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The role of hydrophobic mismatch in tuning lipid membrane dynamics ELIZABETH KELLEY, National Institute of Standards and Technology, RANA ASHKAR, Oak Ridge National Laboratory, ROBERT BRADBURY, National Institute of Standards and Technology, ANDREA WOODKA, United States Military Academy, MICHIHIRO NAGAO, PAUL BUTLER, National Institute of Standards and Technology — Lipid membranes undergo an array of conformational and dynamic transitions, ranging from individual lipid motions to undulations of micron-sized patches of the membrane. However, the collective dynamics at intermediate length scales are largely unexplored due to experimental challenges in accessing the appropriate length and time scales. Here we use neutron spin echo spectroscopy (NSE) to provide unique insights into these elusive dynamics and measure membrane mechanical properties by probing both bending and thickness fluctuations in model lipid bilayers. We show that hydrophobic mismatch between lipids with different acyl chain lengths tunes the dynamics in a way not achievable in single component systems. For example, the thickness fluctuation amplitude is enhanced in the fluid phase of mixed lipid bilayers, reaching approximately 20% of the bilayer thickness. Combining these experimental results with deformation free energy calculations suggests the mixed bilayers are more compressible than single component bilayers and provides new insights into the role of lipid diversity in controlling the rich dynamics of biomembranes.

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