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No-slip and anomalous behavior at the liquid/solid interface[1]
JUSTIN PYE, CLAY WOOD, JUSTIN BURTON, Department of Physics, Emory University — The vast majority of problems in fluid mechanics assume a no-slip condition at the liquid/solid interface. In the last few decades, a number of controlled experiments have found that the no-slip assumption is violated, however, there is little agreement as to the origin and magnitude of the slip. We report new stringent limits on intrinsic slip at a liquid/solid interface. By growing a drop of one liquid (water) on a quartz crystal microbalance (QCM) surface while the system is immersed in a second, matched liquid (undecane), we obtain a high-precision, differential measurement which minimizes systematic effects due to stress, temperature, etc. Our results on all surfaces investigated thus far, including plasma cleaned gold and glass as well as two different self-assembled monolayers (SAMs), show relative slip lengths of 2 nm or less, regardless of contact angle, suggesting that any slip effects are confined to the first few molecular layers in the liquid. In addition to molecular-scale slip lengths, we see anomalous dissipation on the SAM surfaces that cannot be explained by simple slip models. We will also discuss the effects of fluorinated SAM surfaces and a variety of other liquids in the experiments.

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