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Towards Structural Complexity with Colloids[1]

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Colloids rather easily assemble into simple crystal structures like the face-centered cubic lattice or the body-centered cubic lattice. More complex phases are harder to achieve, but have recently been reported using a number of approaches. Yet, assembling complex structures often results from trial-and-error and is not well understood. In this presentation, we show how novel crystals, quasicrystals, and liquid crystals can be achieved with colloidal building blocks by varying the interactions and the shapes of the building blocks. Using computer simulations, we demonstrate the formation of unusually ordered phases both with isotropic pair potentials, as well as with facetted shapes like polyhedra. We describe new tools we have developed to perform complex structural analysis on simulated systems and show how they may be used to analyze real space images from colloid experiments. We also compare the assembled structures with densest packings of the building blocks and show that good packings can often be distinct from what is observed to assemble from the disordered state. This suggests that dense packings may not be illustrative of what is achievable in colloid experiments.

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