
Quantum Field Theory 2 – Tutorial 5

Lectures: Jan Pawłowski

j.pawlowski@thphys.uni-heidelberg.de

Tutorials: Eduardo Grossi

e.grossi@thphys.uni-heidelberg.de

Institut für Theoretische Physik, Uni Heidelberg

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Problem 1: Loop expansion as expansion in \hbar

On exercise sheet 4 you derived an expression for the effective action in terms of a loop expansion

$$\Gamma[\phi] = S[\phi] + \frac{1}{2} \text{Tr} \ln S^{(2)}[\phi] + \dots \quad (1)$$

from the integral representation

$$e^{-\Gamma[\phi]} = \int D\varphi e^{-S[\phi+\varphi] + \int d^d x \frac{\delta \Gamma}{\delta \phi}(x) \varphi(x)}.$$

Use the fact that the actions $S[\phi]$ and $\Gamma[\phi]$ are measured in units of \hbar to show that the expansion in Eq. (1) can be seen as an expansion in \hbar .