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Renormalization vs Causality in Finite-Time-Path Out of Equilibrium

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We formulate the perturbative renormalization for the out-of-equilibrium $g\phi^3$, $g\phi^4$, QED ... quantum field theory in the formalism with the finite time path. We use the retarded/advanced (R/A) basis of out-of-equilibrium Green functions, in which time ordering plays a role.

We use the dimensional regularization method and find the correspondence of diverging contributions in the Feynman diagrams and their counterparts in R/A basis. We find that the Dimensional Renormalization works exactly the way it does within the S-matrix field theories with the same number of subtraction. Although we reveal a number of problems related to energy (non-)conservation and causality, they are kept under control thanks to the $D < 4$ sector.

(This talk is based on collaboration with D. Klabučar and D. Kuić.)

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