Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Charge Inversion in semi-permeable membranes SIDDHARTHA DAS, SHAYANDEV SINHA, HAOYUAN JING, University of Maryland, College Park — Role of semi-permeable membranes like lipid bilayer is ubiquitous in a myriad of physiological and pathological phenomena. Typically, lipid membranes are impermeable to ions and solutes; however, protein channels embedded in the membrane allow the passage of selective, small ions across the membrane enabling the membrane to adopt a semi-permeable nature. This semi-permeability, in turn, leads to electrostatic potential jump across the membrane, leading to effects such as regulation of intracellular calcium, extracellular-vesicle-membrane interactions, etc. In this study, we theoretically demonstrate that this semi-permeable nature may trigger the most remarkable charge inversion (CI) phenomenon in the cytosol-side of the negatively-charged lipid bilayer membrane that are selectively permeable to only positive ions of a given salt. This CI is manifested as the changing of the sign of the electrostatic potential from negative to positive from the membrane-cytosol interface to deep within the cytosol. We study the impact of the parameters such as the concentration of this salt with selectively permeable ions as well as the concentration of an external salt in the development of this CI phenomenon. We anticipate such CI will profoundly influence the interaction of membrane and intra-cellular moieties (e.g., exosome or multi-cellular vesicles) having implications for a host of biophysical processes.

Siddhartha Das
University of Maryland, College Park

Date submitted: 11 Nov 2016 Electronic form version 1.4