

Homework #7

Due April 03, 2026

Problem I

Consider a scalar field with N components $\varphi = (\varphi_1, \dots, \varphi_N)$, and assume that the interaction is invariant under $O(N)$ transformations of the vector φ . We study the massless *linear sigma model*, governed by the Euclidean action (see PS Problem 4.3 for details):

$$\mathcal{A} = \int d^4x \left[\frac{1}{2}(\partial\varphi)^2 + \frac{\lambda}{4}(\varphi^2)^2 \right].$$

- (1) Compute the β -function and the γ -function at leading order in perturbation theory.
- (2) Compute γ_{φ^2} .