Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

**Reentrant phase transitions from depletion: colloidal crystals to flocculation** LANG FENG, ExxonMobil Research and Engineering, Corporate Strategic Research, BEZIA LADERMAN, STEFANO SACANNA, PAUL CHAIKIN, New York University — Conventional depletion is supposed to be temperature independent. However, we find that many typical colloid-depletion systems show remarkable phenomena as temperature is varied. $1\mu m$ polystyrene spheres in water are known to form colloidal crystals when PEO is added as a depletant. When this system is heated the crystal melts at a first critical temperature $T_1 \sim 60C$, and then at higher temperature $T_2 \sim 70C$ the colloids flocculate. We argue that a weak temperature-dependent interaction between polymer and colloid is responsible for the observed phenomena: crystals form when the colloid-polymer interaction is repulsive, flocculation occurs when the interaction is attractive, and melting occurs in between when both phases are frustrated. The melted phase occurs due to an unexpected cancelation when combining both entropic and enthalpic attractions. We propose a simple statistical model to map out the observed transitions and fill the theoretical gap between the two established scenarios for colloid-polymer systems, namely depletion and flocculation. We have seen the same temperature dependent phenomena for TPM, PS and silica spheres with PEO and dextran as depletants. Our discovery provides a fundamental understanding of the polymer-colloid system and opens new possibilities for colloidal self-assembly and temperature-controlled viscoelastic materials.

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Date submitted: 12 Nov 2013 Electronic form version 1.4