Complex-valued fractional statistics for D-dimensional harmonic oscillators

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Properties of a system of harmonic oscillators in a space having the dimension $1 \leq D \leq 2$ are studied. The oscillators obey the fractional statistics of Polychronakos [1] with the parameter being a complex number on the unit circle [2]. Heat capacity of such a system is calculated and the peculiarities of its behavior are studied in the bosonic limit. A possible interpretation of the complex parameter is to consider a Bose-system with a weak dissipative part in the spectrum of elementary excitations [2]. The nature of the observed phase transitions is clarified. Both numerical and analytical estimates for the critical temperature are made depending on the number of particles, space dimensionality, and statistics parameter.

The obtained results can be easily transferred from oscillators to systems of free particles in dimensions $2 \leq D \leq 4$ due to similarities of the density-of-state functions. Indeed, for the linear spectrum of harmonic oscillators the density of states is $g(\varepsilon) \propto \varepsilon^{D-1}$ while for free particles $g(\varepsilon) \propto \varepsilon^{D/2-1}$. Therefore, the obtained approach can be used to study the properties of a continuous transition between planar and bulk geometries.

1. A. P. Polychronakos, Phys. Lett. B **365**, 202 (1996).
2. A. Rovenchak, J. Phys.: Conf. Ser. **400**, 012064 (2012).

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