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Realizing Fractional Chern Insulators in Dipolar Systems NORMAN YAO, Harvard University, ALEXEY GORSHKOV, IQIM, Caltech, CHRIS LAUMANN, Harvard University, ANDREAS LAUCHLI, University of Innsbruck, JUN YE, JILA, University of Colorado at Boulder, MIKHAIL LUKIN, Harvard University — Strongly correlated quantum systems can exhibit exotic behavior controlled by topology. We predict that the $\nu = 1/2$ fractional Chern insulator arises naturally in a two-dimensional array of driven, dipolar-interacting spins. As a specific implementation, we analyze how to prepare and detect synthetic gauge potentials for the rotational excitations of ultra-cold polar molecules trapped in a deep optical lattice. With the motion of the molecules pinned, under certain conditions, these rotational excitations (acting as effective spins) form a fractional Chern insulating state. We present a detailed experimental blueprint for its realization and demonstrate that the implementation is consistent with near-term capabilities. Prospects for the realization of such phases in solid-state dipolar systems are discussed as are their possible applications.

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