Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Splash Criteria for Liquid Drop Impact on Smooth, Dry Surfaces

CACEY STEVENS, SIDNEY NAGEL, The University of Chicago — It is important to find a criterion that predicts the transition from smooth deposition to splashing of low-viscosity liquid drops when they land on a smooth, dry surface. Using high-speed imaging, we have determined the threshold pressure, P_T, of the ambient gas for which a liquid drop splashes as a function of the relevant parameters (gas molecular weight m_G, liquid viscosity ν_L, surface tension σ, drop diameter D, and impact speed U_0). There is a non-monotonic trend of P_T versus U_0 [1]. We find this same trend as we systematically change other liquid and gas properties; they simply shift the curve. By defining a scaled pressure, $P_{T,scaled} = P_T D^{0.5} \nu_L^{0.25} m_G^{0.5} \sigma^{-0.25}$, and scaled impact speed $U_{0,scaled} = U_0 D^{0.3} \nu_L^{0.4} \sigma^{-0.35}$, we find a collapse of all data sets onto a single curve. This scaling applies to both high and low velocity regimes.

[1] Xu L. Xu, S. Nagel, and W. Zhang. Phys. Rev. Lett. 94, 184505 (2005).

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Date submitted: 10 Aug 2012 Electronic form version 1.4