Modeling project: Opening probability of a membrane channel

Physics of Complex Systems M2 – Biophysics

Membrane channels are protein complexes that span across the cell membrane and allow the passage of ions or other molecules depending on a number of biochemical and biophysical factors. The channel MscL, for instance, is sensitive on the mechanical stress of the membrane and regulates osmotic pressure in cells by releasing intracellular fluid, ions and small proteins when they become too stretched. The structure of the open and closed configurations of the channel are known (Fig. 1), and so is the response of its opening probability to a mechanical stimulus (Fig. 2).

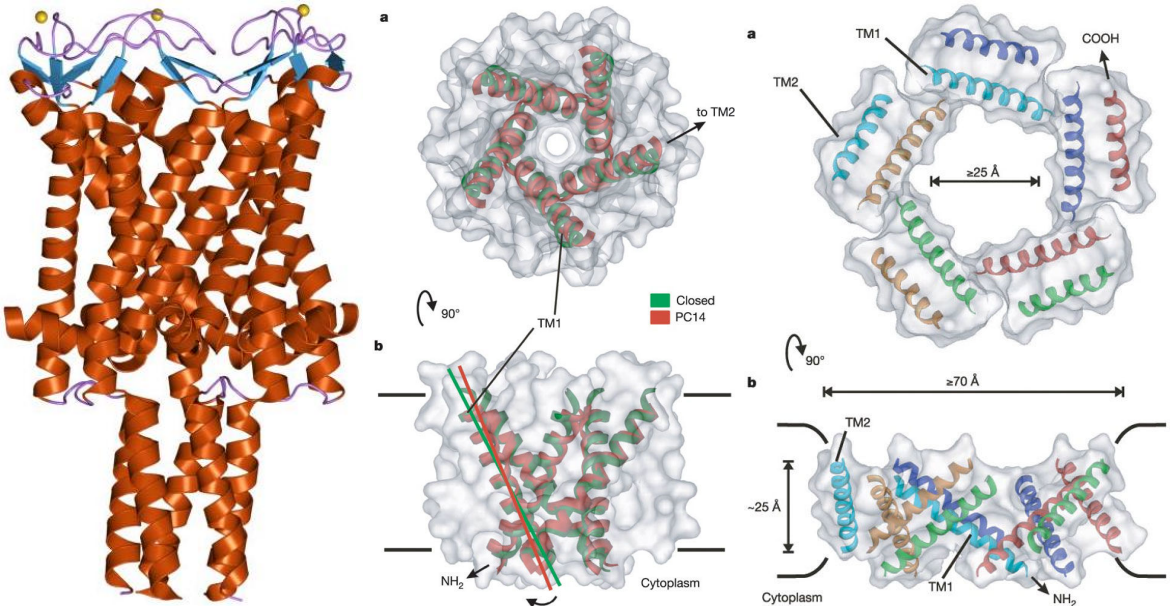

Figure 1: Side view of the MscL channel in the closed state (left), and detailed views of its bottom, thinner cylinder in the closed (middle) and open (right) states.

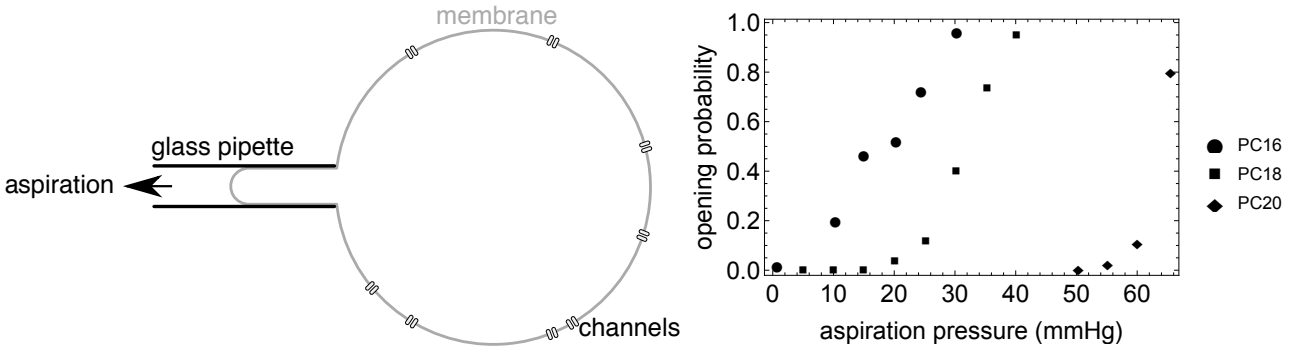

Figure 2: Micromanipulation experiment where the ionic current through a channel as a function of a mechanical stimulus is measured. The left panel shows a schematic of the experimental setup, in which the current through a collection of channels is measured (measurement equipment not shown) as a function of the suction applied by the aspiration pipette. The right panel shows the opening probability as a function of that pressure (1 mmHg $\simeq$ 133.3 Pa). The three symbols are for channels incorporated in membranes whose Phosphatidylcholine (PC) lipids have 16, 18 and 20 carbon atoms respectively.