Supplementary Material (ESI) for *Soft Matter*

ELECTRONIC SUPPLEMENTARY INFORMATION

for

Lateral coupling and cooperative dynamics in the function of the native membrane protein bacteriorhodopsin

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Movies S1 to S5 with legends

Movie S1: High-speed AFM movie of two bR trimers at the purple membrane cytoplasmic surface imaged in solution at 26±1 C° and at a scan speed of 19 ms/frames (~50 frames/s). The movie is slowed down 10 times (5 frames/s) for better visualization. The x, y and z scales are 15 nm, 4.5 nm and 0.8 nm respectively (z is autoscaled, same color scale as in Fig. 1). In the first part of the movie the membrane is in darkness (grey background) while illuminated with a green laser (532 nm) in the second part of the movie (green background).

Movie S2: High-speed AFM movie of purple membrane cytoplasmic surface throughout several illumination/darkness cycles with tracking of individual bR monomers (see section 2.5 for details about the tracking procedure). The tracked proteins and trimers are numbered in (cyan) and (red) respectively. The movie was captured in solution at 26±1

C° and at a scan speed of ~17 frames/s (60 ms/frame). The movie is slowed down 1.7 times (10 frames/s) for better visualization. The x, y and z scales are 15 nm, 15 nm and ~1 nm (autoscaled) respectively. When the green laser is on, a green line appears in the lower part of the frame.

Movie S3: Reconstituted high-speed AFM movie of 3 trimers' cytoplasmic surface throughout several illumination/darkness cycles. Each monomer has been tracked using the procedure described in section 2.5 and only the cytoplasmic surface of each monomer is shown. For easier visualization, the position of the apparent gravity center of each monomer has been kept immobile. The movie used for this analysis was captured in solution at 26±1 C° and at a scan speed of ~40 frames/s (26 ms/frame). The presented movie is slowed down 4 times (10 frames/s) for better visualization. When the green laser is on, a green line appears in the lower part of the frame.

Movie S4: Scanning force effect on the membrane. The movie was acquired in solution at 26±1 C° and at a scan speed of ~17 frame/s (60 ms/frame). The average scanning force (measured by the average deflection of the cantilever) is progressively increased from ~50 pN to 200 pN. The contour of one trimer (taken a given height) is highlighted to evidence the force effect. The initial contour of the trimer (red) is superimposed to all the frames. Further increase of the scanning force triggered severe deformation of the protein and eventual disruption of the protein lattice (not shown). The x, y and z scales are 12 nm, 20 nm and ~0.8 nm respectively. (z is autoscaled, same color scale as in Fig. 1)

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Movie S5: High-Speed AFM movie of purple membrane cytoplasmic surface throughout several illumination/darkness cycles showing the effect of the lateral elastic pressure waves. The tracking of proteins and trimers are as in Movie S2. The movie was captured in solution at 26±1 C° and at ~40 frames/s (26 ms/frame). The movie is slowed down 4 times (10 frames/s) for better visualization. The x, y and z scales are 30 nm, 15 nm and ~1 nm (autoscaled) respectively. When the green laser is on, a green line appears in the lower part of the frame.