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Frustration and glassiness in spin models with cavity-mediated interactions SARANG GOPALAKRISHNAN, University of Illinois at Urbana-Champaign, BENJAMIN LEV, Stanford University, PAUL GOLDBART, Georgia Institute of Technology — Optical cavity photons can mediate interatomic interactions that are both long-ranged and sign-changing, thus enabling the realization of models and phases (such as supersolids [1]) that are inaccessible in conventional optical lattices. Here, we introduce a general scheme for realizing frustrated magnetic models possessing spin-glass states, using three-level atoms trapped at fixed positions inside a transversely pumped multimode cavity. We show that the effective Hamiltonian for such a system is analogous to the Hopfield associative-memory model [2], and, like the Hopfield model, possesses a spin glass phase for a sufficiently large ratio of the number of cavity modes to atoms. We argue that the spin glass phase should be accessible with realistic experimental parameters, discuss experimental signatures of the spin glass phase, and address the impact of dissipative processes such as cavity photon decay on the realizable phases and phase transitions.

[1] K. Baumann et al., *Nature* 464, 1301 (2010); S. Gopalakrishnan et al., *Nat. Phys.* 5, 845 (2009).
[2] J.J. Hopfield, *Proc. Nat. Acad. Sci* 79, 2554 (1982).

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