Jack states and two-body pseudopotentials

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We investigate properties of quantum Hall wave functions based on Jack polynomials. In particular we describe certain many body repulsion states in terms of two-body pseudopotentials. The fractional quantum Hall effect (FQHE) is still one of the most intensively studied phenomenon in solid state physics. During over 35 years or research this remarkable behavior of highly interacting electrons had been approached in many ways. In this presentation we focus on trial wave function method i.e.: to describe physical system one proposes wave function, which is hopefully able to reproduce complex behavior of electrons. Grand success of this approach and milestone in our understanding of FQHE was discovery of the so called Laughlin wave functions. Laughlin wave functions defied as a product of Gaussian and odd power of Vandermonde determinant can be understood as ground states of specific two-body repulsion Hamiltonians.

It is fruitful to search for trial wave functions among polynomials developed by mathematicians involved in the theory of symmetric functions. Amazingly one particular family of symmetric polynomials had been successfully adapted into the FQHE - Jack polynomials [1-4]. Jack polynomials are remarkable objects with many applications in combinatorics and algebraic combinatorics [5]. Clustering properties of specific Jack polynomials allow for association with ground states of many-body repulsion Hamiltonians [1,6]. Jack states (FQHE states associated with Jack polynomials) known to be Jack states include Laughlin, Moore-Read, Read-Rezayi and Gaffnian states.

Question explored in this presentation is whether specific Jack state (corresponding to many-body repulsion Hamiltonians) can validly describe electrons in different Landau levels (whether in conventional materials such as GaAs or in graphene). We examined problem by a numerical search for best overlaps of Jack wave functions and ground states of suitable two-body Hamiltonians. Overlaps are illustrated with series of maps. Analysis of maps allows us for determination of what Jack states are likely to occur as FQH coulomb repulsion ground states.

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