

Electrostatic interactions govern many important properties of biological, soft matter and colloidal systems such as polyelectrolytes, polyampholytes, charged membranes, self-assembled micelles, proteins, etc. In physiological solutions, a randomly charged surface is mostly immersed in a solution containing monovalent ions (such as Na^+ , Cl^- as well as multivalent ions (e.g., Ca^{2+} , Mg^{2+}), which forms an asymmetric ionic fluid with nontrivial interesting properties. An example is the like-charge attraction phenomena seen in the formation of large condensates of DNA and/or large bundles of charged polymers such as microtubules and F-actin and also in dense packaging of DNA in viruses and nano-capsids. In order to correctly treat the multivalent ions that are strongly coupled to fixed charges in these systems one needs to go beyond the standard Poisson-Boltzmann approach and use the Strong Coupling paradigm. On the other hand, the structural disorder in the charge distribution and/or dielectric response spatial profile in the vicinity of the material interfaces couple to long-range electrostatic interactions, leading effectively to long-range disorder effects that are possible to be detected in recent ultrahigh sensitivity experiments on Casimir-van der Waals interactions between surfaces in vacuum. In this work, we employ the dressed multivalent ion theory, which is a variant of the so-called strong coupling theory, valid for large valency and high (low) enough monovalent (multivalent) ion concentrations, in order to investigate the effect of surface charge randomness on the charge distribution in front of these surfaces as well as the electrostatic interactions between them. Our results can be important in problems relating to interactions of heterogeneously charged surfaces such as unstructured proteins and surfactant coated surfaces.