The journey of a drop in a static mixer

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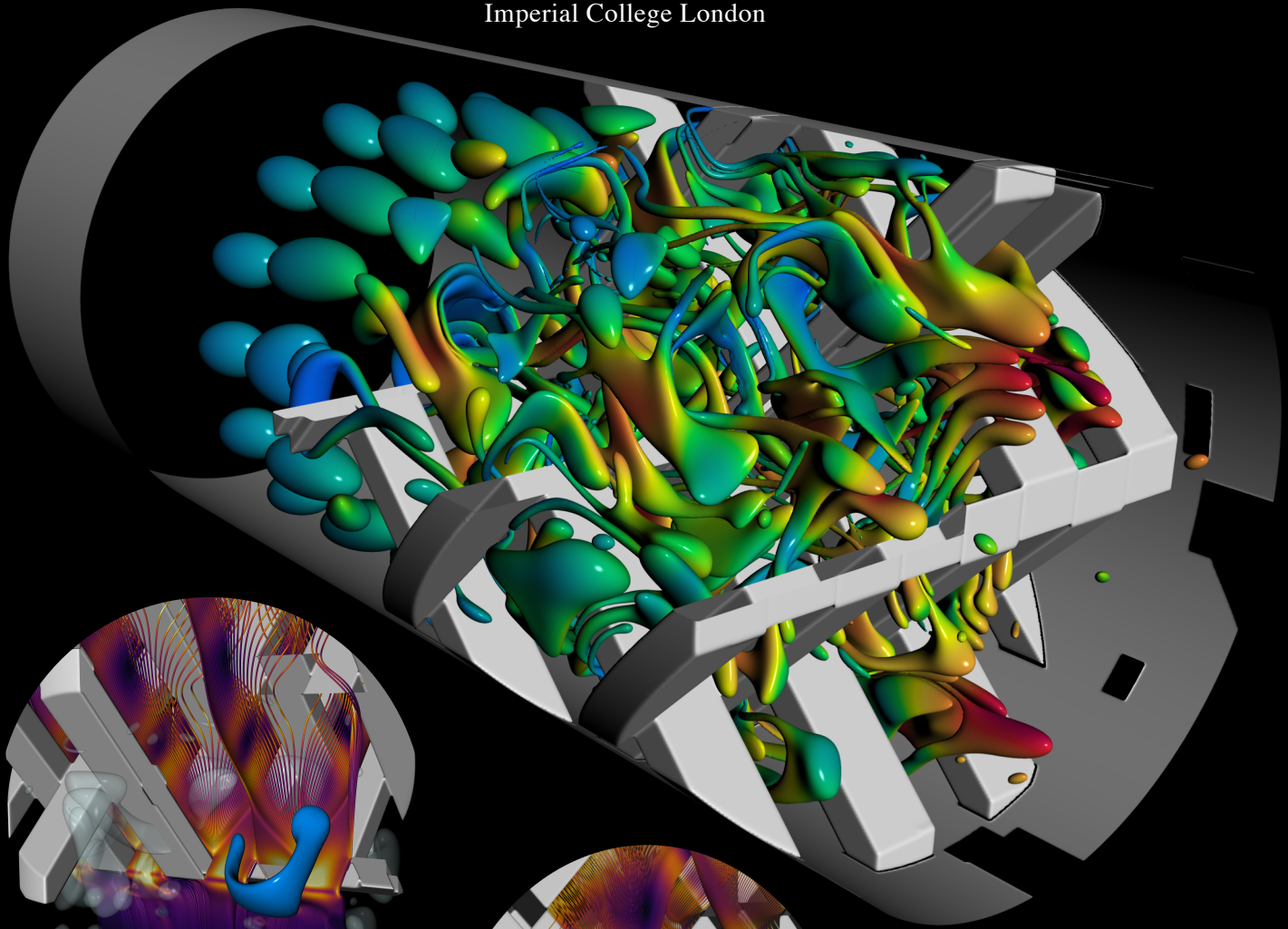

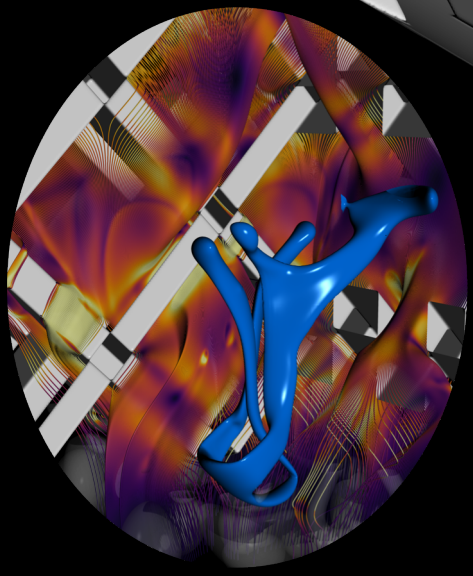

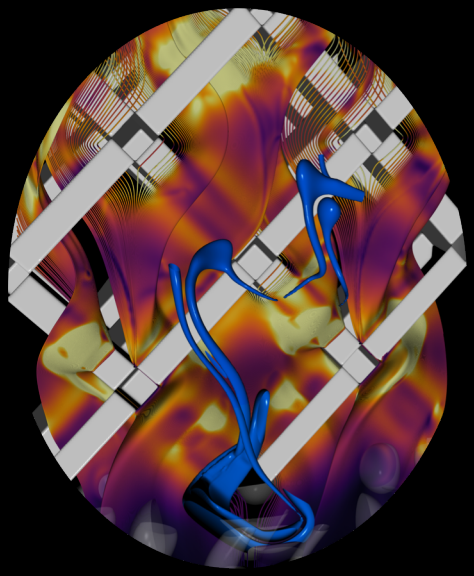

3D DNS of two-phase static mixing with a coarsely pre-dispersed inlet. Top view (velocity-colored) shows an intricate dance of droplets deforming, breaking and coalescing throughout the mixer. Bottom views detail the complex deformation and breakage of one of the droplets.

The drop's journey consists of two steps: firstly, a 3D elongational deformation driven by the mixer's geometry, consisting of stretching, twisting and folding at the cross-point. This stage features dominant extensional stresses induced by buoyant forces pulling the droplet from its bulbous ends, causing it to stretch rather than break. The second step comprises further deformation, influenced by neighboring drops, and a hydrodynamically-governed break-up. The droplet's neck accelerates as it crosses the high strain rate corridors in between crossbars (depicted in yellow), leading to a breakage by Rayleigh-Taylor instability.

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