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The unsteady flow over a bat wing in mid-downstroke. FLORIAN MUIJRES, CHRISTOFFER JOHANSSON, RYAN BARFIELD, MARTA WOLF, Lund University, GEOFFREY SPEDDING, University of Southern California, ANDERS HEDENSTROM, Lund University — Birds, bats and insects have provided inspiration for human-designed small-scale flying machines, and while insects have long been known to rely on unsteady separated flows for their above-average aerodynamic performance at small-scale, the details of air flows over bird and bat wings have been harder to elucidate, mainly because of the extra complexity and precautions required in live experiments. Here we report on the first experiments of the airflow around a bat wing in free (but trained) flight in a low-turbulence wind tunnel. The aerodynamics of fixed wings at these Reynolds numbers are notoriously sensitive to small disturbances of the initially laminar, attached boundary layer, but these flight experiments show that the instantaneous flow fields around the flapping wing bear almost no resemblance to an equivalent fixed-wing experiment. The circulation increment due to the presence of a strong leading-edge vortex is estimated to provide a significant fraction of the total lift. Implications for the design and control of micro-air vehicles are considered.

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