Engineering of frustration in colloidal artificial ice

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Frustration has become a ubiquitous explanation for long standing problems in soft matter systems, from glassy behaviors [1] to protein folding [2]. It is also present in solid state materials such as water ice [3] or rare earth magnets [4], and it is of technological importance for information storage in traditional magnetic recording devices.

We present an experimental realization of artificial colloidal ice; a mesoscopic system in which we can introduce frustration by design, and on which we can fully control initial conditions [5].

Our system has shown to be a platform to design devices for information storage and magnetronic logic devices, and we have observed both frozen defects such as domain walls and dynamic excitations, present as bound charged quasiparticles with a Coulombic interaction.

We also proved experimentally previous theoretical calculations [6] which predicted how the analogue between artificial spin ice and colloidal ice breaks when the lattice coordination is multiple. This shows how colloidal ice, as a special case of the more general particle ice, holds the promise to deliver rich phenomenology beyond simply replicating the existing plethora of observations in spin ice materials.

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