

Cosmic Structure Formation

Heidelberg University
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Problem Sheet 10

Discussion in the tutorial group on Jan. 25th, 2023

1. **Diagrams for perturbation theory.** In the lecture, we have introduced diagrams for terms contributing to perturbation theory, and described the rules for constructing these. This exercise should give an example for doing so.

- (a) Construct two possible diagrams for perturbative terms of second order, contributing to a power spectrum.
- (b) Identify the shift vectors \vec{L}_{q_j} and \vec{L}_{p_j} with the wave vectors occurring in these diagrams.
- (c) Define all wave vectors needed to set up the factorized generating functional.
- (d) Write down the response-field factors for these diagrams.

2. **Asymptotic behaviour of integrals.** With the methods described in the lecture and the lecture notes, derive the asymptotic behaviour for $\lambda \rightarrow \infty$ for the following integrals.

(a)

$$\int_0^\infty dx e^{-\lambda(a+bx^2)} \cos x$$

with $a, b \in \mathbb{R}$ and $b > 0$ and

(b)

$$\int_0^\infty dx e^{-\lambda b(x-x_0)^2} x^m$$

with $b \in \mathbb{R}$, $b > 0$, and $m \in \mathbb{N}$.

(c) Specialize the last result for $m = 2$.