

## Ultrasound-induced acoustophoretic motion of microparticles in three dimensions - DTU Orbit (09/11/2017)

### Ultrasound-induced acoustophoretic motion of microparticles in three dimensions

We derive analytical expressions for the three-dimensional (3D) acoustophoretic motion of spherical microparticles in rectangular microchannels. The motion is generated by the acoustic radiation force and the acoustic streaming-induced drag force. In contrast to the classical theory of Rayleigh streaming in shallow, infinite, parallel-plate channels, our theory does include the effect of the microchannel side walls. The resulting predictions agree well with numerics and experimental measurements of the acoustophoretic motion of polystyrene spheres with nominal diameters of 0.537 and 5.33  $\mu\text{m}$ . The 3D particle motion was recorded using astigmatism particle tracking velocimetry under controlled thermal and acoustic conditions in a long, straight, rectangular microchannel actuated in one of its transverse standing ultrasound-wave resonance modes with one or two half-wavelengths. The acoustic energy density is calibrated in situ based on measurements of the radiation dominated motion of large 5- $\mu\text{m}$ -diameter particles, allowing for quantitative comparison between theoretical predictions and measurements of the streaming-induced motion of small 0.5- $\mu\text{m}$ -diameter particles.

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