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The hydrodynamic lift on a slender, neutrally buoyant fiber in a wall bounded shear flow at small Reynolds number JOHNSON DHANASEKARAN, DONALD KOCH, Cornell — The hydrodynamic lift velocity of a neutrally buoyant fiber in a simple shear flow near a wall is determined for small fiber Reynolds number. The generalized reciprocal theorem is used to relate the lift velocity to the Stokes flow generated by the fiber. This Stokes velocity field is determined using slender-body theory with the no slip velocity at the wall enforced using the method of images. This study is among the first analytical treatments of the lift on a non-spherical particle and illustrates how particle shape can contribute to separation methods such as those in microfluidic channels or cross-flow filtration processes. To leading order the lift velocity at distances large compared with the fiber length and small compared with the Oseen length is found to be 0.029*(rho*gamma^2*L^2*d)/(nu*ln(2*L/d)) where L and d are the half-fiber length and diameter, gamma is the shear rate and nu is the kinematic viscosity of the fluid. When the fiber separation from the wall is less than the fiber half-length a process of pole vaulting coupled with inertially induced changes of fiber orientation determine the lift velocity.

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