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The break-up of a viscous liquid drop in a high Reynolds number shear flow CHIN HEI NG, ALBERTO ALISEDA, University of Washington — The break-up of a viscous liquid droplet in a sheared turbulent flow evolves in several steps, the most visually dominant of which is the formation of high aspect ratio ligaments. This feature takes them apart from the various break-up models based on the Hinze-Kolmogorov paradigm of eddy-spherical particle collisions. We investigate the development of ligaments in a high Reynolds number (up to 250,000) submerged round jet, within the high viscosity, near-unity density ratio regime. Unlike in H-K theory, applicable to the break-up of inviscid fluid particles, break-up of inertial-scale viscous droplets occurs through a sequence of eddy collisions and long-term deformation, as evidenced by measurements of the aspect ratio that fluctuates and increases progressively during the deformation stage, and results in non-binary break-up. Additionally, the ligament formation stretches a droplet to multiple times its original size, bringing the influence of integral-scale structures. High speed imaging has been statistically analyzed to inform and validate theoretical models for the break-up time and the break-up probability. In addition, a particle size scaling model has been developed and compared with the experimental measurements of the frozen-state particle size.

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