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Hydrodynamically synchronized motion of externally driven colloids[1] TAKASHI TANIGUCHI, KOSUKE TESHIGAWARA, JOHN MOLINA, RYOICHI YAMAMOTO, NORIHIRO OYAMA, Department of Chemical Engineering, Kyoto University, TRANSPORT PHENOMENA GROUP, KYOTO UNIVERISTY TEAM — Recent experiments by Kimura et al on externally driven colloidal particles have identified a unique mode of collective motion in three-particle systems. In the experiment, three colloidal particles are dispersed in water and trapped between two flat parallel plates. The particles are then driven by an optical tweezer along a predefined circular path. They have found a doublet-singlet periodic motion, in which a doublet (a pair of particles) approaches the remaining single particle from the back. The newly formed triplet will quickly break up into a new doublet at the front, and a singlet at the back. The doublet leaves the remaining particle behind. In this work, we numerically investigate the dynamics of various numbers of trapped spherical particles moving along a closed path under a constant tangential force. In particular, we have studied the dependence of the gap size, and the strength of the external driving force. With increasing tangential force, we found a transition in the most stable collective mode: from double-singlet periodic motion, to a newly predicted triplet state, which has not yet been observed experimentally. Our results indicate that this transition of the most stable mode of collective motion, from the doublet-singlet to the triplet, occurs continuously.

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