nanosystems initiative munich

Biological Soft Matter Theory
Physics Department TUM

"Soft-Matter Seminar"

Colloidal Spin Ice on Arrays of Optical Traps

Prof. Andras Libal
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Abstract:
We demonstrate how a colloidal version of artificial spin ice can be realized on optical trap lattices. Using numerical simulations, we show that this system obeys the ice rules and that for strong colloid-colloid interactions, an ordered ground state appears. We show that the ice-rule ordering can occur for systems with as few as 24 traps (feasible experimentally) and that the ordering transition can be observed at constant temperature by varying the barrier strength of the traps. We further show that artificial spin ice systems exhibit an imperfect return point memory when subject to drives below full saturation. The loss of return point memory is correlated with the presence and movement of grain boundaries in the square ice. We argue that the hexagonal ice regains full return point memory at a faster rate than the square ice because the lattice is not bipartite and cannot support real grain boundaries. We also show that substrate disorder can immobilize the grain boundaries and help regaining return point memory in these systems. We also discuss how charge ordered states appear during the hysteresis and describe the multiple phases they undergo upon melting.

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Raum PH 3344

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