

Provable properties of asymptotic safety in $f(R)$ approximation

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We study an $f(R)$ approximation to asymptotic safety, using a family of cutoffs, kept general to test for universality. Matching solutions on the four-dimensional sphere and hyperboloid, we prove properties of any such global fixed point solution and its eigenoperators. For this family of cutoffs, the scaling dimension at large n of the n^{th} eigenoperator, is $\lambda_n \propto b n \ln n$. The coefficient b is non-universal, a consequence of the single-metric approximation. For right-sign conformal mode cutoff, the fixed points form at most a discrete set. The eigenoperator spectrum is quantised. They are square integrable under the Sturm-Liouville weight. For wrong sign cutoff, as required if starting from the Einstein-Hilbert action, the fixed points form a continuum, and so do the eigenoperators unless we impose square-integrability. If we do this, we get a discrete tower of operators, infinitely many of which are relevant. These are $f(R)$ analogues of novel operators in the conformal sector which were used recently to furnish an alternative quantisation of gravity.

Orateur: MORRIS, Tim (University of Southampton)