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New Memory Effects in Unsteady Forces on Slip Particles HSIEN-HUNG WEI, A.R. PREMLATA, National Cheng Kung University — For a slip particle moving unsteadily in a viscous fluid, the extent of slip is not fixed but constantly varies with time, depending on the slip length λ relative to the boundary layer thickness δ. For this dynamic slip situation, we show that that even the amount of slip is minuscule, it can significantly change the characteristics of the history force. Our analysis reveals that there exists a constant force plateau for $\delta<\lambda$, persisting until the slip-stick transition point $\delta \sim \lambda$ after which the usual no-slip Basset $1/\delta$ decay dominates the force response. We also analyze the unsteady force response for a stick-slip Janus particle, showing that a slightly smaller Basset force can re-emerge in place of the slip force plateau in the small δ regime. This re-entrant history force transition becomes even more evident for a slip particle having a small no-slip patch. These unusual force responses may not only provide unique hydrodynamic fingerprints for characterizing heterogeneous particles, but also have potential uses in active manipulation and sorting of these particles.

David Halpern
University of Alabama

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