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Kevin Falls: Asymptotic safety and gauge independence

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The problem of obtaining a gauge independent beta function for Newton's constant is addressed. By a specific parameterisation of metric fluctuations a gauge independent functional integral is constructed for the semiclassical theory around an arbitrary Einstein space. The effective action then has the property that only physical polarisations of the graviton contribute, while all other modes cancel with the functional measure. We are then able to compute a gauge independent beta function for Newton's constant in d-dimensions to one-loop order. Going beyond the one-loop approximation we compute a non-perturbative beta function using functional renormalisation group methods and calculate the critical exponent at an asymptotically safe fixed point. Close to two dimensions the critical exponent is found to be regulator independent. Furthermore close to four dimensions quantitive agreement is found with lattice results for regulators which obey Litim's optimisation criteria.