Entropy Facilitated Translocation in Active Transport

Anders Lervik [C, S]
Department of Chemistry, Norwegian University of Science and Technology, Trondheim, Norway
anders.lervik@ntnu.no

J. Miguel Rubi
Department of Fundamental Physics, University of Barcelona, Barcelona, Spain

Dick Bedeaux and Signe Kjelstrup
PoreLAB, Department of Chemistry, Norwegian University of Science and Technology, Trondheim, Norway

In active transport by proteins, compounds (e.g. ions and lipids) are transported against a chemical potential gradient by coupling the transport to an ATP-reaction, counter transport of ions, or absorption of light [1]. During active transport, large conformational changes have been observed in several proteins [1, 2] and one may ask about the meaning of these conformational changes, and in particular how they influence the transport? Here, we discuss how active transport of ions and the associated conformational changes can be interpreted as an entropy-facilitated process. In this interpretation, the driving force (e.g. chemical reaction, counter transport of ions, or absorption of light) is used to create a protein geometry favorable for uphill transport. We show how this geometry brings about an entropic contribution to the transport, and we estimate the importance of this contribution for several proteins. Further, we discuss how this effect can be used to understand how energy transduction in active transport can take place over a relatively long distance [3].

References:

[1] J. M. Berg, J. L. Tymoczko, and L. Stryer, Biochemistry, 5th ed., W. H. Freeman and Company, New York, USA, (2002).
[2] O. Sitsel, C. Grønberg, H. E. Autzen, K. Wang, G. Meloni, P. Nissen, and P. Gourdon, Biochemistry, 54, 5673 (2015).
[3] J. M. Rubí, A. Lervik, D. Bedeaux, and S. Kjelstrup, J. Chem. Phys. 146, 185101 (2017).