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This paper introduces the fundamental continuum theory governing momentum transport in isotropic nanofluidic systems. The theory is an extension of the classical Navier-Stokes equation, and includes coupling between translational and rotational degrees of freedom as well as nonlocal response functions that incorporate spatial correlations. The continuum theory is compared with molecular dynamics simulation data for both relaxation processes and fluid flows, showing excellent agreement on the nanometer length scale. We also present practical tools to estimate when the extended theory should be used. It is shown that in the wall-fluid region the fluid molecules align with the wall, and in this region the isotropic model may fail and a full anisotropic description is necessary.

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