On hydration repulsive forces between various phospholipid bilayers

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The dispersion behavior of charged colloid systems can be explained well by the Derjaguin, Landau, Verwey, and Overbeek theory where electrostatic and van der Waals forces are considered. For the interaction between flexible membranes, such as phospholipid bilayers in water, other two additional repulsive forces must be taken into consideration [1]. The one is a force due to thermal fluctuations. It is the so-called Helfrich interaction [2]. The other is a hydration repulsive force that is believed to be attributing responsibility to a hydration at the membrane interface. The physical origin of the hydration repulsive force between lipid bilayers, however, still remains to be revealed [3].

In the present study, the repulsive interactions have been estimated for various phospholipid bilayer systems by combining experimental data of interbilayer distances of the hydrated lipid systems coexisting with ice at subzero temperatures and the reported data of the Gibbs free energy of ice formation [4]. It was found that the repulsive force of phosphatidylethanolamine (PE) bilayers is stronger than that of phosphatidylcholine (PC) bilayers. Molecular simulation study has reported that interaction of water with PE differs from that with PC [5]. The data of other phospholipid bilayers system will be presented. The molecular origin of the hydration repulsive force will be discussed based on the present results.