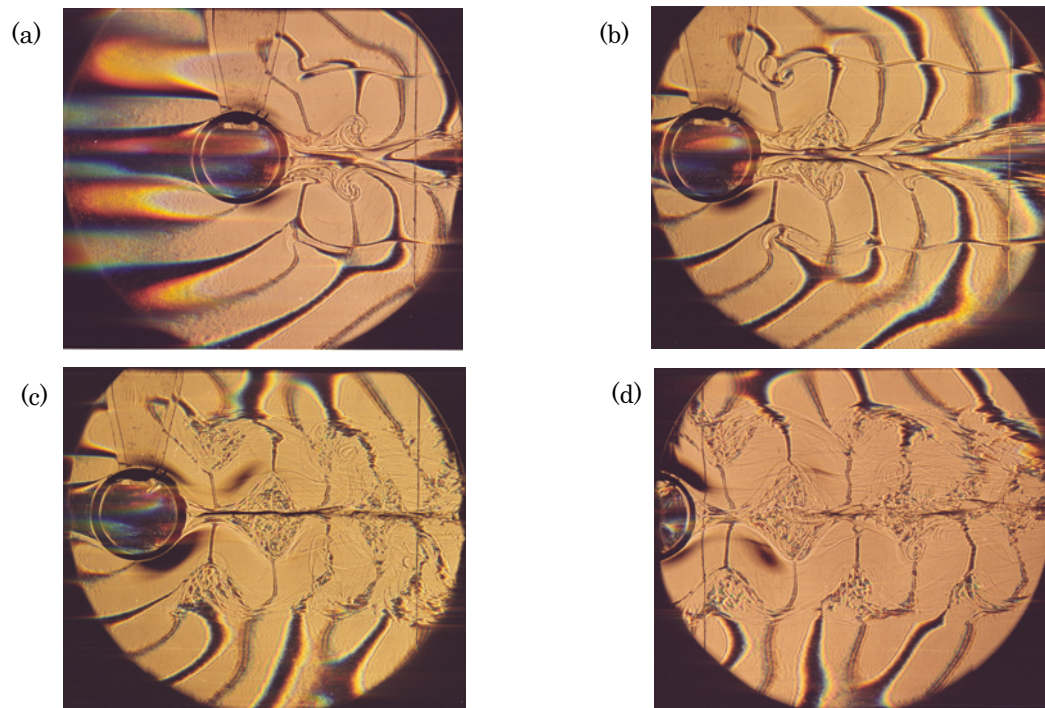


Formation of Vortex Systems on Soaring Interfaces Inside Attached Internal Waves Past Horizontal Cylinder Starting to Move Uniformly in a Linearly Stratified Fluid

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Schlieren images of flow induced by starting horizontal cylinder in a continuously stratified liquid (buoyancy period is $T_b = 13$ s). Method is “vertical slit-thin thread in focus”, colouring of image is caused by natural dispersion of light in the salt brine, and diameter of view field is 23 cm (Chashechkin, 1999). The cylinder of diameter $D = 5$ cm is towed with velocity $U = 0.35$ cm/s; the internal Froude number is $Fr = U/ND = 0.14$, the Reynolds number is $Re = 175$. Evolution of the flow with time after beginning of the motion: (a) – forming soaring interfaces, time from start of the motion, normalized on the buoyancy period, is $\tau = t/T_b = 3.9$; (b) – gradual formation of vortex pairs on leading edges of soaring interfaces, $\tau = 5.8$; (c, d) – vortex systems in phases of formation $\tau = 25$ and stabilization of the flow, $\tau = 28$.

Note: The motion is from right to left, sloping rays of transient internal waves ahead of the body bound upstream disturbance on the horizon of the cylinder. Downstream wake with embedded vortices is bounded by thin interfaces. Curved black lines visualise crests and double grey lines are troughs of waves. Positions of embedded vortices as well as crests and troughs of attached internal waves are synchronised. In Fig. (a) crests and troughs come to the same point on different sides of interfaces opposite large vortex bubble embedded inside downstream wake. Internal waves deform the density wake and soaring interfaces. New vortex structures are placed between embedded vortex bubbles. Distinctive vortex pair in Fig. (b) shows that the vortices are produced by incoming fluid interacting with external opposite flow. Soaring vortices distort shapes of internal waves in Fig. (c, d).

Reference: Chashechkin, Yu.D., Schlieren Visualization of a Stratified Flow around a Cylinder, J. of Visualization, 1999, 1-4, pp. 345-354