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Portfolio Paper

On the Evolution of Counter Rotating Vortex Ring Formed Ahead of a Compressible Vortex Ring

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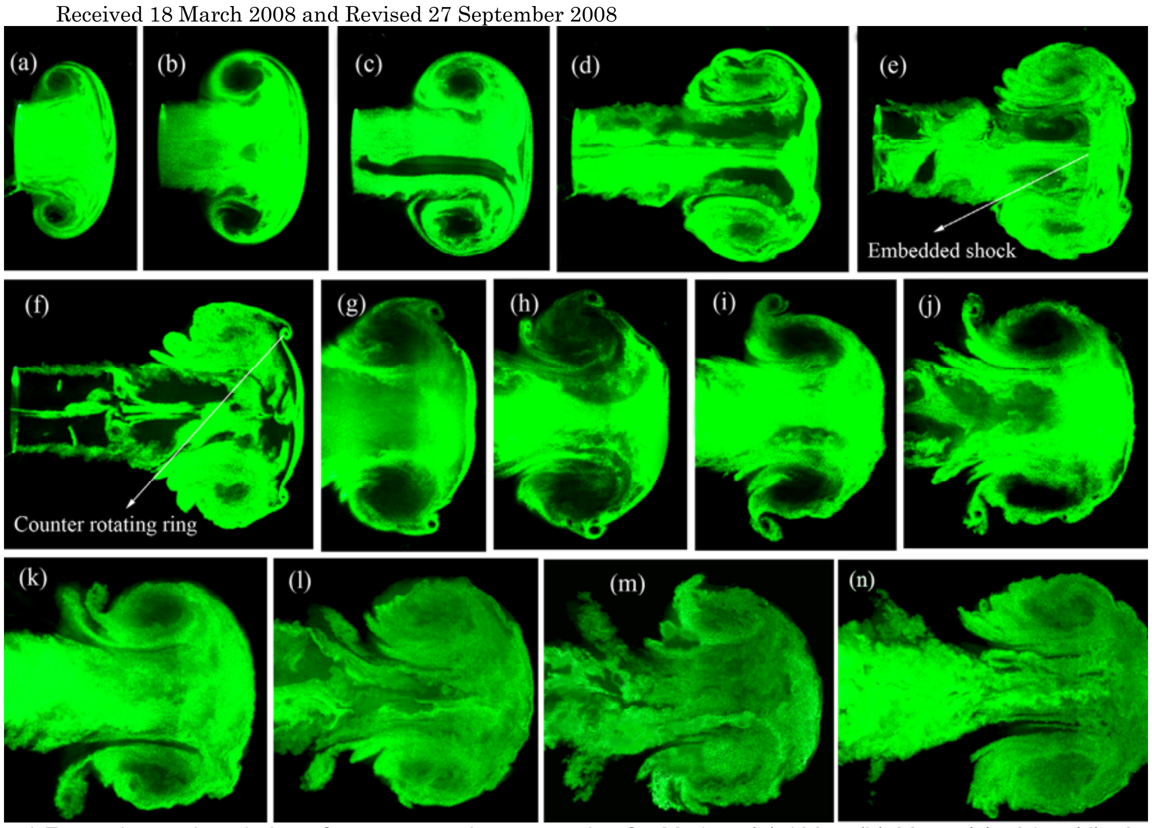

Fig. 1 Formation and evolution of counter rotating vortex ring for M=1.75 (a) 130μs (b) 387μs (c) 504μs (d) 787μs (e) 847μs (f) 994μs (g) 1074μs (h) 1167μs (i) 1280μs (j) 1367μs (k) 1520μs (l) 1667μs (m) 1807μs (n) 2007μs

Fig. 1 shows the formation and evolution of counter rotating vortex ring ahead of primary vortex ring generated at the open end of a shock tube, for shock Mach number (M) 1.7. Driver and driven section length of the shock tube are 165mm and 1200mm. The details of the experiments and visualization method are given in Ref. 1. Earlier visualization studies [2-4] using shadowgraph and schlieren do not show the clear structure of the counter rotating vortex ring and its complete evolution due to integral nature of the techniques. The strong embedded shock (Fig. 1e) present at this M is normal along the axis of the vortex ring and oblique near the vortex core [5]. Thus, the flow decelerates more along the axis compared to the outer portion, which causes formation of a strong shear layer that rolls up into a counter-rotating vortex ring. The counter rotating vortex ring rolls over the periphery of the primary ring and moves in the upstream direction (w.r.t to primary ring) due to its self induced velocity and interaction with primary ring. Finally it ejected into the trailing jet where it interacts with the shear layers of the trailing jet, loses its identity and become turbulent structure due to its opposite circulation of shear layer vortices.

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