

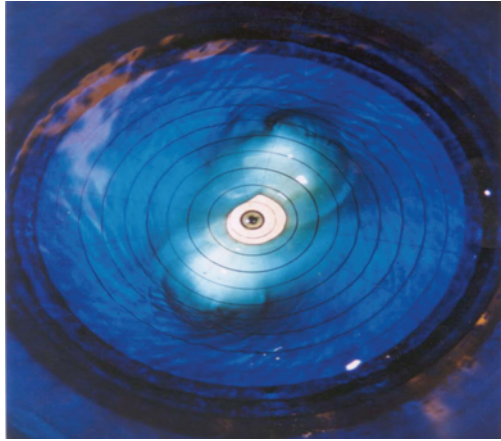
## Visualization of Kelvin waves activity in the hollow vortex

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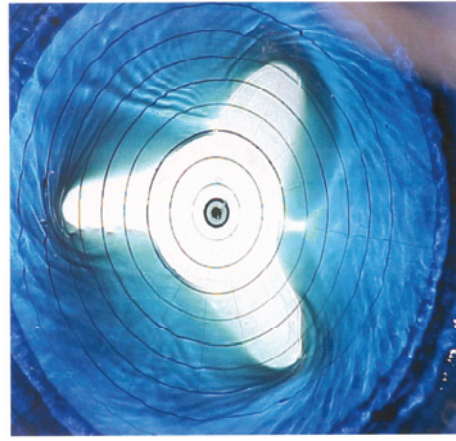
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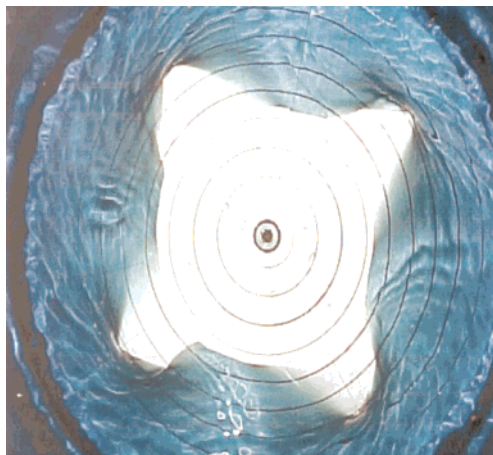
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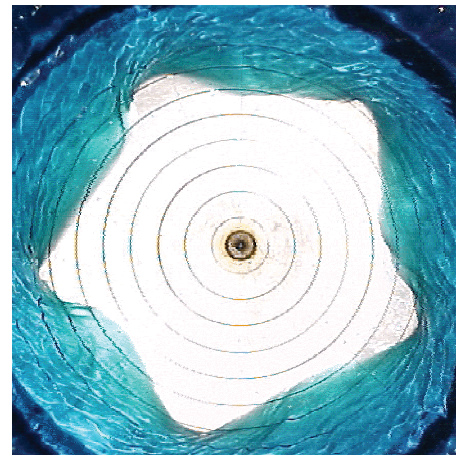
Mode 2 of Kelvin's equilibria



Mode 3 of Kelvin's equilibria



Mode 4 of Kelvin's equilibria



Mode 5 of Kelvin's equilibria

The figures above bring into view the wave activity in a hollow vortex generated under shallow water conditions within a cylindrical container with a flat disk rotating (in counter-clockwise direction) near the bottom. The diameters of the container and the flat disk were 285 mm and 252 mm respectively, whereas the initial height of the water was 27 mm. Depending on the angular velocity of the disk stationary Kelvin modes (Kelvin's equilibria) ranging from two to six were observed (here we only show up to five). The range of disk speed where the equilibria existed became narrower as the wave number increased. These vortex patterns were made visible via a blue water soluble dye. The ratio of the celerity of the modes to the angular velocity of the disk decreases linearly. The figures also show an additional wave activity, manifested by shaded ripples travelling along with the basic patterns. Two kinds of ripples, similar to those generated by ships, were observed. Coalescent (compression\*) waves were detected ahead of the main pattern while the refraction (expansion) type, was found to develop behind the pattern.

\*In the gas dynamic analogous system