Mystery on Charge Assymetry: Anionic Marcions in Periodic Lattices Held by Hydrated Cations and Not Vice-versa

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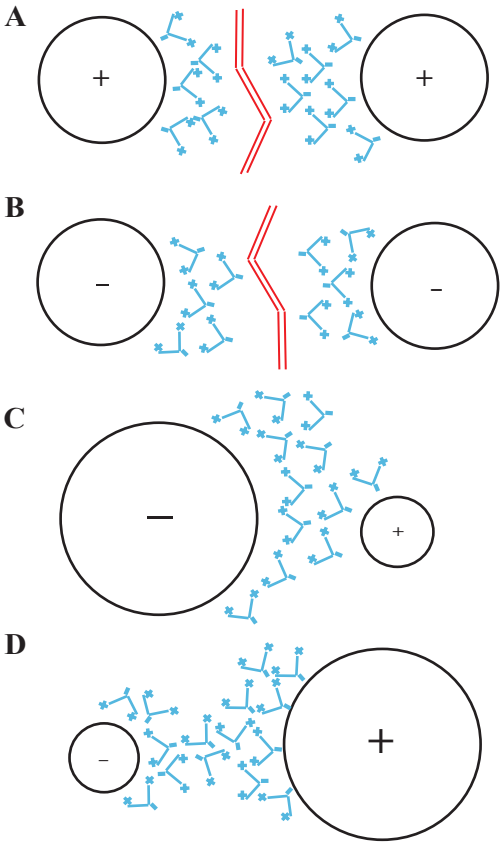
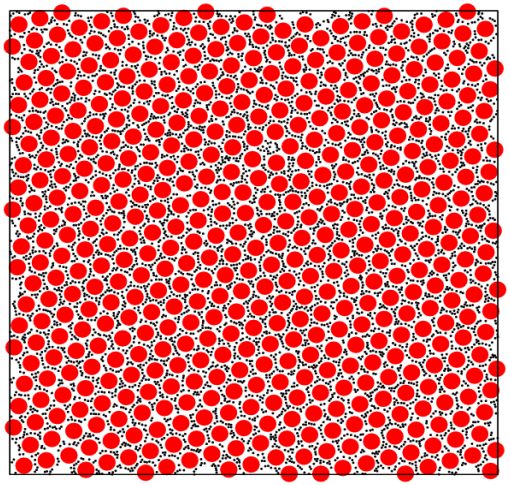
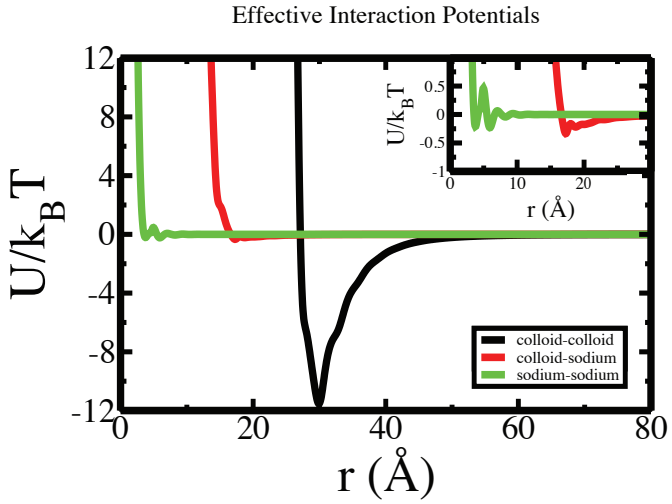
There has been recent experimental indications that this long-range attraction occurs only between colloidal particles of negative charge and not of the opposite kind. A mean-field analytical model to account for the observed asymmetry in the ability to form long-range attraction by the negatively charged colloidal particles and not their equivalently charged positive counterpart, based on the conjecture that this asymmetry is due to solvation effects. Its physics is phenomenologically captured by considering the relative strength of this water-induced short-range repulsion between the different charge species. This model is applied to the colloidal system of negatively charged disks that are neutralized by a sea of counterions and strongly absorbed to an interface in a coressible binary system and demonstrates the resulting coexistence between a dilute isotropic ionic phase and a condensed hexagonal lattice phase as a function of density and interaction strength.







(LEFT) Interactions between the bent-core water molecules (blue) and the positive and negative particles. There exists great frustration in the arrangements of water molecules around neighboring like-charge particles in (A) and (B). Due to the bent-core geometry of the water molecules, they arrange themselves in more favorable configurations of the larger negative particles with smaller positively charged particles (C) than of the reverse scenario (D). (ABOVE) Simulation snapshots of the counterions (blue) - colloids (red) interactions. (ABOVE RIGHT) Effective interaction potentials between the various components computed from HNC integral equations

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