Operational Reconstruction of Quantum Statistics

Bosons, Fermions and Transtatistics

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Question: Why bosons and fermions?

The real problem

The physical motivation for the symmetrisation postulate or the (anti)commutation relations is poorly understood and not well-motivated from the operational point of view.

Strategy for a solution

Assume a set of operationally well-motivated assumptions that imply the boson-fermion duality assuming only quantum mechanics of a single particle.

The Postulates

- Unitary complex dynamics defines the single-particle transformations
- Phase act locally in the space of multi-particle systems

Methodology

Each representation of the group U(d) is labeled by a symmetric polynomial called the character of the representation. Bosonic and Fermionic Fock spaces as representations have specific characters. The postulates can be interpreted as factorisation properties of the characters as complex polynomials.

Main Theorem

Every representation of the group U(d) that is consistent with the postulates is isomorphic to tensor products of Bosonic and Fermionic Fock spaces up to fractional degeneracy.

Discussion

- If we add irreducibility of the particle number sectors we get exactly bosons and fermions.
- The degeneracy when integral is still a valid type of quantum multi-article statistics. This type of physics have not been described before in the literature.

New statistics! (Transtatistics)