Correlations in incompressible quantum liquid states: constructions of electronic trial wavefunctions

JOHN QUINN, University of Tennessee, Knoxville — 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 $2l = \nu^{-1} N - c_\nu$. Here, $\nu$ is the filling factor and $c_\nu$ is a “finite size shift.” The values of $c_\nu$ found numerically depend on correlations, and for $\nu = p/q \leq 1/2$ are given by $c_\nu = q + 1 - p$. This finite size shift points the way to constructing electronic trial wavefunctions. A trial wavefunction can always be written $\Psi = FC$, where $F = \prod_{i<j} z_{ij}$ and $C(z_{ij})$ is a symmetric correlation function caused by interactions. For the Moore-Read state, $C_{MR}(z_{ij})$ is a product of $F$ and the antisymmetric Pfaffian. $C_{MR}$ is not the only possible correlation function for this state. Another choice is the quadratic function $C_Q = S \left\{ \prod_{i<j \in g_A} \prod_{k<l \in g_B} (z_{ij}z_{kl})^2 \right\}$, where $S$ is a symmetrizing operator, and $g_A$ and $g_B$ each contain $N/2$ particles resulting from a partition of $N$ into two sets. For the Jain states (e.g. $\nu = 2/5$), different partitioning of $N$ particles into sets of unequal size gives appropriate correlation functions.

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