Phase behaviour, structure and aggregation of colloids immersed in near-critical solvents

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We study stability and thermodynamic properties of a colloidal suspension with a phase-separating solvent, such as a binary-liquid mixture with a miscibility gap. We focus on thenear-critical region of a solvent , where the critical fluctuations drive the divergence of the correlation length. As a consequence, the adsorption properties of the colloids become important and the effective so-called critical Casimir forces (CCFs) acting between the colloids emerge. The range and the strength of the CCFs are easily and reversible tunable by temperature and the bulk ordering field. Within an approach in terms of effective one-component colloidal systems we analyze colloidal aggregation due to CCFs and thus allude to previous experimental studies which are still under debate. Concerning the phase diagram, the phase segregation into two phases, one being rich and the other poor in colloidal particles, is investigated and the limitations of the effective approach, which is commonly used, are discussed.