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Global and local statistics in turbulent emulsions[1] LEI YI, Tsinghua University, FEDERICO TOSCHI, Eindhoven University of Technology, CHAO SUN, Tsinghua University — Turbulent emulsions are complex systems characterized by a coupling between small-scale droplets and large-scale rheology. By using a specifically designed Taylor-Couette shear flow system, we can characterize the statistical properties of a turbulent emulsion made of oil droplets dispersed in an ethanol-water solution, at the oil volume fraction up to 40%. We find that the dependence of the droplet size on the Reynolds number of the flow at the volume fraction of 1% can be well described by Hinze's criterion. The droplet sizes are found to have a log-normal distribution, hinting at a fragmentation process in the droplet formation. Additionally, the effective viscosity of the turbulent emulsion increases with the volume fraction of the dispersed oil phase, and decreases with increasing shear strength. We find that the dependence of the effective viscosity on the shear rate can be described by the Herschel-Bulkley model, with a flow index decreasing with increasing the oil volume fraction. This finding indicates that the degree of shear thinning increases with the volume fraction of the dispersed phase. The current findings have important implications for bridging the knowledge on turbulence and low-Reynolds-number emulsion flows to turbulent emulsion flows.

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