1172-34-162 **Peter Bates**, **Zhenshu Wen** and **Mingji Zhang*** (mingji.zhang@nmt.edu). *Effects on I-V relations from small permanent charge and channel geometry via classical Poisson-Nernst-Planck equations with multiple cations.*

We analyze a one-dimensional Poisson-Nernst-Planck system for ionic flow through a membrane channel with nonzero but small permanent charge. The system includes two cations with the same valences and one anion. The cross-sectional area of the channel is included in the system, which provides certain information of the geometry of the three-dimensional channel. We treat the model as a boundary value problem of a singularly perturbed system of differential equations. Under the framework of geometric singular perturbation theory, together with specific structures of the model, the existence and local uniqueness of solutions to the boundary value problem for small permanent charges is established. Furthermore, treating the permanent charge as a small parameter, via regular perturbation analysis, we are able to derive an approximation of the I-V (current-voltage) relations explicitly, from which the permanent charge and channel geometry effects on ionic flows are analyzed in detail. Critical potentials are identified and their roles in characterizing the ionic flow properties of interest are studied. Some critical potentials can be experimentally estimated, and this provides an efficient way to adjust the boundary potential to observe distinct dynamics of ionic flows. (Received August 25, 2021)