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Controlled symmetry breaking and vortex dynamics in intersecting flows AMY SHEN, Okinawa Institute of Science and Technology, NOA BURSHTEIN, SIMON HAWARD, Okinawa Institute of Science and Technology Graduate University — Vortices are a ubiquitous feature in complex flows and turbulence, but their dynamics are challenging to study due to their typically transient nature. Here, we perform a detailed study of the vortex dynamics and interactions associated with a symmetry-breaking flow instability at a 4-way intersection. By precisely controlling the flow rate above a critical value, we are able to induce the merging of two co-rotating vortices into a single structure and similarly to induce a single vortex to split into two. Using quantitative flow velocimetry, both processes are recorded with high spatial and temporal resolution. We find that both the merging and the splitting of vortices are exponential processes, with a rate that depends on the imposed flow rate. The vortex dynamics in our system are intimately connected with the symmetry-breaking transition and are affected by the degree of vortex confinement, which we control by varying the aspect ratio of the microfluidic device. We show how the confinement affects the fundamental nature of the flow transition, which varies from super through subcritical as the aspect ratio is increased. Our results are relevant to understand and predict flow transitions and vortex dynamics in flow intersections, particularly in confined environments.

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