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Colloidal Clusters via Short, Specific, and Isotropic DNA Interactions JESSE W. COLLINS, Harvard SEAS, VINOTHAN N. MANOHARAN, Harvard SEAS and Physics — Many of the material systems scientists have successfully described using statistical mechanics have a number of distinct chemical species that does not scale with the total number of particles. Do any different equilibrium phenomena emerge in systems of a much wider variety of chemical species? We investigate the case in which the number of chemical species is equal or very nearly equal the total number of particles. We coat microspheres with short and specific DNA strands, and observe small numbers of these spheres at a time self-assemble using various forms of microscopy, including holography for 3-D particle positions and fluorescence for species identification. We have learned some simple rules that modulate the energy landscape of these particles. The relative chirality of substructures, including pairs of trimers, varies for each local minima on the landscape of small clusters like the ones we observe. If the ground state structure is rigid, the higher energy local minima structures are generally soft. Although our experiments are limited to about 6 particles, ideas from graph theory and statistical mechanics suggest that much larger numbers of short-ranged, specific and chemically isotropic spheres can robustly assemble into rigid ground state clusters as well.

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