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Cosmic Fibers and the parametrization of time in CDT quantum gravity

Causal Dynamical Triangulations is an attempt to quantize gravity via lattice regularization, where 4-dimensional simplices play the role of the building blocks of space-time. Numerical simulations show that CDT has a well defined semi-classical limit. One of the questions of this approach which needs clarification is: whether the space-time foliation introduces a preferred time coordinate? By incorporating scalar fields with non-trivial boundary conditions, we created a new space-time coordinate system, where the the field in the time direction admits to a time coordinate different from that of the original foliation. The distribution of the scalar field observed in various phases varies depending on the choice of the coupling constants. Furthermore coupling the scalar fields to the gravitational action results in nontrivial effects.

Author: NÉMETH, Dániel (Németh Dániel)

Presenter: NÉMETH, Dániel (Németh Dániel)