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The origin of and conditions for clustering in fluids with competing interactions RYAN JADRICH, JONATHAN BOLLINGER, THOMAS TRUSKETT, University of Texas at Austin — Fluids with competing short-range attractions and long-range repulsions exhibit a rich phase behavior characterized by intermediate range order (IRO), as quantified via the static structure factor. This phase behavior includes cluster formation depending upon density-controlled packing effects and the magnitude and range of the attractive and repulsive interactions. Such model systems mimic (to zeroth order) screened, charge-stabilized, aqueous colloidal dispersions of, e.g., proteins. We employ molecular dynamics simulations and integral equation theory to elucidate a more fundamental microscopic explanation for IRO-driven clustering. A simple criterion is identified that indicates when dynamic, amorphous clustering emerges in a polydisperse system, namely when the Ornstein-Zernike thermal correlation length in the system exceeds the repulsive potential tail range. Remarkably, this criterion also appears tightly correlated to crystalline cluster formation in a monodisperse system. Our new gauge is compared to another phenomenological condition for clustering which is when the IRO peak magnitude exceeds ~ 2.7. Ramifications of crystalline versus amorphous clustering are discussed and potential ways of using our new measure in experiment are put forward.

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