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Viscous to Inertial Crossover in Liquid Drop Coalescence JOSEPH PAULSEN, JUSTIN BURTON, SIDNEY NAGEL, James Franck Institute, University of Chicago — When two liquid drops coalesce, a dramatic topological transition occurs. We use an electrical method and high-speed imaging to probe the coalescence down to 10 ns after the drops touch. Immediately after contact, the resistance varies as t^{-1} and later crosses over to $t^{-1/2}$. In the case of water drops [1], this behavior had been interpreted with a model in which coalescence occurs between slightly deformed interfaces. By varying the liquid viscosity over two decades, we conclude that at sufficiently low approach velocity where deformation is not present, the drops coalesce as spheres, but with an unexpectedly late crossover time between a regime dominated by viscous (i.e., t^{-1}) and one dominated by inertial (i.e., $t^{-1/2}$) effects. This interpretation is consistent with experiments in which we change the drop approach velocity and the surrounding gas pressure and molecular weight. We argue that the late crossover, not accounted for in the theory [2], is due to the flow field in the liquid and an additional length-scale present in the drop geometry.

[1] S. C. Case, and S. R. Nagel, PRL **100**, 084503 (2008).
[2] J. Eggers, J. Lister, and H. A. Stone, JFM **401**, 293 (1999).

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