1081-34-100 **Shuguan Ji*** (jisg@jlu.edu.cn), College of Mathematics, Jilin University, 2699 Qianjin Street, Changchun, Jilin 130012, Peoples Rep of China, and **Weishi Liu** (wliu@math.ku.edu), Department of Mathematics, University of Kansas, 1460 Jayhawk Blvd., 405 Snow, Lawrence,, KS 66045. *Poisson-Nernst-Planck Systems for Ion Flow with Density Functional Theory for Hard-Sphere Potential: I-V relations and Critical Potentials.*

In this work, we analyze a one-dimensional steady-state Poisson-Nernst-Planck type model for ionic flow through a membrane channel including ionic interactions modeled from the Density Functional Theory in a simple setting: Two oppositely charged ion species are involved with electro-neutrality boundary conditions and with zero permanent charge, and only the hard sphere component of the excess (beyond the ideal) chemical potential is included. By using a combination of geometric singular perturbation theory and functional analysis, we first establish the existence result for small ion sizes, and then also derive an approximation of the I-V (current-voltage) relation. For this relatively simple situation, it is found that the ion size effect on the I-V relation can go either way – enhance or reduce the current. More precisely, there is a critical potential value V_c so that, if $V > V_c$, then the ion size enhances the flow; if $V < V_c$, it reduces the current. There is another critical potential value V^c so that, if $V > V^c$, the current is increasing with respect to $\lambda = r_2/r_1$ where r_1 and r_2 are, respectively, the radii of the positively and negatively charged ions; if $V < V^c$, the current is decreasing in λ. (Received February 02, 2012)