Eliminating time travel in the context of causal fermion systems

Acronym: ET

Aim and Objective: ET aims to prove that within the framework of causal fermion systems (CFS) time travel is impossible.

As a first objective one needs to develop a robust definition of what it means for a curve to be future pointing in a generalized spacetime in CFS.
The next objective is to define global notions of causality within CFS analogous to the causal latter in Lorentzian manifolds.
Finally the aim is to use these tools to prove that spacetimes emerging in the continuum limit from CFS cannot contain closed causal curves.

Relevance and Impact: Closed time like curves (aka the possibility of time travel) are one of the main causal pathologies admitted by Einstein's General Relativity. Leading to issues with determinism such as for example in the grandfather paradox. The causal action principle minimizes the number of timelike separated points in a spacetime which leads one to believe that time travel should be impossible in this setting. This would establish further support to establish the causal fermion system framework as a valid candidate for a fundamental theory of physics.

Background: Causal fermion systems are a new approach developed by Felix Finster to obtain a unified theory of fundamental physics. Recently established results by him succeed at deriving a remarkable amount of known physics from one fundamental equation. This includes but is not limited to the existence of three generations of fermions, the gauge group of the standart model, the field equations of general relativity (on the linearized level), second quantization as a necessary condition for global minimizers.

Rough outline of approach: The study would be mostly concerned with the properties of the eigenvalues of the closed chain A(x,y) along a curve y(t) in the space of linear operators. That affects the behavior of the Causality functional C(x,y) along the curve. First one would have to search for a good definition for y(t) to be a locally future directed curve.
This definition should then be used to try and establish different notions of global causality structures on the minimizers of the causal action principle.
Finally this should allow to tackle the question of the existence of closed timelike curves for emerging spacetimes in the continuum limit.

Comments and fun facts: In this context it would also be interesting to investigate the causal properties of the neighborhood of a point x. Note that by definition x is timelike separated from itself however lies neither in the future not the past of itself as the Causality functional is antisymmetric and hence C(x,x)=0. For these considerations it might be interesting that apparently (private communication with Felix Finster) every element in the support of a minimizer has at least two degenerate Eigenvalues. Despite that (for some reason I don't quite understand there apparently exists an open region B(x) around every point x in the support of the minimizing measure such that every y in B(x) is timelike separated from x)