Local and Covariant Flow Relations for OPE Coefficients in Curved Spacetime

Mark G. Klehfoth*
Robert M. Wald†

Abstract

Although pointwise products of quantum field observables are not well defined, products of field observables evaluated at distinct spacetime points are known to satisfy asymptotic relations called operator product expansion (OPEs) in the coincidence limit. Hollands and Wald have argued that key information about a quantum field theory (QFT) is contained in the coefficients of its OPEs. For interacting $\lambda\phi^4$-theory in flat Euclidean spacetime, Holland and Hollands have derived "flow relations" which govern how OPE coefficients vary under changes in the interaction parameter, λ. However, serious obstacles arise if one attempts to generalize their result to curved Lorentzian spacetimes in a local and covariant manner. In this talk, I will describe these issues and sketch our resolutions for a "toy model" which is Klein-Gordon theory in curved Lorentzian spacetime with the mass parameter, m^2, viewed as an interaction parameter. The strategies I describe for ensuring the locality and covariance of this toy model's flow relations are expected to be applicable, more generally, to QFTs with nonlinear interactions in curved Lorentzian spacetimes.

*mklehfoth@uchicago.edu
†rmwa@uchicago.edu