Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Piezoelectricity of Fluid Lipid Lamellar Phases and Their Chirality Dependence JOHN HARDEN, NICHOLAS DIORIO, Kent State Univ., ALEXANDER PETROV, Institute of Solid State Physics, Bulgarian Academy of Sciences, ANTAL JAKLI, Liquid Crystal Institute, Kent State Univ. — The effects of chirality of membrane-forming lipids, has been largely ignored at present. Here we demonstrate that the chirality of phospholipids makes fluid lipid bilayers piezoelectric. This implies that chiral lipids would play a central role in the functioning of cell membranes as active mechano-transducers. By periodically shearing and compressing nonaqueous lamellar phases of left (L-alpha-Phosphatidylcholine), right (D-alpha-Phosphatidylcholine) and racemic (DL-alpha-Phosphatidylcholine) lipids, we induced a tilt of the molecules with respect to the bilayer's normal and produced an electric current perpendicular to the tilt plane with the chiral lipids but not with a racemic mixture. This effect occurs because the lipids from a SmA* phase liquid crystal structure of the bilayers. Under molecular tilt, a ferroelectric SmC* phase is formed, creating a polarization which is normal to the tilt plane. This coupling allows for a wide variety of sensory possibilities of cell membranes such as mechanoreception, magneto-sensitivity, as well as in-plane proton membrane transport and related phenomena like ATP-synthesis, soft molecular machine performance, etc.

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Date submitted: 12 Nov 2008 Electronic form version 1.4