Colloidal musical chairs - String- and loop-like cooperative motion in locally perturbed 2D colloidal crystals

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The application of a local or point perturbation within a crystalline solid is known to result in defect proliferation or even cause local precipitation of disordered and/or liquid phases. We study these effects experimentally in soft 2-dimensional colloidal crystals by actively driving one of the particles along the lattice axes. This local perturbation results in a rich spectrum of cooperative particle motions. Most strikingly, we observe the emergence of string- and loop-like rearrangements of particles moving in sequence. Analysis of the defect patterns suggests that these "musical chair" motions result from the unbinding and diffusion of actively generated vacancy interstitial pairs. These results shed new light on the microscopic mechanisms with which crystals can yield or melt.