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Light induced fractional hall phases in graphene

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We show how to realize two-component fractional quantum Hall phases in monolayer graphene by optically driving the system. A laser is tuned into resonance between two Landau levels of graphene and acts as an effective tunneling term between these states. We study systems with small number of electrons for filling factor 2/3 using exact- diagonalization. When the lower state is the first Landau level, we find that tuning the effective tunneling amplitude causes the system to undergo a phase transition from a spin-singlet phase to a particle-hole conjugate 1/3 Laughlin phase of the antisymmetric optical dressed states. This phase transition can be traced to the presence of additional cross interaction terms that arise in the rotating wave approximation. These results pave the way towards the realization of new phases, as well as the control of phase transitions, in graphene quantum Hall systems using optical fields and integrated photonic structures.

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