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Bosons in Thermal Contact: A C^*-Algebraic Model*

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Abstract. A gas of two Boson systems coexisting in $\mathbf{R}^3$, and interacting only mutually, is analyzed. The interaction is quadratic, so that the dynamical problem may be solved completely and exactly.

The initial state is taken to be the mutually uncorrelated Gibbs states: $\phi_\beta^{(1)} \otimes \phi_\beta^{(2)} = \psi_\beta$. We find the time evolved state, and its projections onto the separate species and the subvolumes.

The principle consequences of this model are discussed. In particular we examine the possible occurrence of harmonic oscillations between the species.

§ 1. Introduction

In this note we present a model consisting of two species of Bosons, $\underline{1}$ and $\underline{2}$, coexisting in $\mathbf{R}^3$. The species are, by themselves, free; but between them there is an interaction, quadratic in the fields. That being so, a "linear combination of fields" transformation "diagonalizes" the Hamiltonian. In the diagonal frame, there are two types of "quasiparticles" which we denominate $\underline{a}$ and $\underline{b}$; they evolve in time by quasifree evolutions.

The principle consequence of the interaction is that persistent interchanges between the original species occur. A local observable formed from $\underline{1}$ before interaction will be formed from both $\underline{1}$ and $\underline{2}$ after interaction.

As persistent interchange is typical of hyperusiastic[1] leakage behaviour such as in "superfluid leak", this model may be relevant to a semi-phenomenological treatment of such phenomena [1, 2].

The paper is organized as follows. In § 2 we discuss the necessary configurational geometry, introduce the appropriate Fock spaces, and the pertinent algebras. The next section (§ 3) discusses the constituent Gibbs states and the initial state of the system constructed from them.

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[1] A Hellenized generic term for super-substances such as Superfluids (J. M. Fergusson).