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Realization of atomistic transitions with colloidal nanoparticles using an ultrafast laser GURSOY AKGUC, SERIM ILDAY, OMER ILDAY, OGUZ GULSEREN, GHAITH MAKEY, KORAY YAVUZ, ONUR TOKEL, IHOR PAVLOV, OZGUN YAVUZ, bilkent university — We report on realization of rapid atomistic transitions with colloidal nanoparticles in a setting that constitutes a dissipative far-from-equilibrium system subject to stochastic forces. Large colloidal crystals (comprising hundreds of particles) can be formed and transitions between solid-liquid-gas phases can be observed effortlessly and within seconds. Furthermore, this system allows us to form and dynamically arrest metastable phases such as glassy structures and to controllably transform a crystal pattern from square to hexagonal lattices and vice versa as well as to observe formation and propagation of crystal defects (i.e. line defects, point defects, planar defects). The mechanism largely relies on an interplay between convective forces induced by femtosecond pulses and strong Brownian motion; the former drags the colloids to form and reinforce the crystal and the latter is analogous to lattice vibrations, which makes it possible to observe phase transitions, defect formation and propagation and lattice transformation. This unique system can help us get insight into the mechanisms underlying various solid state phenomena that were previously studied under slowly evolving (within hours/days), near-equilibrium colloidal systems.

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