

## Supporting Information for

# Anomalous Lateral Diffusion of Lipids during the Fluid/Gel Phase Transition of Lipid Membrane

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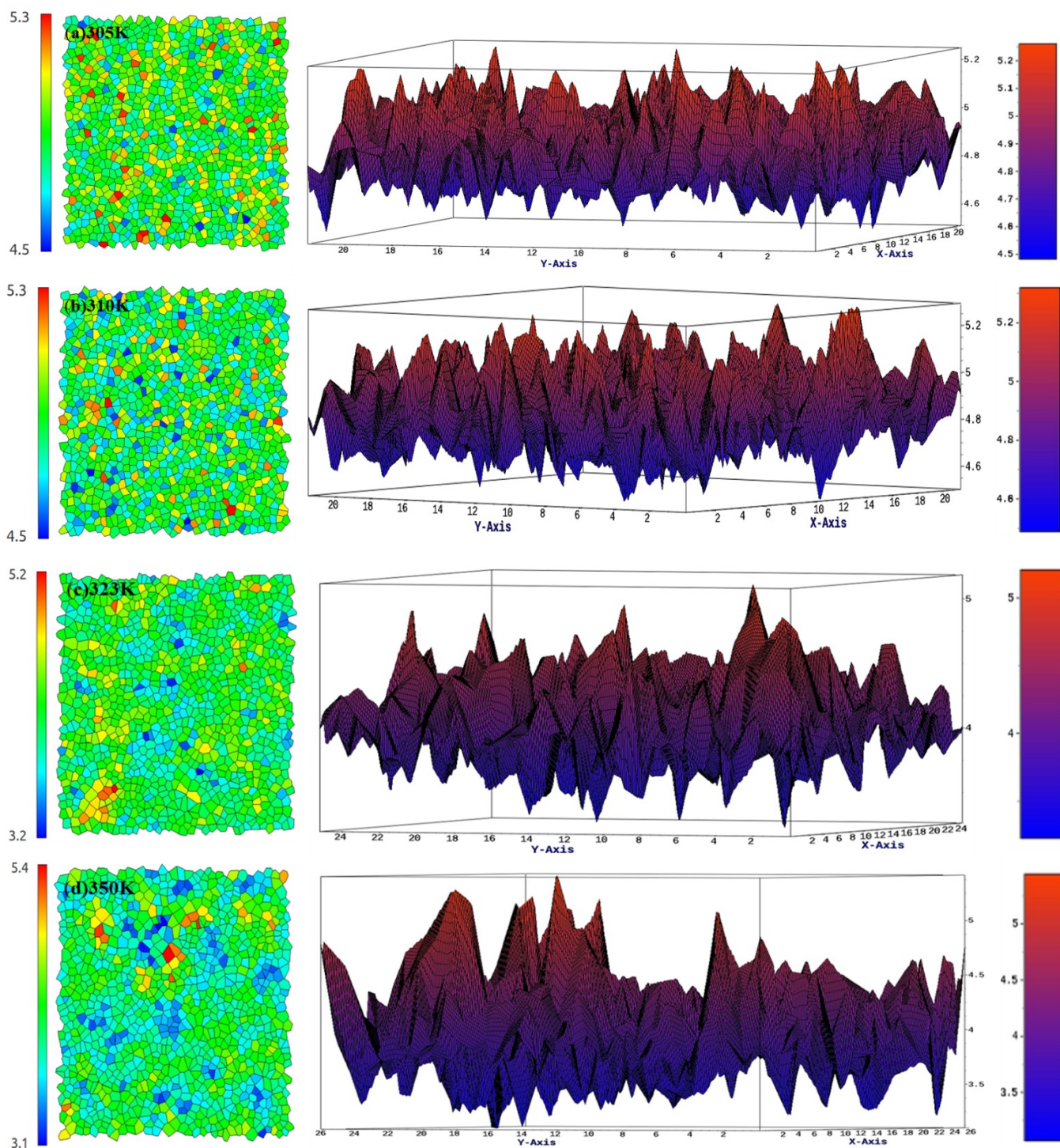


Figure S1. Voronoi diagram with corresponding 3D-plot of membrane thickness  $T_L$  for DPPC lipid at six temperatures out of four are there: (a) 305 K(gel), (b) 310 K(gel), (c) 323K(fluid) and (d) 350 K(fluid).

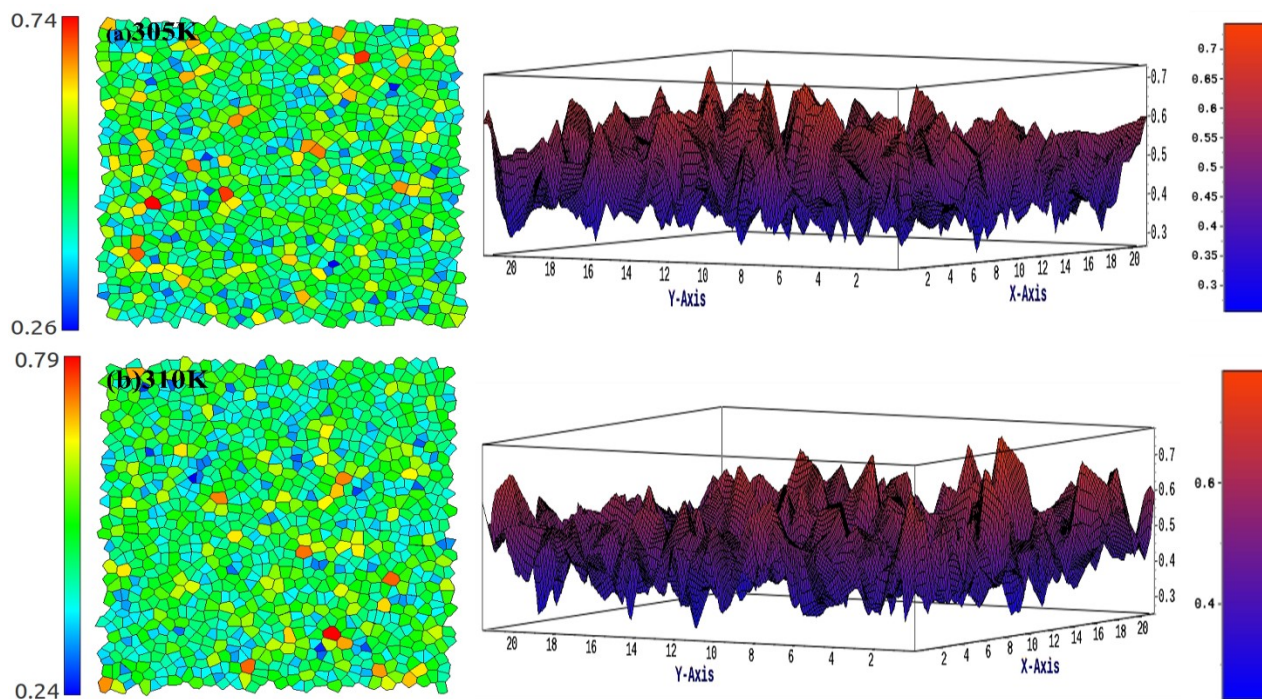


Figure S2. Voronoi diagram with corresponding 3D-plot of membrane area  $A_L(xy)$  for DPPC lipid at two temperatures: (a) 305 K(gel), (b) 310 K(gel).

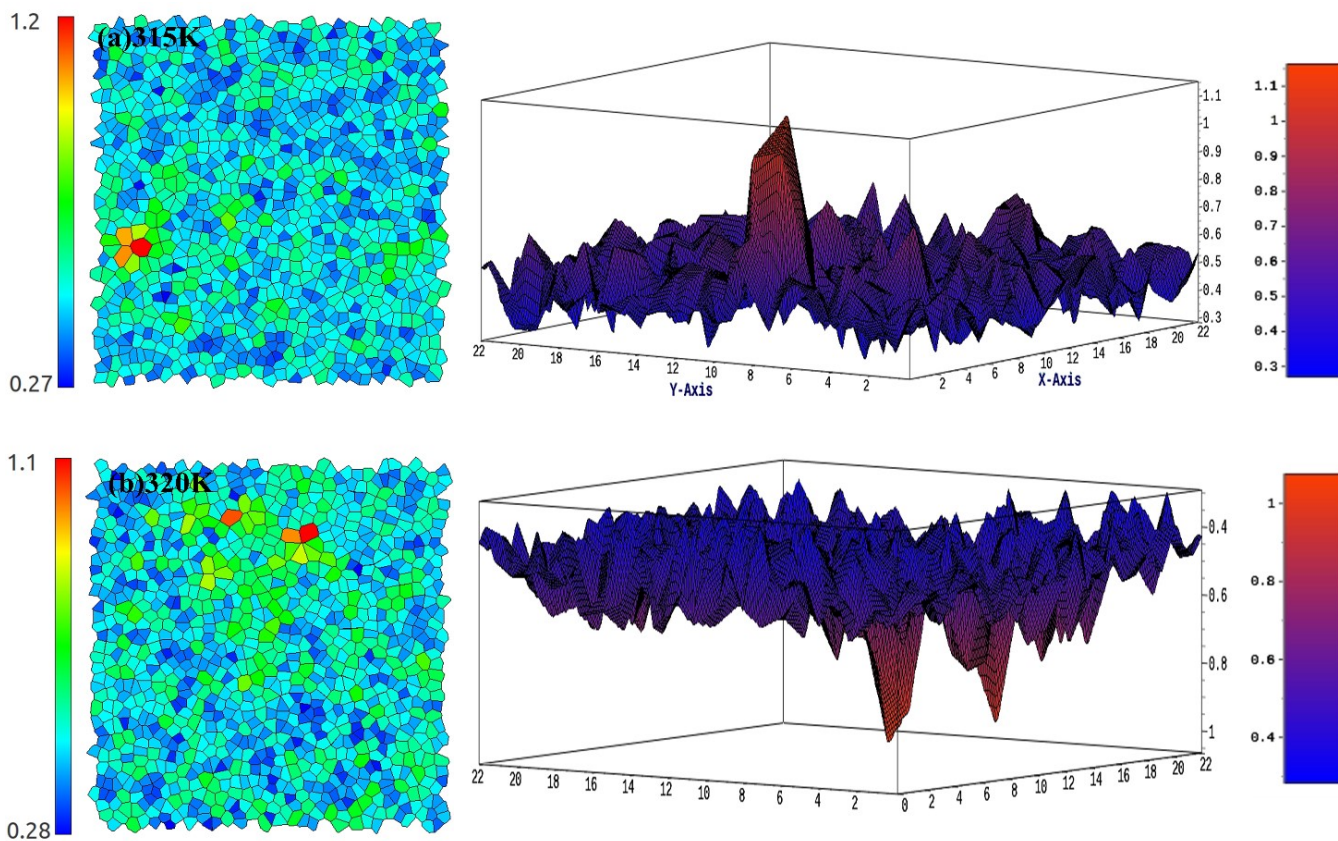


Figure S3. Voronoi diagram with corresponding 3D-plot of membrane area  $A_L(xy)$  for DPPC lipid at two temperatures: (a) 315 K(gel-fluid), (b) 320 K(gel-fluid) .

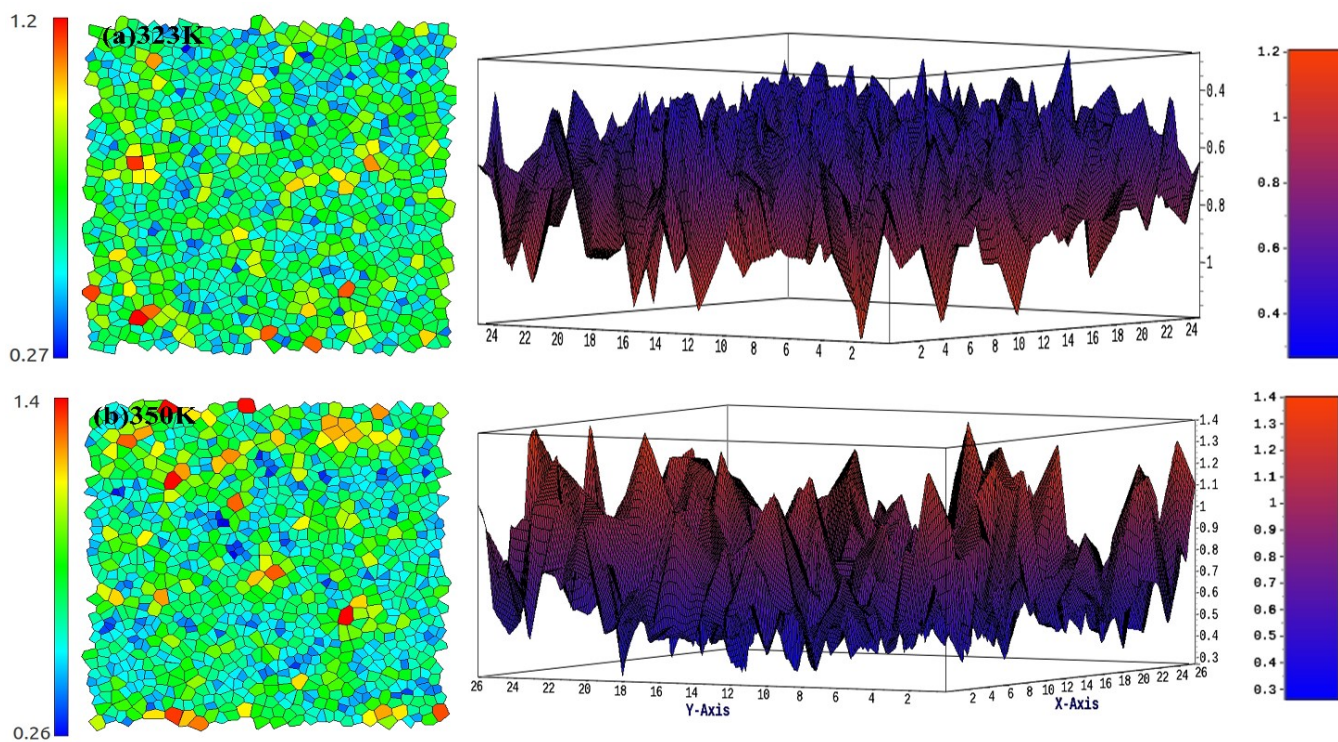


Figure S4. Voronoi diagram with corresponding 3D-plot of membrane area  $A_L(xy)$  for DPPC lipid at two temperatures: (a) 323K(fluid) and (b) 350 K(fluid).

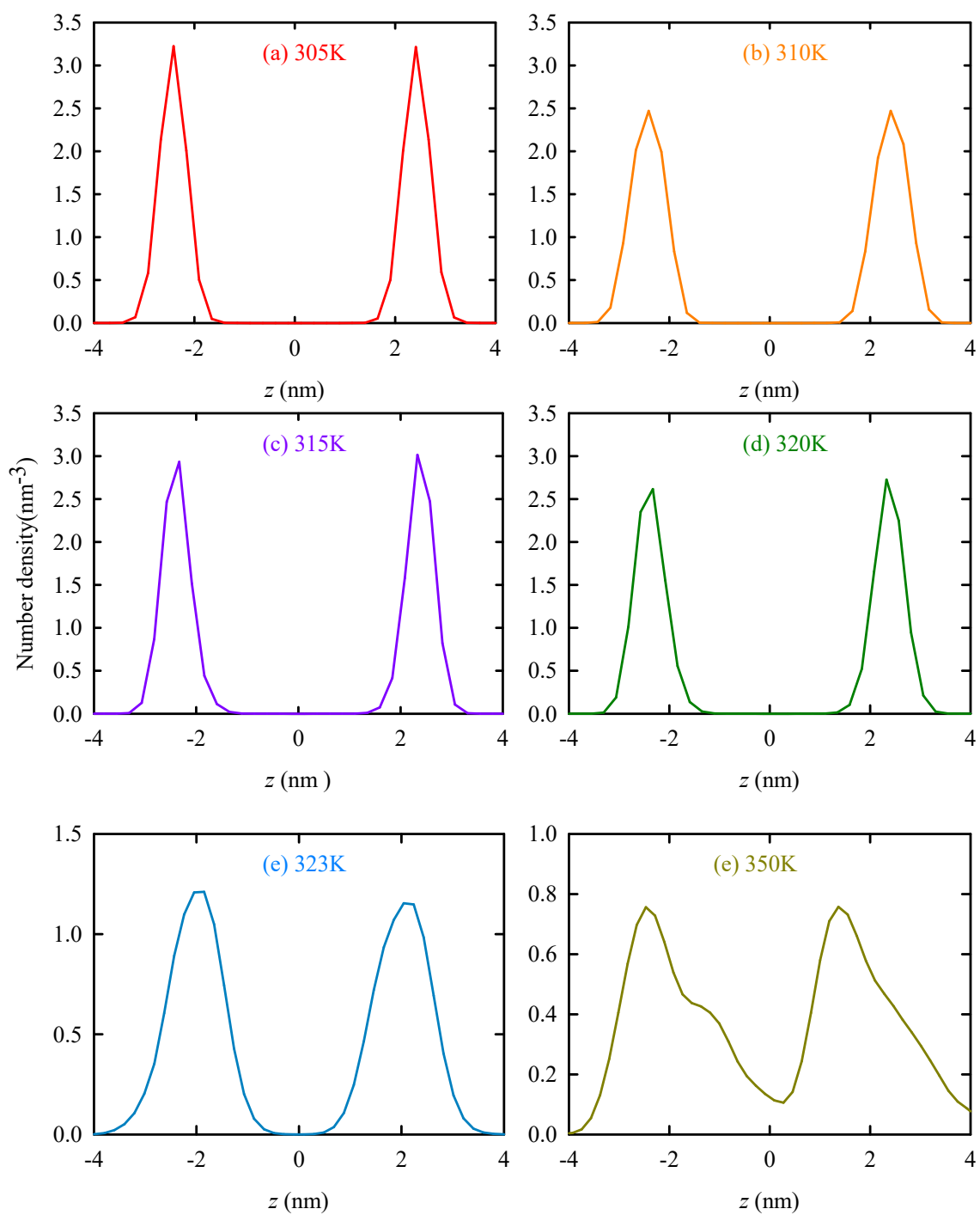


Figure S5. Number density profiles of DPPC lipid with phosphate group as the head group at all six temperatures.

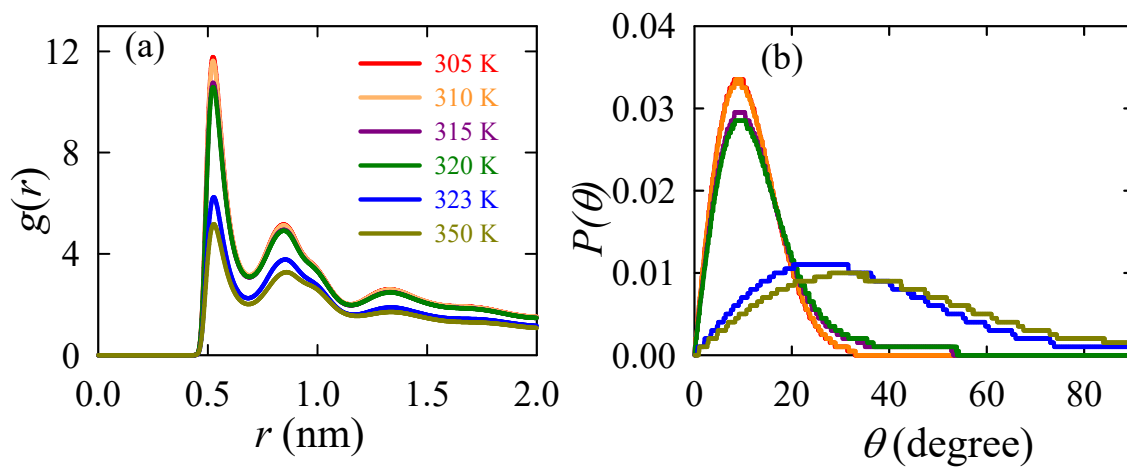


Figure S6. (a) The simulated radial distribution functions  $g(r)$ , and (b) the tilt angle distribution of DPPC lipid at six temperatures.

Table S1. Different jump parameters, obtained by analyzing the lipid dynamics using the TJD method considering seven different trajectory durations for DPPC lipid at 315 K. The parameters are as follows:  $n_{Jump}$  (the total number of jump occurrences analyzed here),  $P_{Jump}$  (percentage of jump-trajectory segments),  $\lambda_{Jump}^2$  (average square jump length),  $v_{Jump}$  (jump frequency),  $D_{Jump}$  (jump-diffusion coefficient),  $\chi_{Jump}$  (percentage contribution of jump-diffusion to the total diffusion).

Jump parameters	315K						
	$\Delta t=50\text{ns}$	$\Delta t=t^*(120\text{ns})$	$\Delta t=200\text{ns}$	$\Delta t=500\text{ns}$	$\Delta t=1\mu\text{s}$	$\Delta t=3\mu\text{s}$	$\Delta t=5\mu\text{s}$
$n_{Jump}$	25473	12249	8095	3897	2113	726	424
$P_{Jump}$	4.15	4.78	5.27	6.34	6.88	7.09	6.90
$\lambda_{Jump}^2(\text{nm}^2)$	5.37	10.24	14.65	26.37	38.97	63.01	76.95
$v_{Jump}/10^{-4}(\text{ns}^{-1})$	8.29	3.99	2.64	1.27	0.69	0.24	0.14
$D_{Jump}(\text{cm}^2\text{s}^{-1})$	$1.11\times 10^{-8}$	$1.02\times 10^{-8}$	$0.97\times 10^{-8}$	$0.84\times 10^{-8}$	$0.67\times 10^{-8}$	$0.37\times 10^{-8}$	$0.27\times 10^{-8}$
$\chi_{Jump}$	88.80	80.97	76.52	66.30	53.14	29.52	21.05
$r_2(\text{nm})$	1.81	2.46	2.96	4.08	5.14	6.88	7.64

Table S2. Different jump parameters, obtained by analyzing the lipid dynamics using the TJD method considering seven different trajectory durations for DPPC lipid at 320 K.

Jump parameters	320K						
	$\Delta t=50\text{ns}$	$\Delta t=t^*(74\text{ns})$	$\Delta t=200\text{ns}$	$\Delta t=500\text{ns}$	$\Delta t=1\mu\text{s}$	$\Delta t=3\mu\text{s}$	$\Delta t=5\mu\text{s}$
$n_{Jump}$	27821	19676	8440	3834	1927	706	222
$P_{Jump}$	4.53	4.76	5.49	6.24	6.27	6.89	3.61
$\lambda_{Jump}^2(\text{nm}^2)$	7.11	9.63	20.11	35.80	53.85	88.19	121.79
$v_{Jump}/10^{-4}(\text{ns}^{-1})$	9.06	6.40	2.75	1.25	0.63	0.23	0.07
$D_{Jump}(\text{cm}^2\text{s}^{-1})$	$1.61\times 10^{-8}$	$1.54\times 10^{-8}$	$1.38\times 10^{-8}$	1.12	$0.84\times 10^{-8}$	$0.51\times 10^{-8}$	$0.22\times 10^{-8}$

					8		
$\chi_{Jump}$	76.66	73.44	65.81	53.21	40.23	24.14	10.48
$r_2(\text{nm})$	2.10	2.43	3.56	4.88	6.17	8.06	9.74