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Emergent glassy state in a disordered artificial spin ice YIFEI SHI, McGill University, CRISTIANO NISOLI, Los Alamos National Laboratory, GIA-WEI CHERN, University of Virginia — Artificial spin ice has enabled the study of exotic frustrated matter not directly accessible in nature. Recently a new type of artificial spin ice on the shakti lattice has been proposed and experimentally observed. Here we investigate the emergence of the shakti ice phase starting from the well studied square spin-ice array. Due to the lack of a true degeneracy among the various ice-rule vertices, the square ice array develops a long-range Néel type order at low temperatures. By introducing long island spin to the center of randomly selected plaquettes, we show that the spin Néel order is quickly destroyed when the density of the center islands reaches the site percolation threshold, giving rise to a glassy phase. Interestingly, further addition of the center islands pushes the system into a spin ice phase. While spins remain disordered in both the glass and ice states, these two phases are distinguished by different dynamical behaviors as we demonstrated through a finite-size study of the spin-glass susceptibility. Our work also suggests a new approach to study the interplay of long range order, spin glass, and spin ice.

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