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## Tunable interactions and the fractional quantum Hall effect[1]

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We explore several realistic methods of tuning the interactions in two-dimensional electronic systems in high magnetic fields. We argue that these experimental probes can be useful in studying the interplay of topology, quantum geometry and symmetry breaking in the fractional quantum Hall effect (FQHE). In particular, we show that the mixing of subbands and Landau levels in GaAs wide quantum wells breaks the particle-hole symmetry between the Moore-Read Pfaffian state and its particle-hole conjugate, the anti-Pfaffian, in such a way that the latter is unambiguously favored and generically describes the ground state at 5/2 filling [1]. Furthermore, the tilting of the magnetic field, or more generally variation of the band mass tensor, probes the fluctuation of the intrinsic metric degree of freedom of the incompressible fluids, and ultimately induces the crossover to the broken-symmetry and nematic phases in higher Landau levels [2]. Some of these mechanisms also lead to an enhancement of the excitation gap of the non-Abelian states, as observed in recent experiments. Finally, we compare the tuning capabilities in conventional systems with that in multilayer graphene and related materials with Dirac-type carriers where tuning the band structure and dielectric environment provides a simple and direct method to engineer more robust FQHE states and to study quantum transitions between them [3].

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