Objections to Quantum Gravity Theories based on Causal Dynamical Triangulation

Dear Editor(s) of Classical and Quantum Gravity,

My letter is in regards to the recently published contribution by R. Loll "The emergence of space-time and quantum gravity on your desktop" 25 (2008) 114006.

The article claims that "causal dynamical triangulation" offers a "robust" non-perturbative theory of quantum gravity. On closer examination, the approach is built on many questionable premises. Specifically,

1) Quantitative models of space-time near the Planck scale, regardless of how intriguing and attractive they might be, are *non-testable*. One does not know if Quantum Field Theory (QFT) survives past the Cohen-Kaplan threshold of about 100 TeV, let alone what happens in close proximity to the Planck scale. As such, the approach is not falsifiable and unable to make contact to experiment for any foreseeable future.
2) Looking for a "potential presence of a non-perturbative vacuum" for quantum gravity (deep in the TeV sector and beyond) is most likely a fruitless enterprise. This is because far-from-equilibrium processes are expected to dominate at very large energies and invalidate the fundamental postulate of QFT regarding unitary evolution. Non-equilibrium field theory *is not* based on minimization of the energy function that normally drops the system on its "vacuum" state. As a result, non-perturbative "vacuum" may be part of an ever-evolving, emergent configuration whose content and dynamics may deviate substantially from what traditional QFT "vacuum" is.

3) Path Integral formalism and the Sum-over-Histories technique cease to be applicable in the deep TeV sector or beyond due to the likely onset of *non-local interactions* and *chaotic dynamics* of strongly coupled theories.
4) Attempting to derive the space-time dimensionality in the absence of matter violates a basic lesson of General Relativity according to which matter and space-time are *inseparable entities*. Furthermore, no one knows what "matter" really is at these extremely large energies, which makes the entire approach questionable.
5) Appealing to cosmological models of space-time (such as the de Sitter model) to formulate or interpret dynamics near the Planck scale is an "ad-hoc" ansatz. There is simply no empirical evidence that motivates extrapolation of the four dimensional manifold of General Relativity all the way down to the sub-nuclear scale.

Having said that, the paper points out complex ensembles such as sets of elementary objects tend to self-organize into a universal emerging structure. This fact suggests (but does not prove it yet) that self-organization plays a major role in the emergence of four-dimensional space-time at our level of observation.

As a scientist working for many years in the field of nonlinear dynamics and complexity theory, I am appalled by the fact that the paper fails to acknowledge a well documented body of concepts and ideas developed in the last 20 years and known as fractal/ Cantorian space-time model. The main contributors to this model are El Naschie, Ord, Nottale, Marek-Crnjak, Goldfain, Tanaka, Iovane, Castro, He and others. There is by now a large volume of contributions and a number of conferences dedicated to this topic, see for instance Elsevier's "Chaos, Solitons and Fractals" and similar resources. The net effect of

this regrettable omission is that the audience is given a false account on how scientific ideas take shape and evolve. In the interest of objectivity and fairness, I respectfully request a note of correction from your office or from the authors of the article. It will help setting the record straight and restore honesty in scientific reporting.

Sincerely,

Ervin Goldfain

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