

### Supplemental files

Supplemental file including 5 movie files of collective motions observed in experiments.

(1) Movie1.mov

Rhythmic mode I observed in a three-particle system at  $l = 40$  for  $d = 85 \mu\text{m}$ . The movie is played at 2 times speed.

(2) Movie 2.mov

Oscillation mode observed in a three-particle system at  $l = 45$  for  $d = 7 \mu\text{m}$ . The movie is played at 2 times speed.

(3) Movie 3.avi

Triplet stationary cluster at  $l = 55$  for  $d = 85 \mu\text{m}$ . The movie is played at 2 times speed.

(4) Movie 4.mov

Rhythmic mode II observed at  $l = 55$  for  $d = 6 \mu\text{m}$ .

The movie is played at 2 times speed.

(5) Movie 5.mov

Collective motion observed in a seven-particle system at  $l = 55$  and  $d = 6 \mu\text{m}$ . The leading particle leaves the triplet and catches up to the doublet ahead. A singlet-transferring wave propagates along the ring of doublets.