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Topological Corrections and Conformal Backreaction in the Einstein Gauss-Bonnet/Weyl Theories of Gravity at D=4

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We investigate the gravitational backreaction, generated by coupling a general conformal sector to external, classical gravity, as described by a conformal anomaly effective action. We address the issues raised by the regularization of the topological Gauss-Bonnet and Weyl terms in these actions and the use of dimensional regularization (DR). We discuss both their local and nonlocal expressions, as possible IR and UV descriptions of conformal theories, below and above the conformal breaking scale. Our discussion overlaps with several recent studies of dilaton gravities - obtained via a certain singular limit of the Einstein-Gauss-Bonnet (EGB) theory - originally introduced as a way to bypass Lovelock's theorem.Nonlocal, purely gravitational realizations of such EGB theories, quadratic in the dilaton field, beside their local quartic forms, are possible by a finite renormalization of the Euler density.

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