Preprint Series in Particles and Cosmos Physics

nº IPARCOS-UCM-23-140

INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

IPARCOS

A dynamical implementation of canonical second quantization

by J. J. Gálvez Viruet, and F. J. Llanes Estrada

December 2023

Plaza de las Ciencias, 1 28040 Madrid, Spain

www.ucm.es/iparcos/

UNIVERSIDAD COMPLUTENSE MADRID

INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

IPARCOS

Abstract

We provide the basic theoretical methods for the implementation of creation and destruction operators in separate registers of a quantum computer, allowing for a transparent and dynamical creation and destruction of particle modes in second quantization in problems with variable particle number. We establish theorems for the commutation (anticommutation) relations and provide the needed symmetrizing and antisymmetrizing operators. Finally, we provide formulae in terms of these operators for unitary evolution under conventional two- and four-body Hamiltonian terms.

An advantage of this formalism over that of the Wigner-Jordan transformation one is the more efficient scaling of the encoding for few-body systems with large number of available states (whereas it is less advantageous for a large number of particles with few states available to each).

UNIVERSIDAD
COMPLUTENSE
MADRID