Quantum electron liquids and fractional quantum Hall effect

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When squeezed to a narrow, effectively two-dimensional layer, and subject to low temperature and high magnetic field, a gas of electrons of appropriate density may condense into a new form of quantum matter called “quantum electron liquid”, discovered for the first time in the context of “fractional quantum hall effect” (1998 Nobel prize in physics). The properties of this fascinating state of strongly correlated electrons are conveniently described in terms of a new particle called “composite fermion” pictured as an electron carrying with itself some quantized magnetic flux. Elementary excitations of certain composite fermion systems may have exotic properties such as fractional and nonabelian quantum statistics, leading to such effects as memory of past trajectories. These properties have been proposed as building elements of a future “topological quantum computer”. My talk will review these fascinating concepts, with emphasis of my own field of research.