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Microfluidic pinball made of quasi-2D microbubbles: on the collective dynamics of confined bubbles pulsating under ultrasound FLORE MEKKI-BERRADA, PIERRE THIBAULT, PHILIPPE MARMOTTANT, LIPhy — The pulsation properties of air bubbles under ultrasound have received much attention since the development of sonoporation and contrast agents. Spherical bubbles are well known to induce streaming when excited by ultrasound. Here we study how the vibration of very confined bubbles pinned to pits (assuming a quasi-2D "pancake" shape) influences the streaming inside a microfluidic channel. For a single bubble, 20 to 70 μm in radius, we observe the well-known parametric instability, giving rise to a shape deformation, and sketch a phase diagram of existence of the surface modes. We also evidence very active out-of-plane fluid circulations located near the bubble that are correlated with the surface modes. In the case of a bubble pair, the interaction results in an additional bipolar surface mode. We demonstrate that a long-range multipolar recirculating flow occurs from a combination of phase-lagged vibration modes. Using a large triangular lattice of these microbubbles, we obtain a unique acoustic bubble "pinball" driving fluid and particles in complex paths, the constructive interference between vibration modes leading to the elaborate in-plane microstreaming vortices. This work gives a new insight in bubbles efficiency to trigger local and non-local mixing in laminar flows.

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