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Multimodal Asymmetric Rectified Electric Fields and Long-Range Symmetry Breaking in Electric Field Orientation S. M. H. HASHEMI AMREI, TIMOTHY HUI, GREGORY H. MILLER, WILLIAM D. RISTENPART, University of California, Davis — Recent numerical, theoretical, and experimental work has established the existence of asymmetric rectified electric fields (AREFs), a type of long-range steady field induced by a sinusoidal potential between parallel electrodes containing an electrolyte with unequal ionic mobilities. Here, we show that certain classes of multimodal applied electric potentials yield AREFs that are spatially asymmetric, causing a net nonzero electric field at the midplane between the electrodes. A profound consequence is that swapping the powered and grounded electrodes alters the long-range direction of the steady field component, even though the applied wave-form has zero time average. We provide experimental observations with micron-scale colloids that corroborate the existence of multimodal AREFs. The findings have implications for a broad variety of systems that involve oscillatory fields, including low-energy water desalination and manipulation of flows and particles in microfluidic systems.

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