the volumes (not space itself!) is quantized in discrete steps. These “quanta of space” in loop quantum gravity (LQG) correspond to the quanta (frequency) of photons in quantum electrodynamics (QED). Intuitively the author thinks the network could and should be reduced to a network of tetrahedrons (as is the case in my theory!).
3. The spinnetwork can be represented by graphs Γ. Each link between two nodes has a source and a target, i.e. it is oriented. An automorphism of a graph is a map from Γ to itself. It is discrete and possibly it might represent a physical particle.
4. In (QED) the nodes of the graphs are like a photon. In quantum chromodynamics (QCD) the lattice sites are small regions of space; according to general relativity, these are excitations of the gravitational field and therefore themselves quanta of a quantum field theory (QFT). In LQG the nodes represent the quanta of the gravitational field.
5. A basis in Hilbert space $\mathcal{H}$ is labelled by three sets of “quantum numbers”: 1. an abstract graph Γ, 2. a coloring j_l of the links of the Γ and 3. a coloring of each node of Γ with an element v_n in an orthonormal basis in the intertwiner space $\mathcal{H}_n$. The states Γ, j_l, v_n labelled by these quantum numbers are called “spin network states”. Each node *n* represents a “grain” of quantum of space.
6. The geometry represented by a state $|\ \Gamma, j_l, v_n\ \rangle$ is a quantum geometry: It is discrete because area and volume are discrete. The unit length L_{loop} of the loops can be related to the Planck length by the formula $L^2_{loop} = 8\pi\gamma\hbar G$, where γ is a positive real number. A state $\mathcal{H}$ is not interpreted as “state at some time”, but as a “boundary state”.
7. The vertex (transition) amplitudes give the probability amplitude for a single spacetime process (= event?), i.e. for a single grain of space splitting into several grains of space. It appears to yield the Einstein equations in the large distance classical limits. But calculations and predictions about the future are difficult or impossible.

8. By sending the number *N* of lattice sites to infinity and the lattice spacing *a* (which is related to the Planck length) to zero one obtains the physical limit.

II. Comparison of LQG with my own theory

9. LQG is a mathematical tool with only little relation to physical reality. It seems that the author is not aware of the meaning of the term reality. Thus he has to find a rather complicated method to get rid of any infinity and continuity.
10. There is no “between”-axiom in LQG although this is basic for every physical theory. Perception always is dependent on between states.
11. The chosen connections between the nodes are rather arbitrary, whereas in my theory every point is related to all the other points of the universe.
12. According to graph theory the links between any two nodes are oriented. The author does not explain the physical meaning of this orientation. He ignores chirality.
13. The nodes in LQG have innner properties, whereas in my theory points have no inner properties. The only property of a point is its relation to all the other points of the universe. This approach seems to be mathematically simpler and nearer to physical reality.
14. LQG presents a mathematical tool for proceeding from a small number of nodes to a large one. This might be applied to my theory. It might open a way to go from just 4 points to 100 or even ∞ points and to find a definition of the term distance.
15. I doubt that instantaneous nonlocal phenomena can be discribed by LQG.