

# Molecular study of ultrasound-triggered release of fluorescein from liposomes

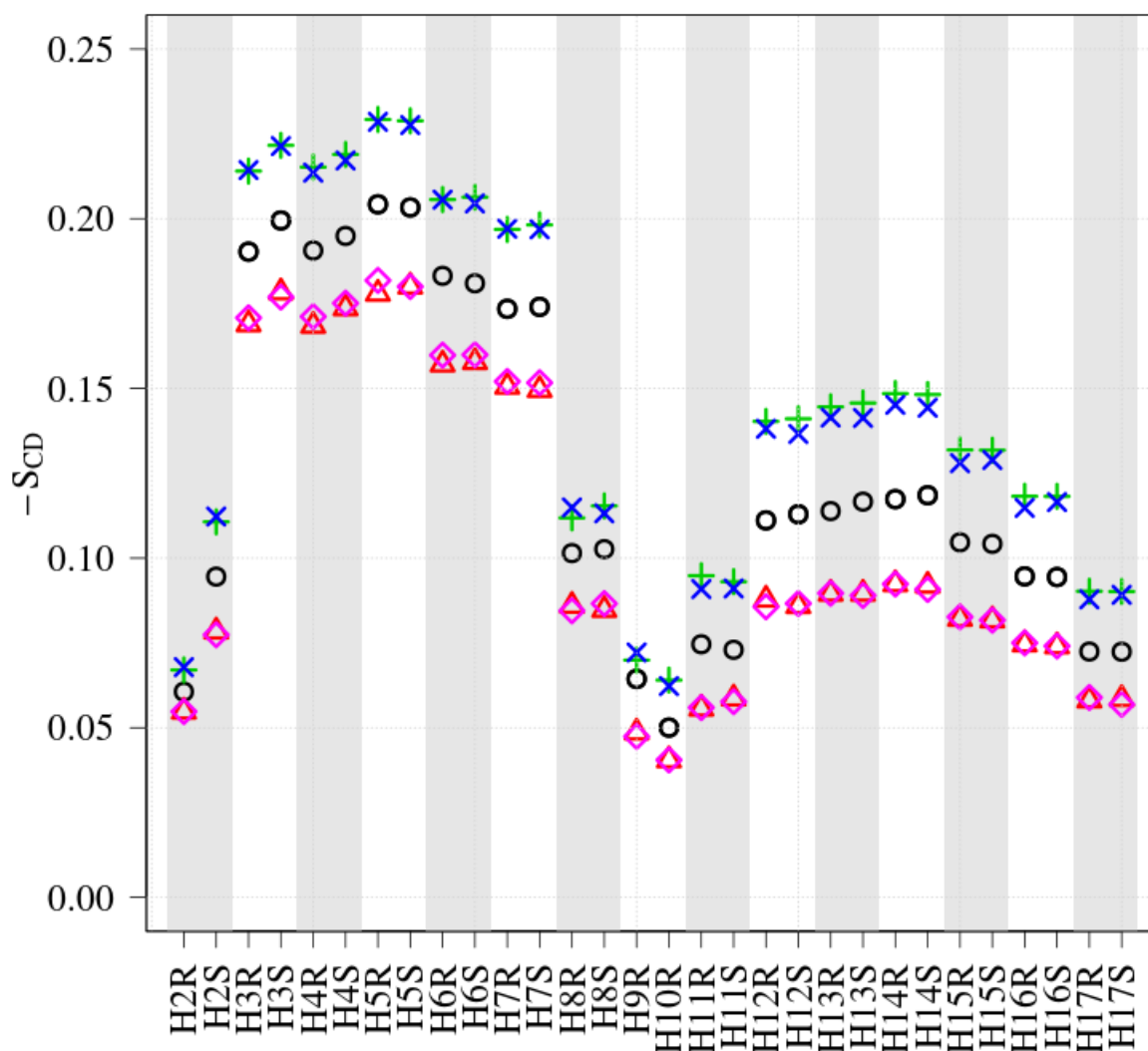
Fatima El Hajj,<sup>†,‡</sup> Patrick F. J. Fuchs,<sup>¶</sup> Wladimir Urbach,<sup>§</sup> Mohammad Nassereddine,<sup>‡</sup> Salah Hamieh,<sup>‡</sup> and Nicolas Taulier<sup>\*,†</sup>

<sup>†</sup> Sorbonne Université, CNRS, INSERM, Laboratoire d'Imagerie Biomédicale, LIB, F-75006 Paris, France

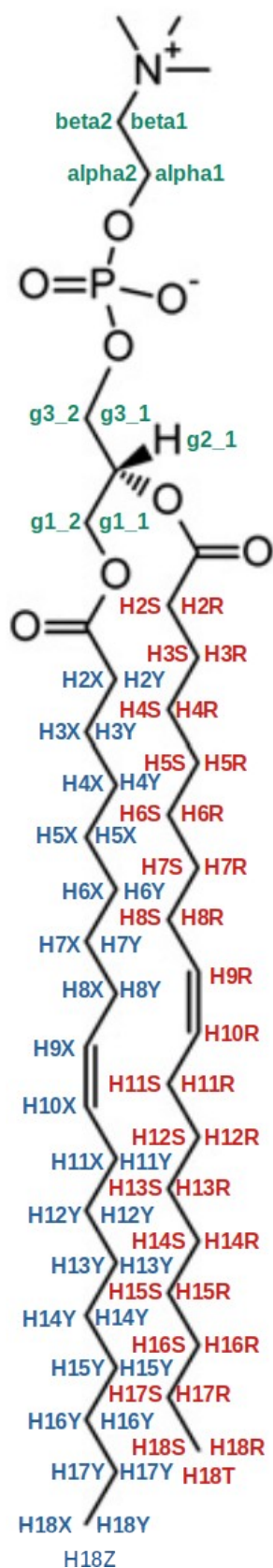
<sup>‡</sup> Faculté des Sciences, Université Libanaise, Liban

<sup>¶</sup> Université de Paris

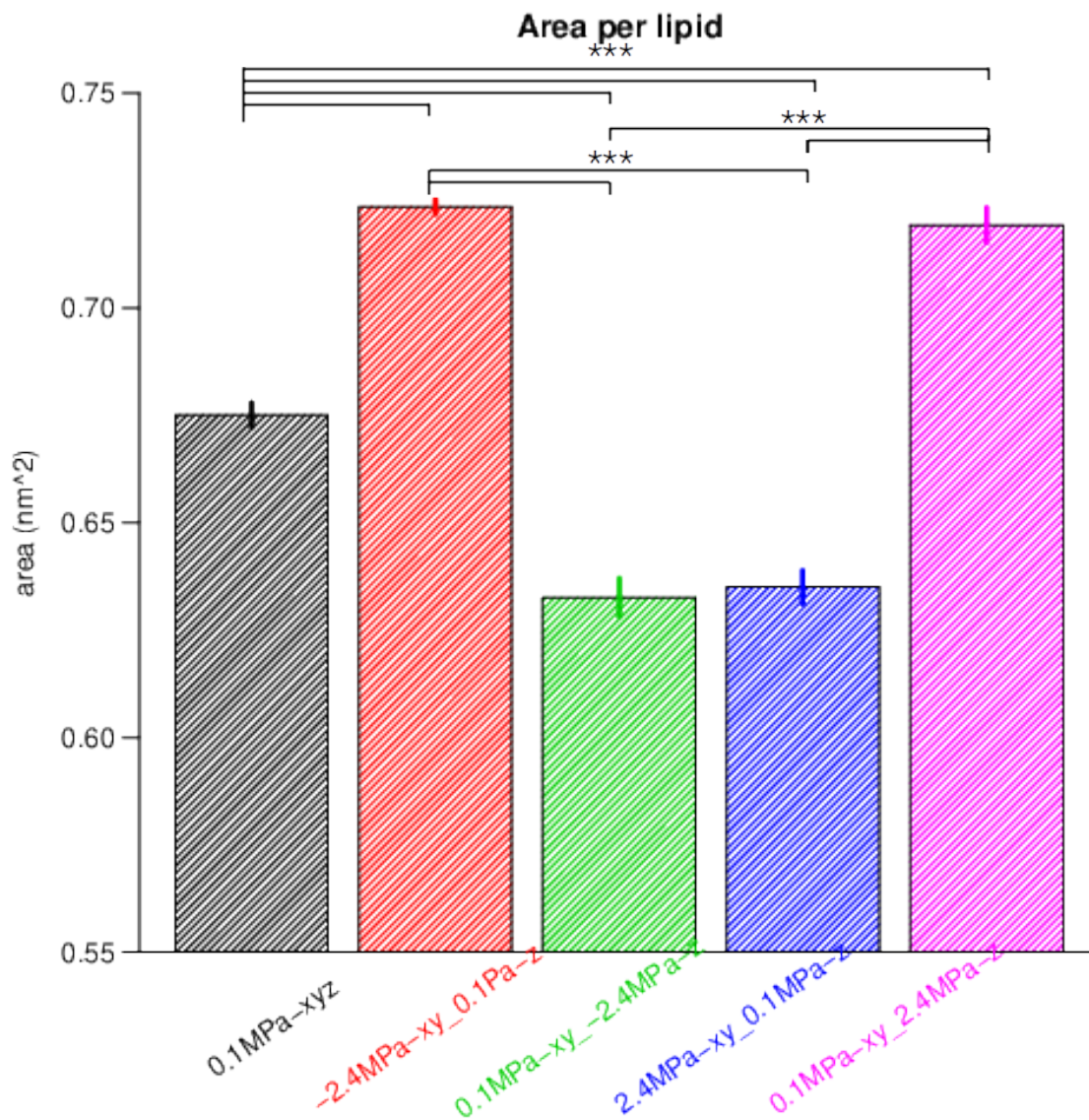
<sup>§</sup> Laboratoire de Physique de l'École Normale Supérieure, ENS, Université PSL, CNRS, Sorbonne Université, Université de Paris, F-75005 Paris, France.



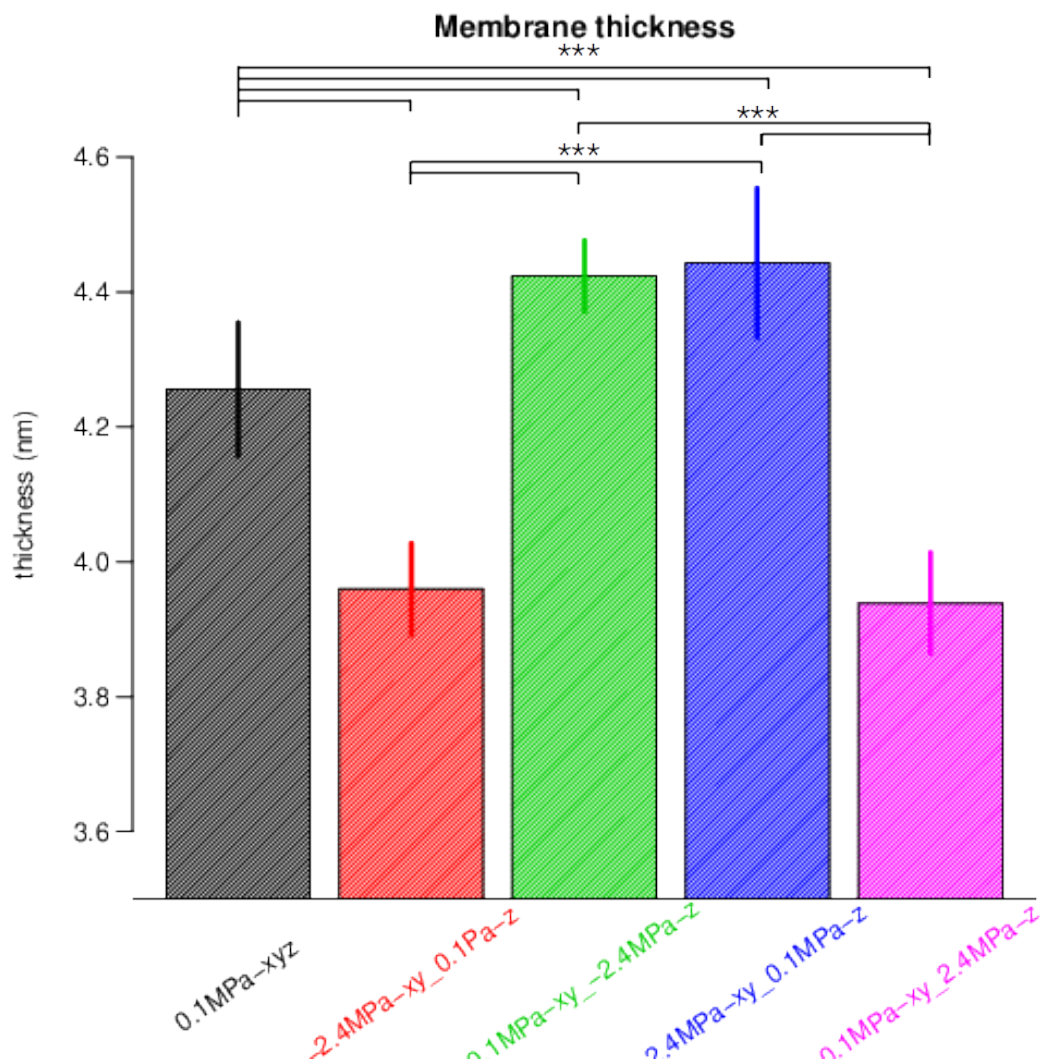
**Figure 1S.** Order parameter for each hydrogen atoms of one of the sn-2 DOPC acyl chain. The symbols correspond to the case where a uniform pressure of 0.1 MPa was applied (○), when a pressure of 2.4 MPa (◇) or a -2.4 MPa (⊕) was applied perpendicularly to the membrane surface, and when a pressure of 2.4 MPa (×) or -2.4 MPa (△) was applied laterally to the membrane



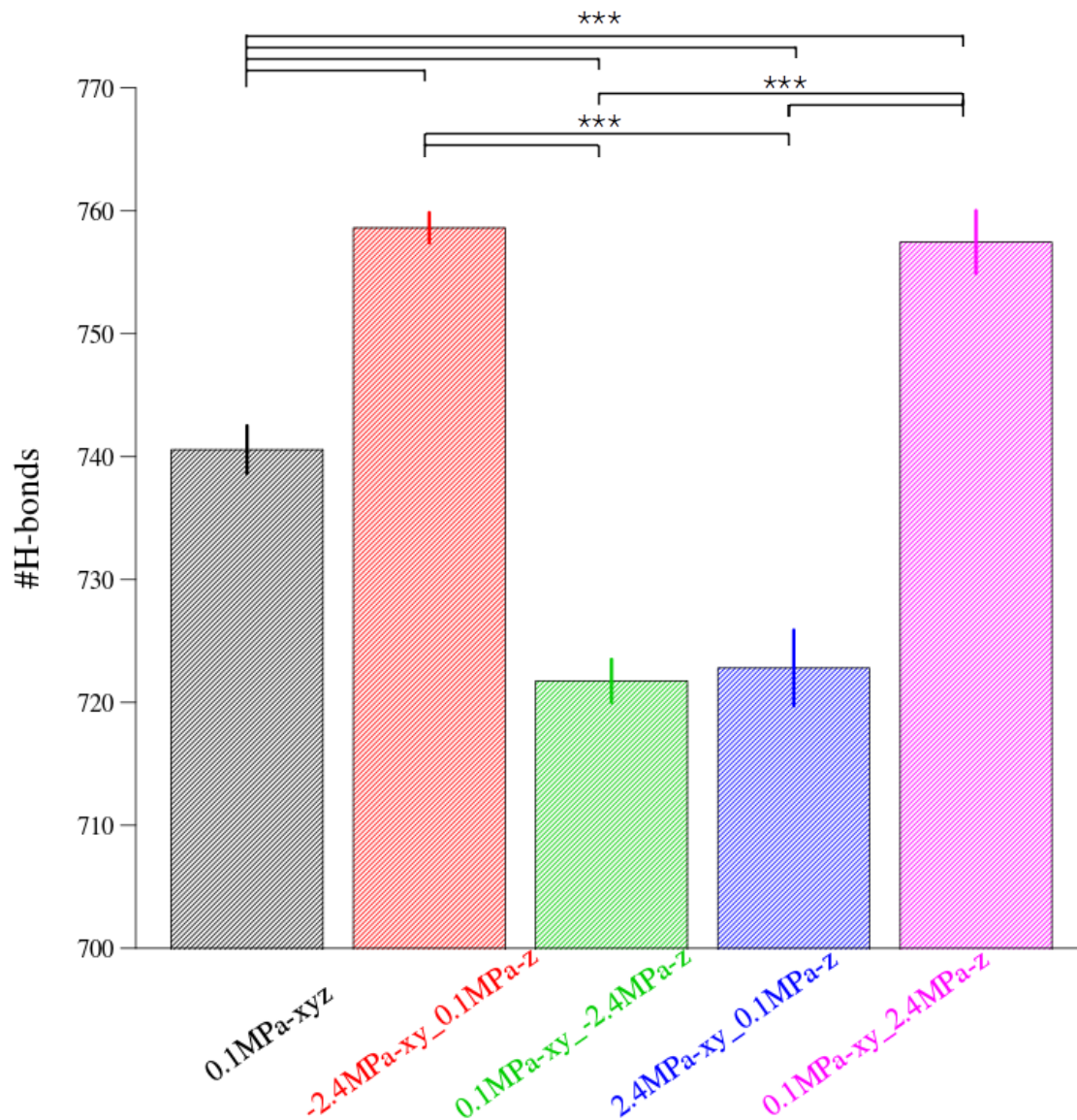
**Figure 2S.** Chemical structure of a DOPC lipid with the displayed labels used in the x-axis of the figures displaying order parameters (i.e. Fig. 5 and 1S). The green labels are for the hydrogen of the DOPC polar head, the blue and red labels are for, respectively, the sn-1 and sn-2 DOPC acyl chains.



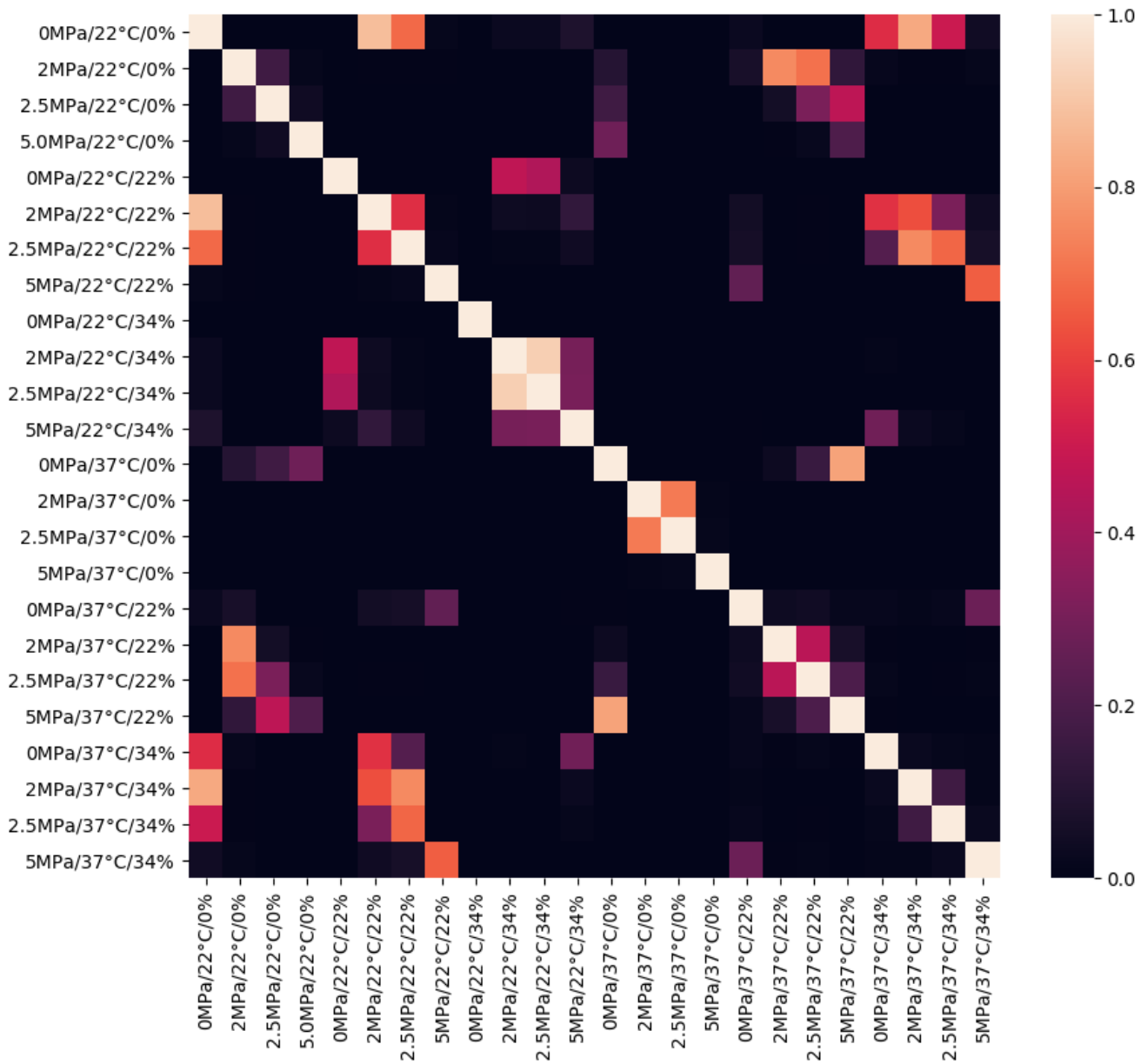
**Figure 3S.** Bar plot displaying the area per lipid  $a$  derived from small size membrane simulations. The bars correspond to the case where a uniform compression of 0.1 MPa was applied in all directions (black), when a pressure of 2.4 MPa (magenta) or a -2.4 MPa (green) was applied perpendicularly to the membrane surface, and when a pressure of 2.4 MPa (blue) or of -2.4 MPa (red) was applied laterally to the membrane



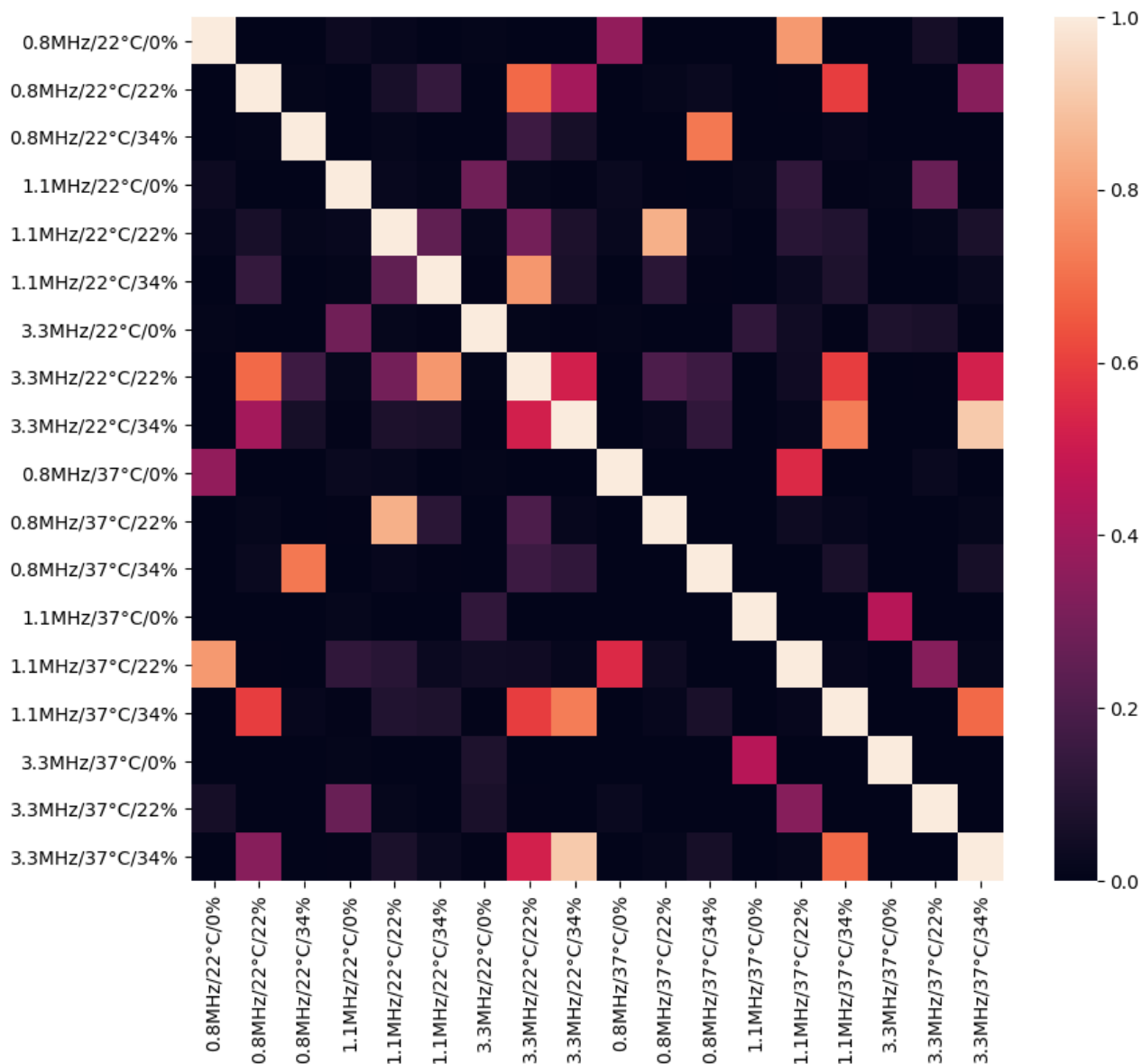
**Figure 4S.** Bar plot displaying the membrane thickness  $d$  derived from small size membrane simulations. The bars correspond to the case where a uniform compression of 0.1 MPa was applied in all directions (black), when a pressure of 2.4 MPa (magenta) or a -2.4 MPa (green) was applied perpendicularly to the membrane surface, and when a pressure of 2.4 MPa (blue) or of -2.4 MPa (red) was applied laterally to the membrane



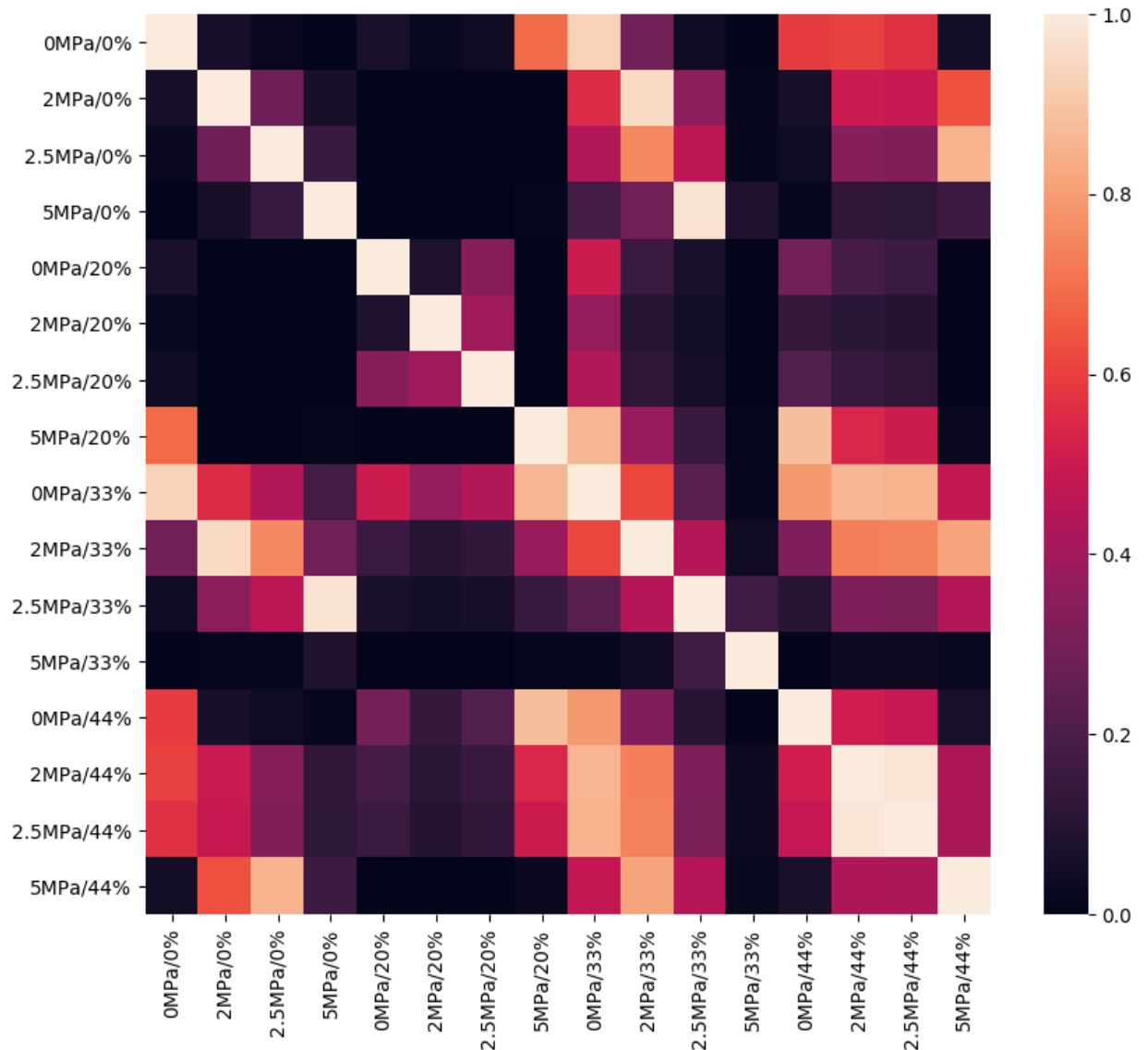
**Figure 5S.** Bar plot displaying the number of hydrogen bonds between DOPC lipid and water molecules as derived from small size membrane simulations. The bars correspond to the case where a uniform compression of 0.1 MPa was applied in all directions (black), when a pressure of 2.4 MPa (magenta) or a -2.4 MPa (green) was applied perpendicularly to the membrane surface, and when a pressure of 2.4 MPa (blue) or of -2.4 MPa (red) was applied laterally to the membrane



**Figure 6S.** The figure is a heatmap of p-values that indicates if the points displayed in the top figure of Fig . 3 were significantly different (in black) from each other. Each point is characterized by the tuple (pressure/temperature/cholesterol fraction).

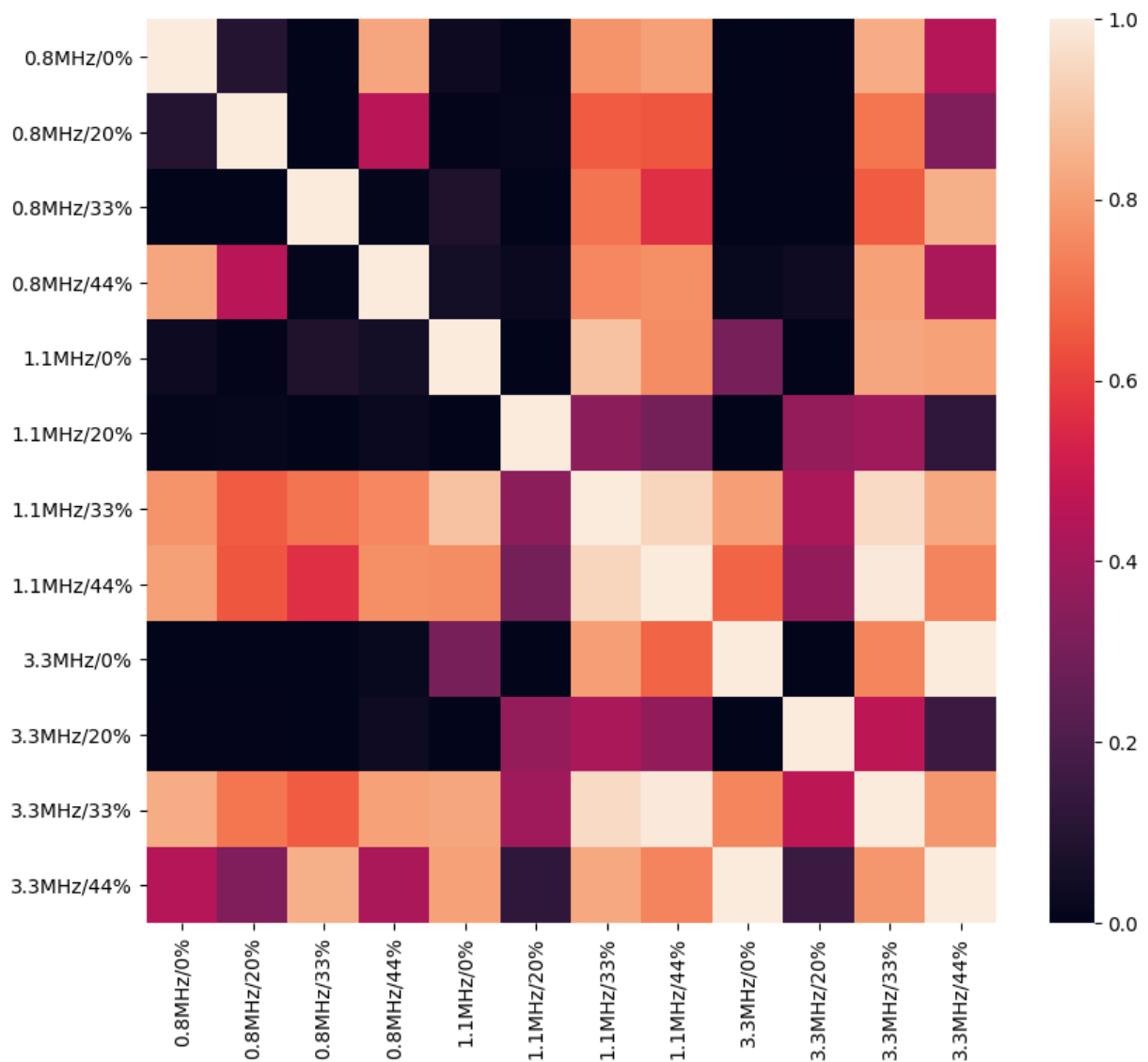


**Figure 7S.** The figure is a heatmap of p-values that indicates if the points displayed in the bottom figure of Fig . 3 were significantly different (in black) from each other. Each point is characterized by the tuple (pressure/temperature/cholesterol fraction).

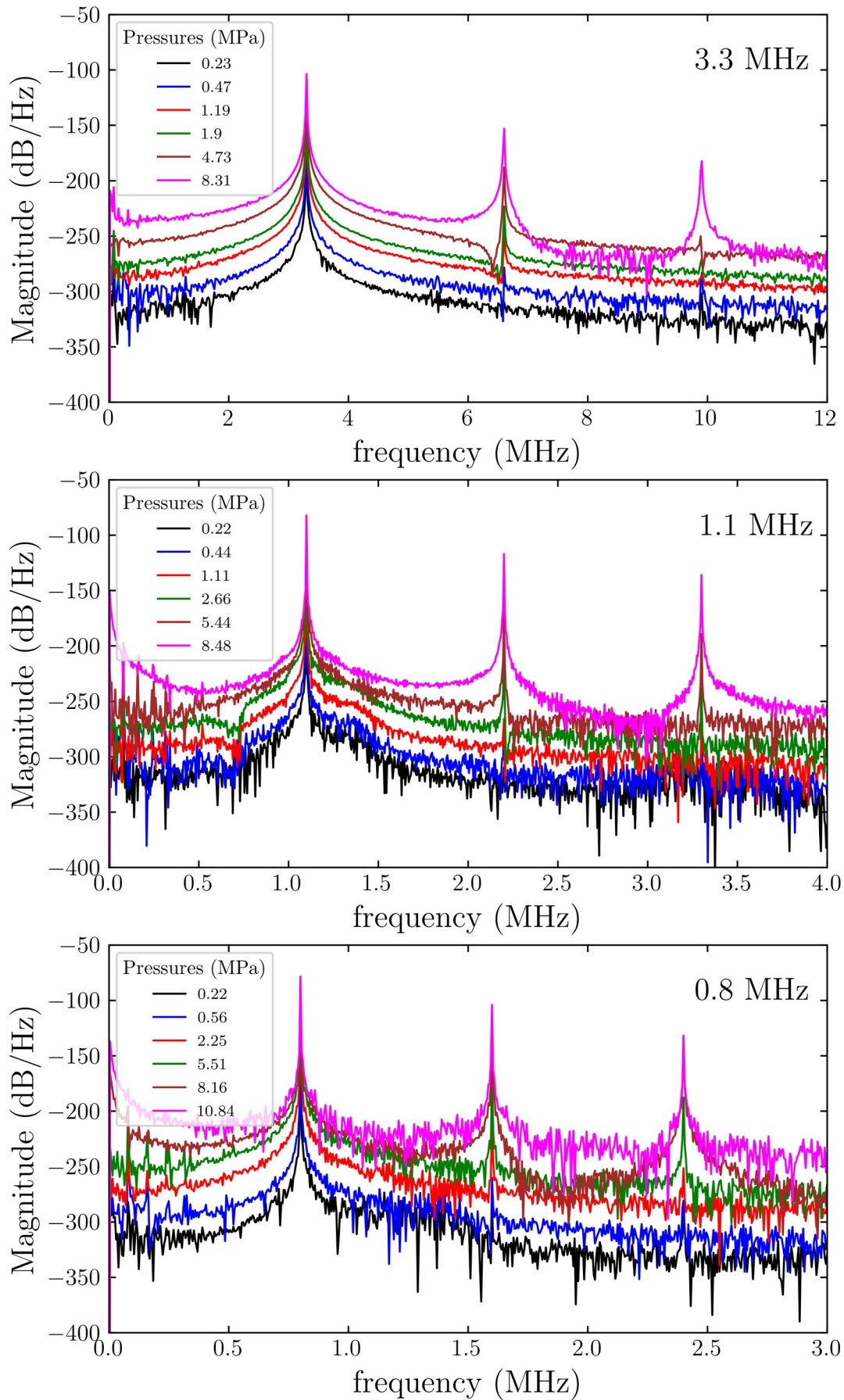


**Figure 8S.** The figure is a heatmap of p-values that indicates if the points displayed in the top figure of Fig . 4 were significantly different (in black) from each other. Each point is characterized by the tuple (pressure/temperature/cholesterol fraction).





**Figure 9S.** The figure is a heatmap of p-values that indicates if the points displayed in the bottom figure of Fig . 4 were significantly different (in black) from each other. Each point is characterized by the tuple (pressure/temperature/cholesterol fraction).



**Figure 10S.** Power spectrum densities of acoustic signals recorded in water by the needle hydrophone at the focus of the transducer for various peak-to-peak pressures and frequencies.