Sustaining mechanism of turbulence in a precessing sphere

Abstract:

A precessing sphere, which can sustain fully developed turbulence of a confined fluid, is one of the most powerful turbulence generators. Our recent studies [1,2] found a pair of large-scale vortex tubes in turbulence in the sphere. To reveal how these large vortices sustain turbulence, we experimentally investigate the turbulence suppression due to the addition of a small amount of surfactant. More concretely, we conduct a series of systematic laboratory experiments of turbulence of both of water and a dilute surfactant solution by means of flow visualizations and particle image velocimetry. Combining our experimental results and previous theories [2,3,4] on the turbulence suppression due to additives, we can conclude that small-scale turbulent eddies in a precessing sphere are sustained by an energy cascading process. The present method using surfactant (or polymer) additives may be useful to understand the sustaining mechanism of turbulence also in other wall-bounded flows.


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