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"Schooling" of wing pairs in flapping flight SOPHIE RAMANANARIVO, Courant Institute, NYU, JUN ZHANG, NYU, and NYU Shanghai, LEIF RISTROPH, Courant Institute, NYU, AML, COURANT COLLABORATION, PHYSICS NYU COLLABORATION — The experimental setup implements two independent flapping wings swimming in tandem. Both are driven with the same prescribed vertical heaving motion, but the horizontal motion is free, which means that the swimmers can take up any relative position and forward speed. Experiments show however clearly coordinated motions, where the pair of wings 'crystallize' into specific stable arrangements. The follower wing locks into the path of the leader, adopting its speed, and with a separation distance that takes on one of several discrete values. By systematically varying the kinematics and wing size, we show that the set of stable spacings is dictated by the wavelength of the periodic wake structure. The forces maintaining the pair cohesion are characterized by applying an external force to the follower to perturb it away from the 'stable wells'. These results show that hydrodynamics alone is sufficient to induce cohesive and coordinated collective locomotion through a fluid, and we discuss the hypothesis that fish schools and bird flocks also represent stable modes of motion.

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