Accepted Manuscript

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PII: S0378-4371(17)30894-4
DOI: http://dx.doi.org/10.1016/j.physa.2017.09.002
Reference: PHYSA 18607

To appear in: *Physica A*

Received date : 10 May 2017
Revised date : 6 July 2017

Please cite this article as: Y. Vasiuta, A. Rovenchak, Modeling free anyons at the bosonic and fermionic ends, *Physica A* (2017), http://dx.doi.org/10.1016/j.physa.2017.09.002

Modeling free anyons at the bosonic and fermionic ends

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September 5, 2017

Abstract

The topology of particle trajectories in two-dimensional space allows for existence of anyons – particles obeying statistics intermediate between that of bosons and fermions. In this article, the functional form of the occupation numbers of free anyons is suggested as a modification of the Gibbs factor in the Bose and Fermi statistics. The proposed expressions are studied in the bosonic and fermionic limits. The obtained virial coefficients coincide with those of free anyons up to the fourth and fifth virial coefficients (the proposed approach can be extended for higher ones as well) and up to the second order in the anyonic parameter. The effective excitation spectrum corresponding to anyons is calculated.

Key words: Fractional statistics; Anyons; Virial expansion; Occupation numbers.

1. Introduction

The theoretical possibility of existence of what is called 'anyons' was made in 1977 [1]. In early 1980s, Wilczek proposed a model based on the (2+1)-dimensional electrodynamics and showed that an exchange of two particles leads to an arbitrary ('any') change of the wave function phase, so he proposed the term 'anyons' [2].

It is worth mentioning some earlier approaches to intermediate statistics. Back in 1940, Gentile [3] postulated a finite occupation