Abstract Submitted
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Rolling up of Large-scale Laminar Vortex Ring from Synthetic Jet Impinging onto a Wall[1] YANG XU, CHONG PAN[2], JINJUN WANG, Fluid Mechanics Key Laboratory of Education Ministry, BeiHang University, FLOW CONTROL LAB TEAM — Vortex ring impinging onto a wall exhibits a wide range of interesting behaviors. The present work devotes to an experimental investigation of a series of small-scale vortex rings impinging onto a wall. These laminar vortex rings were generated by a piston-cylinder driven synthetic jet in a water tank. Laser Induced Fluorescence (LIF) and Particle Image Velocimetry (PIV) were used for flow visualization/quantification. A special scenario of vortical dynamic was found for the first time: a large-scale laminar vortex ring is formed above the wall, on the outboard side of the jet. This large-scale structure is stable in topology pattern, and continuously grows in strength and size along time, thus dominating dynamics of near wall flow. To quantify its spatial/temporal characteristics, Finite-Time Lyapunov Exponent (FTLE) fields were calculated from PIV velocity fields. It is shown that the flow pattern revealed by FTLE fields is similar to the visualization. The size of this large-scale vortex ring can be up to one-order larger than the jet vortices, and its rolling-up speed and entrainment strength was correlated to constant vorticity flux issued from the jet.

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[2]Corresponding author

Yang Xu
BeiHang University

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