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Crossover between Rayleigh-Taylor Instability and turbulent cascading atomization mechanism in the bag-breakup regime

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The question whether liquid atomization (or pulverization) resorts to instability dynamics (through refinements of Rayleigh-Plateau, Rayleigh-Taylor or Kelvin-Helmholtz mechanism) or to turbulent cascades similar to Richardson and Kolmogorov first ideas seems to be still open. In this paper, we report experimental evidences that both mechanisms are needed to explain the spray drop PDF obtained from an industrial nozzle. Instability of Rayleigh-Taylor kind governs the size of the largest droplets while the smallest ones obey a PDF given by a turbulent cascading mechanism resulting in a log-L\'evy stable law of stability parameter close to 1.68. This value, very close to the inverse of the Flory exponent, can be related to a recent model for intermittency modeling stemming from self-avoiding random vortex stretching.

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