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Formation Flight: Upstream Influence of a Wing on a Streamwise Vortex CHRIS MCKENNA, DONALD ROCKWELL, Lehigh University, LEHIGH UNIVERSITY FLUIDS LAB TEAM — Aircraft flying together in formation can experience aerodynamic advantages. Impingement of the tip vortex of the leader wing on the trailer wing can increase the lift to drag ratio L/D and the unsteady loading on the trailer wing. These increases are sensitive to the impingement location of the vortex on the wing. Particle image velocimetry is employed to determine patterns of velocity and vorticity on successive crossflow planes along the vortex, which lead to volume representations and thereby characterization of the streamwise evolution of the vortex structure as it approaches the trailer wing. This evolution of the incident vortex is affected by the upstream influence of the trailer wing, and is highly dependent on the location of vortex impingement. As the spanwise impingement location of the vortex moves from outboard of the wing tip to inboard, the upstream influence on the development of the vortex increases. For spanwise locations close to or intersecting the vortex core, the effects of upstream influence of the wing on the vortex are to: increase the streamwise velocity deficit; decrease the streamwise vorticity; increase the in-plane vorticity; decrease the downwash; and increase the root-mean-square of both streamwise velocity and vorticity.

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