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Emulsions in homogeneous and isotropic turbulence

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Emulsions are a major class of multiphase flows, crucial in industrial process (e.g. food and drug production) and ubiquitous in environmental flows (e.g. oil spilling in maritime environment). Already at volume fractions of few precents, the dispersed phase interacts with pre-existing turbulence created at large scale, yet the interaction between phases and the turbulent energy transport across scales is not yet fully understood.
In this work, we use Direct Numerical Simulation to study emulsions in homogeneous and isotropic turbulence, where the Volume of Fluid (VOF) method is used to represent the complex features of the liquid-liquid interface.
We consider a mixture of two matching-density phases under various conditions, aiming to understand the turbulence modulation and the observed droplet size distributions. We observe the -10/3 and -3/2 scaling on droplet size distributions, suggesting that the dimensional arguments which led to their derivation are verified in HIT conditions and denser conditions. Finally, we discuss the highly intermittent behaviour of the multiphase flow, which can be directly related to the polydisperse nature of the flow.

Primary authors: CRIALESI ESPOSITO, Marco (Istituto Nazionale di Fisica Nucleare); BOFFETTA, Guido (TO); Prof. BRANDT, Luca (KTH - Royal Institute of Technology); Prof. CHIBBARO, Sergio (Universite Paris-Saclay, LIMSI); MUSACCHIO, Stefano (Istituto Nazionale di Fisica Nucleare)

Presenter: CRIALESI ESPOSITO, Marco (Istituto Nazionale di Fisica Nucleare)

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