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Acoustophoretic particle motion in a square glass capillary[1]

RUNE BARNKOB, ALVARO MARIN, MASSIMILIANO ROSSI, CHRISTIAN J. KÄHLER, Bundeswehr University Munich — Acoustofluidics applications often use complex resonator geometries and complex acoustic actuation, which complicates the prediction of the acoustic resonances and the induced forces from the acoustic radiation and the acoustic streaming. Recently, it was shown that simultaneous actuation of two perpendicular half-wave resonances in a square channel can lead to acoustic streaming that will spiral small particles towards the pressure nodal center (Antfolk, Anal. Chem. 84, 2012). This we investigate in details experimentally by examining a square glass capillary with a 400-μm microchannel acoustically actuated around its 2-MHz half-wave transverse resonance. The acoustic actuation leads to the formation of a half-wave resonance in both the vertical and horizontal direction of the microchannel. Due to viscous and dissipative losses both resonances have finite widths, but are shifted in frequency due to asymmetric actuation and fabrication tolerances making the channel not perfectly square. We determine the resonance widths and shift by measuring the 3D3C trajectories of large particles whose motion is fully dominated by acoustic radiation forces, while the induced acoustic streaming is determined by measuring smaller particles weakly influenced by the acoustic radiation force.

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