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On the origins of surfactant-driven microthread cascades in jet breakup PRITISH KAMAT, OSMAN BASARAN, Purdue University — A startlingly beautiful phenomenon arises in capillary thinning of surfactant-laden liquid threads: just prior to pinch-off, a series of progressively thinner, microscopic threads telescope out from the rupture location. Similar microthread cascades have been observed in a myriad of other interface rupture problems including during breakup of highly viscous Newtonian fluid threads in air or another viscous fluid, in electrospinning, and in breakup of 2D liquid lenses on a free-surface. Despite their prevalence, the mechanistic understanding of how microthread cascades originate remains poor. Conventional wisdom claims that microthread cascades might originate from minuscule interfacial perturbations produced by noise of either molecular or ambient origin. However a plausible noise source has not yet been identified. Here, we present novel insights on the formation of surfactant-driven microthread cascades in rupturing axisymmetric liquid threads. Using experimentally benchmarked simulations, devoid of any artificial inputs, we demonstrate that surfactants are capable of generating spontaneous perturbations via a fully deterministic process. The mechanics of the process is elucidated and the critical roles played by inertia and Marangoni stress are identified.

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