Abstract Submitted
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Fluctuation-driven dynamics of nano-threads: Rayleigh-Plateau instability and break-up[1] CHENGXI ZHAO, School of Engineering, University of Warwick, JAMES SPRITTLES, Mathematics Institute, University of Warwick, DUNCAN LOCKERBY, School of Engineering, University of Warwick — Interface dynamics of liquid threads is usually analysed in two stages: (i) the linear Rayleigh-Plateau (RP) instability and (ii) the nonlinear rupture. Both are shown to strongly depend on thermal fluctuations at the nanoscale, which are naturally occurring within molecular dynamics (MD) simulations and can be incorporated via fluctuating hydrodynamics into a stochastic lubrication equation (SLE). In the linear stage, The classical RP theory is re-evaluated and revised, where MD experiments demonstrate its inadequacy. A new theoretical framework, SLE-RP is developed, which captures nanoscale flow features and highlights the critical role of thermal fluctuations at small scales. For the nonlinear behaviours, a robust numerical scheme is then developed to explore the rupture process and its statistics, where the double-cone profile reported by Moseler and Landmann [Science 289, 1165 (2000)] is observed, as well as other distinct profile forms depending on the flow conditions. Comparison to the Eggers similarity solution [Phys. Rev. Lett. 89, 084502 (2002)], a power law of the minimum thread radius against time to rupture, shows agreement only at low surface tension; indicating that surface tension cannot generally be neglected when considering rupture dynamics.

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