

## Diffeomorphism invariance and critical scaling in quantum gravity

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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 semiclassical theory, by means of the exact renormalisation group, the beta function for Newton's constant is found within a simple approximation exploiting the gauge independent parameterisation. We then assess the scaling at an asymptotically safe fixed point. Close to two dimensions the critical exponent for Newton's constant is found to be regulator independent. In four dimensions we apply Litim's optimisation criteria on the space of regulators. The critical exponents is then found to agree with the value found in numerical lattice simulations by Hamber.

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