1159-34-12 **Mingji Zhang*** (mingji.zhang@nmt.edu), **Peter Bates** and **Zhenshu Wen**. *Effects on I-V relations from small permanent charge and channel geometry via classical Poisson-Nernst-Planck equations with multiple cations.*

We analyze a quasi-one-dimensional Poisson-Nernst-Planck system for ionic flow through a membrane channel with nonzero but small permanent charge. The system includes *three* ion species, two cations with the same valences and one anion. The cross-section area of the channel is included in the system, which provides certain information of the geometry of the three-dimensional channel. This is critical for our analysis. We treat the model as a boundary value problem of a singularly perturbed differential system. 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 effect on ionic flows are analyzed in details. Critical potentials are identified and their roles in characterizing the ionic flow properties of interest are studies. (Received June 25, 2020)