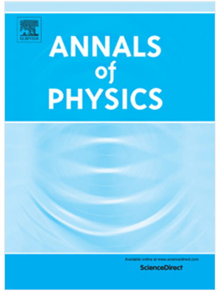

Functional integrals and inequivalent representations in Quantum Field Theory

M. Blasone, P. Jizba, L. Smaldone

PII: S0003-4916(17)30156-2
DOI: http://dx.doi.org/10.1016/j.aop.2017.05.022
Reference: YAPHY 67405

To appear in: *Annals of Physics*

Received date : 13 March 2017
Accepted date : 30 May 2017

Functional integrals and inequivalent representations in Quantum Field Theory

M Blasone[a], P Jizba[b], L Smaldone[a]

[a]Dipartimento di Fisica, Università di Salerno, Via Giovanni Paolo II, 132 84084 Fisciano, Italy & INFN Sezione di Napoli, Gruppo collegato di Salerno, Italy
[b]FNSPE, Czech Technical University in Prague, Břehová 7, 115 19 Praha 1, Czech Republic

Abstract

We discuss canonical transformations in Quantum Field Theory in the framework of the functional-integral approach. In contrast with ordinary Quantum Mechanics, canonical transformations in Quantum Field Theory are mathematically more subtle due to the existence of unitarily inequivalent representations of canonical commutation relations. When one works with functional integrals, it is not immediately clear how this algebraic feature manifests itself in the formalism. Here we attack this issue by considering the canonical transformations in the context of coherent-state functional integrals. Specifically, in the case of linear canonical transformations, we derive the general functional-integral representations for both transition amplitude and partition function phrased in terms of new canonical variables. By means of this, we show how in the infinite-volume limit the canonical transformations induce a transition from one representation of canonical commutation relations to another one and under what conditions the representations are unitarily inequivalent. We also consider the partition function and derive the energy gap between statistical systems described in two different representations which, among others, allows to establish a connection with continuous phase transitions. We illustrate the inner workings of the outlined mechanism by discussing two prototypical systems: the van Hove model and the Bogoliubov model of weakly interacting Bose gas.

Keywords: Theory of quantized fields, Functional integrals, Canonical transformations, Coherent states
PACS: 03.70.+k, 02.90.+p, 03.65.Db, 03.65.Sq

1. Introduction

Soon after the formulation of Quantum Field Theory (QFT), it became clear that this is not a straightforward extension of Quantum Mechanics (QM)

Email addresses: blasone@sa.infn.it (M Blasone), p.jizba@fjfi.cvut.cz (P Jizba), lsmaldone@sa.infn.it (L Smaldone)