Published in *Eur. Biophys. J.* **40,** Suppl. 1, 169 (2011).

Effect of charge fluctuations on the ionic escape rate from a single-site ion channel

I. Kh. Kaufman[1], R. Tindjong[1], D. G. Luchinsky[1,2] , P. V. E. McClintock[1]

[1]Department of Physics, Lancaster University, Lancaster, LA1 4YB, UK
[2]NASA Ames Research Center, MS 269-3, Moffett Field, CA, 94035, USA

We analyse the permeation of an open, single-site, ion channel by use of Brownian Dynamics (BD) simulations at different concentrations. We show for the first time by modelling that the ionic escape rate increases significantly with concentration due to electrostatic amplification of charge fluctuations at the channel mouth.

We use the reduced model of an axis-symmetric water-filled channel whose protein wall has a single charged site. The channel length, radius and fixed charge are selected to match experimental data for Gramicidin A. The ion current, occupancy and escape rate are simulated by the 1D self-consistent BD technique with account taken of the electrostatic ion-ion interaction. The bath with non-zero ion concentration on one side of the channel is modelled via the Smoluchowski arrival rate.

It is shown that: a) The occupancy saturates with Michaelis-Menten kinetics. b) The escape rate starts from the Kramers value at small concentrations and then increases with concentration due to the electrostatic amplification of charge fluctuations. The resulting dynamics of the current can be described by modified reaction rate theory accounting for ionic escape over the fluctuating barrier [1].

[1] D. G. Luchinsky et al, J. Stat. Mech. (2009), 01010