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Spin-orbital liquid state on the square lattice with emergent Majorana fermions and Z_2 topological order ASHVIN VISHWANATH, FA WANG, UC Berkeley — Magnetism from d-electrons often retains orbital degeneracy which can enhance quantum fluctuations and lead to exotic liquid-like ground states with no conventional order. Indeed, experimental systems like $LiNiO_2$, $FeSc_2S_4$ etc. with orbital degeneracy show a lack of order down to low temperatures. We introduce a Majorana-fermion slave particle theory to study such states in spin-1/2 models with e_g orbital degeneracy. This is first applied to a square lattice model with enhanced SU (4) symmetry. A mean field treatment predicts a spin-orbital liquid state with nodal Majorana fermion excitations and Z_2 topological order. A variational Monte-Carlo study of the corresponding wavefunction confirms the absence of magnetic order and bond order, which makes it a candidate state for a spin orbital liquid. Comparing against the exact diagonalization studies in [Bossche et al. Eur. Phys. J. B 17, 367 (2000)], our state is found to have significant overlap with the ground state on small lattices, despite the absence of a variational parameter. More realistic models with lower symmetry and on different lattices are analyzed within our formalism, and applications to S=3/2 atoms confined in optical lattices are pointed out.

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