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Experimental Verification of the Stationary Inertial Alfven Wave and its Relevance to Auroral Plasma Physics[1]

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A small, off-axis mesh anode electrode at one plasma-column end is used to create a paraxial channel of both electron current and depleted density in the Large Plasma Device Upgrade (LAPD-U) at UCLA. It is shown that the on-axis, larger, surrounding-plasma column rotates about its cylindrical axis because a radial electric field is imposed by a multiple-segmented-disk termination electrode on the same end as the mesh-anode electrode. The radial profile of azimuthal velocity is shown to be consistent with rigid-body rotation. Launched inertial Alfven waves are shown to concentrate in the off-axis channel of electron current and depleted plasma density. In the absence of launched waves, time varying boundary conditions, or spatially structured boundary conditions, we demonstrate that a non-fluctuating, non-traveling pattern in the plasma density arises spontaneously in the channel, but only in the combined presence of electron current, density depletion, and cross-field convection (i.e., rotation). The experimental verification of stationary inertial Alfven waves is based on these results and the predictions from a model of finite-collisionality, finite-pressure stationary Alfven waves that links laboratory and auroral plasma regimes. Ground-based optical observations will be shown that indicate the need for a quasi- static theory of structured electron acceleration within auroral arcs. The properties of the stationary inertial Alfven wave suggest it as promising candidate.

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