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Scaling arguments for the radial vorticity advection and the radial planetary vorticity tilting in the leading-edge vortex of revolving wings[1] NATHANIEL WERNER, Penn State University, JUNSHI WANG, HAIBO DONG, University of Virginia, BO CHENG, Penn State University — Within the leading-edge vortex (LEV) of a revolving wing, planetary vorticity tilting (PVTr) can partly remove the radial vorticity generated by advection, a mechanism that relates the effects of Coriolis acceleration, spanwise flow, and the tilting of the planetary vorticity. It has been shown previously that the non-dimensional PVTr scales independently with Aspect Ratio (AR) while the advection scales inversely with AR, suggesting that separate scalings should be applied to these two terms. This study continues the previous investigation, with the goal of finding the correct scaling of the radial vorticity advection with the AR. The wing AR is changed by increasing the wing span and keeping the wing chord length constant; in this process we either keep the wing tip velocity constant (i.e., keeping the wing-chord-based Reynolds number constant) or keep the wing angular velocity constant constant (i.e., keeping the spanwise local Reynolds number constant). For both cases, we show that the correct length scale for the advection is wing span instead of wing chord (as for the PVTr), while both the advection and the PVTr have the tip velocity and planetary vorticity (or wing angular velocity) as the velocity and vorticity scales.

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Nathaniel Werner
Penn State University

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