PDRP Notes

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Contents

1 February 8 - First meeting

1.1 Game Plan

The plan is to cover the following topics in roughly descending order

- Susy and Morse Theory
- Witten TQFT's : Cohomology
- Schwarz : Path Integration
- Chern-Simons theory : Related to condensed matter theory

Some math we'll need for *all* of these Homology, Bundles, and Morse Theory.
Stuff we want to review before the meat:

- QFT, particularly Canonical Quantization
- Path Integrals

1.2 Review of Topology

-Refer to Physics 198 notes lmao

Why is the definition of a topology useful?

2 Path integrals and Fractional Quantization

To consider the time evolution of a state, we need to calculate the

Why do we need fields? To preseve unitary while being able to talk about particle creation and annihilation.

How do we evaluate

$$\langle do \rangle = \int \mathcal{D}\mathcal{A} e^{i\mathcal{S}[\mathcal{A}]}$$

?

This is an infinite dimensional integral and further the action is now a functional. The same issues come up when we try to evaluate correlation functions $\langle 0|T\{\phi(x_1), \ldots, \phi(x_2)\}|0\rangle$. **This is quite the conundrum**.

We're going to try and use Feynman's Trick. To replicate feynman's trick, we perturb the action a bit

$$\mathcal{S}[\mathcal{A}(x)] =$$

Note: We call $\mathcal{J}$ a source, and it is a generator of the partition function $Z[\mathcal{J}]$
We say

$$\mathcal{Z}[\mathcal{J}] = \int \mathcal{D}\mathcal{A} e^{i\mathcal{S}[x]}$$

Then, we get

$$\frac{d}{d\mathcal{J}(x)} \int \mathcal{D}\mathcal{A} e^{i\mathcal{S}[x]} \bigg|_{\mathcal{J}=0} =$$

Usually, we have to deal with *time ordering* to account for causality. When looking at a two point function, we have time ordering if

$$\langle \mathcal{A}(x_1), \mathcal{A}(x_2) \rangle$$

But in the path integral above, these commute. But we get time ordering for free [explain why].