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Trapped ion system for simulation of quantum spin models SYLVI HAENDEL, DANILO DADIC, MICHAEL IP, WES CAMPBELL, UCLA — We describe efforts to study and control ordered systems of charged particles and their formation in an ion trap with radial symmetry. The system is realized within a monolithic fused silica design. Using Yb^+ ions and an appropriate bichromatic beatnote, an effective spin-spin interaction arises between the clock states of all pairs of $^{171}Yb^+$ ions [1,2]. The range and sign of the resulting spin-spin interaction can be controlled through tailoring of the beatnotes. Antiferromagnetic couplings can be generated, allowing the study of highly frustrated magnetism. When simulating frustrated spin system under periodic boundary conditions, the number of ions in the trap plays an important role. For certain trap voltages, ions can crystallize in a 2D planar array in the plane of the RF potential [3]. Nearest-neighbor antiferromagnetic couplings will lead to a highly-frustrated ground state for an odd number of spins. Increasing the number of ions to an even number changes the frustration in the system. We also report on progress with linear RF traps of different architectures.

[1] D. Porras et al., Phys. Rev. Lett. 92, 207902 (2004).
[2] K. Kim et al., Nature 465, 590 (2010).
[3] Itano et al., Proc. Of the Workshop on Crystalline Ion Beams 241-247 (1989).

Sylvi Haendel
UCLA

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