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Hiding in plain view: Colloidal self-assembly from polydisperse populations LUCAS GOEHRING, Max Planck Institute for Dynamics and Self-Organization, BERNARD CABANE, ESPCI ParisTech, JOAQUIM LI, Max Planck Institute for Dynamics and Self-Organization, FRANCK ARTZNER, University of Rennes, ROBERT BOTET, University Paris-Sud, CHRISTOPHE LABBEZ, GUILLAUME BAREIGTS, University of Bourgogne, MICHAEL SZTUCKI, ESRF – The European Synchrotron — We report small-angle x-ray scattering (SAXS) experiments on aqueous dispersions of colloidal silica with a broad monomodal size distribution (polydispersity 14%, size $a = 8$ nm). This distribution of sizes was expected to destroy any long-range order of the particles. However, we found ordered states when the particles repelled each other with soft ionic potentials of range $\sim a$. Over a range of volume fractions the particles segregated to build first one, then two distinct sets of colloidal crystals. These dispersions thus demonstrate fractional crystallization and multiple-phase (bcc, Laves AB_2, liquid) coexistence. Their remarkable ability to build complex crystal structures from a polydisperse population originates from the intermediate-range nature of interparticle forces, and suggests routes for designing self-assembling colloidal crystals from the bottom-up.

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