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From Möbius aromaticity to gapped spin liquids CHENG-CHIEN CHEN, Argonne National Laboratory, LUKAS MUECHLER, TITUS NEUPERT, Princeton University, JOSEPH MACIEJKO, University of Alberta, ROBERTO CAR, Princeton University — Motivated by the concept of Mobius aromatics in organic chemistry, the Hubbard model on ring-shaped molecules has been shown previously to support a fragile Mott insulator (FMI) ground state, which is distinct from a conventional insulator through its nontrivial transformation properties under point-group symmetry operations. In this talk, we discuss two-dimensional lattices of weakly-coupled FMI molecules belonging to multi-dimensional irreducible representations of the molecular point group. The low-energy effective Hamiltonians map onto quantum compass models with broken spin SU(2) symmetry. On the triangular lattice, the ground state develops long-range magnetism, which corresponds to a charge-ordered state of the molecules. On the honeycomb lattice, interestingly, we find a non-degenerate gapped spin-liquid ground state that preserves all spatial symmetries but transforms nontrivially under point-group operations. Our microscopic model therefore realizes an intrinsically interacting fermionic symmetry protected topological (SPT) phase.

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