Commun. math. Phys. 29, 265—284 (1973)

Thermodynamics of Particle Systems in the Presence of External Macroscopic Fields

II. Quantal Case

C. Marchioro*
Istituto Matematico, Università di Roma, Rome, Italy

E. Presutti
Istituto di Fisica, Università dell'Aquila, L'Aquila, Italy

Received August 15, 1972

Abstract. In a previous paper the statistics of a system of identical particles moving in an external field depending on a scale factor has been studied in the classical framework. In particular the case in which the scale factor increases to infinity (macroscopic limit) has been considered.

In the present paper the quantum extension is discussed.

1. Introduction

In some recent papers the thermodynamic behaviour of particle systems in the presence of external macroscopic fields has been discussed in the framework of rigorous statistical mechanics [1–4]. (In the sequel Ref. [4] will be denoted as I.) In this paper we want to obtain the quantum extension of the previous results.

The approach is similar to the classical one. As well known an external field containing a particle gas in thermodynamic equilibrium is considered macroscopic if it is possible to divide the whole space in subregions small enough for the potential to be approximately constant in them, but large enough to consider in each region statistically independent systems.

We simulate a similar situation considering a system of identical interacting particles in an external field depending on a scale factor. The macroscopic limit is achieved letting the scale factor go to infinity. We study the grand partition function and as a result we again find a link between the so obtained pressure and the usual one (barometric formula).

Let us now discuss the features typical of the quantum case. As in I, we want to divide the whole space in subregions and to express the total

* Research supported in part by the Consiglio Nazionale delle Ricerche. (G.N.F.M.A.M.F.I.)