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Proposal for generating synthetic magnetic fields in hexagonal optical lattices BINBIN TIAN, Univ of Pittsburgh, MANUEL ENDRES, Max Planck Institute, DAVID PEKKER, Univ of Pittsburgh — We propose a new approach to generating synthetic magnetic fields in ultra cold atom systems that does not rely on either Raman transitions nor periodic drive. Instead, we consider a hexagonal optical lattice produced by the intersection of three laser beams at 120 degree angles, where the intensity of one or more of the beams is spatially non-uniform. The resulting optical lattice remains hexagonal, but has spatially varying hopping matrix elements. For atoms near the Dirac points, these spatial variations appear as a gauge field, similar to the fictitious gauge field that is induced for for electrons in strained graphene. We suggest that a robust way to generate a gauge field that corresponds to a uniform flux is to aligning three gaussian beams to intersect in an equilateral triangle. Using realistic experimental parameters, we show how the proposed setup can be used to observe cyclotron motion of an atom cloud – the conventional Hall effect and distinct Landau levels – the integer quantum Hall effect.

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