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Emergence by Design in Artificial Spin Ice CRISTIANO NISOLI, LANL, MUIR MORRISON, Caltech, GIA-WEI CHERN, LANL, IAN GILBERT, University of Illinois Urbana Champaign, SHENG ZHANG, ANL, PETER SCHIFFER, University of Illinois Urbana Champaign — Recently a new perspective has opened in the study of frustration through the creation of artificial frustrated magnetic systems [1,2]. These materials consist of arrays of lithographically fabricated single-domain ferromagnetic nanostructures that behave like giant Ising spins, whose interactions can be controlled through appropriate choices of their geometric properties and arrangement on a (frustrated) lattice. Higher control, inclusive of genuine thermal ensembles [3-5] have replaced the earlier and coarser methods based on magnetic agitation. Dynamical versions are now being realized [4,5], characterized in real time via PEEM, revealing statistical mechanics in action. This affords implementation of new geometries [6-8], not found in nature, for dedicated bottom up design of desired emergent properties [8]. Born as a scientific toy to investigate frustration-by-design, artificial spin ice might now be used to open "a path into an uncharted territory, a landscape of advanced functional materials in which topological effects on physical properties can be explored and harnessed." [9]. Ref: [1] Nature 439, 303-306 (2006) [2] Rev. Mod. Phys. 85 (4), 1473 (2013) [3] Nature 500 (7464), 553 (2013). [4] Nature Physics 9, 375–382(2013) [5] Nature Nanotechnology 9, 514 (2014) [6] New Journal of Physics 15 (4), 045009 (2013) [7] Phys. Rev. Lett. 111 (17), 177201 (2013) [8] Nature Physics, 10 (9), 670-675 (2014) [9] Nature Physics, doi:10.1038/nphys3072 (2014)

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