Method of Constructing Trial Wavefunctions for Quantum Hall States

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Numerical studies indicate that incompressible quantum Hall states occur when the relation between the single particle angular momentum ℓ and the number N of electrons in the partially filled Landau level is $2\ell = \nu^{-1}N - c_\nu$. Here, ν is the filling factor and c_ν is a "finite size shift". The values of c_ν found numerically depend on correlations, and for $\nu = n/q < 1/2$ are given by $c_\nu = q + 1 - n$. This finite size shift points the way to constructing electronic trial wavefunctions. A trial wavefunction can always be written $\Psi = FG$, where $F = \Pi_{i<j} z_{ij}$ and $G(z_{ij})$ is a symmetric correlation function caused by interactions. For the Moore-Read state, $G_{MR}(z_{ij})$ is a product of F and the antisymmetric Pfaffian. Another choice is the quadratic function, $G_Q = S\{\Pi_{i<j\in g1} \Pi_{k<l\in g2} (z_{ij}z_{kl})^2\}$, where S is a symmetrizing operator, and g_1 and g_2 each contain $N/2$ particles resulting from a partition of N into two sets. For the Jain states with $\nu = n/q < 1/2$, the N particles can be partitioned into n subsets, g_1, g_2, …, g_n, each containing two particles more than the preceding one. For example, for $n = 3$, g_1; g_2, and g_3 contain N/3 – 2, $N/3$, and N/3 + 2 electrons, respectively. Choosing different correlations among particles within different subsets, and between particles belonging to different subsets can result in the maximum power of z_i in the antisymmetric wavefunction equal to $2\ell = \nu^{-1}N - c_\nu$, with $c_\nu = q + 1 - n$. The choice of correlation functions is not necessarily unique. Exact diagonalization studies of small systems are being carried out to compare different choices.