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Is there solid-on-solid contact when spheres collide in a fluid? NARAYANAN MENON, U. Massachusetts, Amherst, USA and TCIS, Hyderabad, India, SUMIT BIRWA, G. RAJALAKSHMI, RAMA GOVINDARAJAN, TCIS, Hyderabad, India — A solid sphere colliding with another sphere or a wall within a fluid reverses its velocity and bounces back when it is launched with a Stokes number above a critical value, $\mathrm{St_c} \approx 10$. Previous experiments showed that $\mathrm{St_c}$ is only weakly dependent on the material or roughness of the sphere, but did not have the spatial or temporal resolution to determine whether solid impact occurs in the collision. A calculation [1] in the lubrication approximation shows that it is possible for an elastic sphere to rebound under fluid forces alone, without contact between the solids. We report experiments which exploit electrical contact between a sphere and wall to study the collision with high temporal resolution. We find unambiguously that there is solid-on-solid contact when the sphere rebounds from a collision. Analysis of the time of contact, and the time between consecutive impacts, indicates that even when there is impact, fluid viscosity is the dominant dissipative mechanism. The exception is for very smooth spheres, at stokes numbers just above $\mathrm{St_c}$. We present calculations with the incompressible Navier-Stokes equations to assess viscous dissipation and pressure effects in the collision.

[1] R. H. Davis, J.-M. Serayssol, and E. Hinch, Journal of Fluid Mechanics 163, 479 (1986)

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