Quantum Hall states from frustration free lattice models

A variety of short-range interactions are known whose zero energy modes successfully describe the low energy properties of various interesting phases in the fractional quantum Hall regime. The theoretical analysis of Haldane-type pseudo potentials and their generalizations is usually based on a first quantized picture, deriving nice analytical properties of their first quantized zero mode wave functions, which have polynomial form in most standard geometries. Recently, however, the second quantized -or guiding center- form of these pseudo-potentials has enjoyed much interest, e.g., in flat band solids. In such a context, the embedding of the problem into the lowest Landau level of some larger Hilbert space is artificial, and with the construction of new models in mind, it seems beneficial to understand how to systematically ``solve'' known pseudo-potential problems in a purely algebraic picture that emerges in second quantization. Starting with the second quantized, frustration free “lattice” version of quantum Hall parent Hamiltonians to define zero modes relates to the traditional, first-quantized route in a manner that is similar to the way in which the algebraic solution to the Harmonic oscillator relates to its analytic one. In this talk, I will discuss this method in detail for the Laughlin states and their parent Hamiltonians, and furthermore discuss some general theorems that apply to the second quantized forms of general pseudo-potential type Hamiltonians.