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Wigner Crystallization of Chiral Polyelectrolyte Bundles GREGORY GRASON, ROBIJN BRUINSMA, Department of Physics and Astronomy, University of California at Los Angeles — We construct an effective model to describe the thermodynamics of the Wigner- crystalline state of polyvalent counterions absorbed within hexagonal bundles of chiral, rod-like macroions (such as DNA or filamentous actin). We argue that the ground state counterion configuration as well as the associated long-wavelength fluctuations about this state are characterized by a frustrated, antiferromagnetic XY *spin* Hamiltonian defined on the kagomé lattice. The unusual statistical mechanics associated with this model can be treated within a generalized, dual description of interacting vortices (or screw defects), revealing that generically Wigner-crystalline ground states are constructed of arrays of screw-like configurations of counterions which wind helically around the constitute macroions. Further, the dual description reveals that the ground state admits both *integer* and *fractional* screw-like defects as well as Ising- like fluctuations between domains of unlike chirality. We find that the molecular chirality of the macroions plays an important role in suppressing these domain fluctuations, and hence chirality itself becomes a critical parameter in melting behavior of the Wigner-crystalline state.

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