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Interplay between Stochastic Partial Differential Equations and Quantum Field Theory on Curved Backgrounds

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We review a novel framework for the study of a large class of non-linear stochastic partial differential equations (SPDEs), which is inspired by microlocal analysis and by the algebraic approach to quantum field theory (AQFT). In particular, we show that AQFT and SPDEs share similar problems, most notably the existence of pathological divergences. These are dealt with adapting to this framework the Epstein-Glaser renormalization procedure which is used in the analysis of locally covariant quantum field theories. As a concrete example we shall discuss the stochastic Φ^3_d model and we shall comment on its applicability to other models such as the stochastic non-linear Schrödinger equation, the stochastic sine-Gordon equation as well as the stochastic Thirring equation.

Based on joint works with A. Bonicelli, B. Costeri, N. Drago, P. Rinaldi and L. Zambotti

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