Theoretical analysis of velocity fields in microchannel acoustophoresis

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Microchannel acoustophoresis is a rapidly expanding research field allowing gentle and efficient manipulation of cells and other biological particles. To further advance this mainly application-driven research field, more extended theoretical analysis is beneficial [1].

Based on our newly-developed automated and temperature-controlled micro-PIV system [2], we are now able to obtain detailed measurements of the velocity field as cells and particles undergo ultrasound-induced acoustophoresis.

The talk deals with the theoretical analysis of these velocity fields. In particular, the talk focuses on three aspects. Firstly, we study the complex nature of the acoustic resonances underlying the acoustophoresis, where a combination of theoretical modeling and high-resolution measurements lead to improved understanding of the basic physics and may result in designs of more efficient chip systems. Secondly, theoretically we show a decomposition of the acoustophoretic velocity into a gradient and rotational component, which enables a thorough investigation of the crossover from radiation-force-dominated motion for large particles to the acoustic-streaming-dominated motion for small particles. Thirdly, the high-resolution determination of the acoustophoretic velocity field enables the measurement of fundamental acoustophysical properties such as acoustophoretic mobility of different particle and cell species in various buffer media. With this information it will be possible to design highly efficient acoustophoretic binary separation of various cell populations by tuning the buffer medium.

[1] R. Barnkob, P. Augustsson, T. Laurell and H. Bruus, Lab Chip, 2010, **10**, 563-570.
[2] P. Augustsson, R. Barnkob, H. Bruus and T. Laurell, submitted for Lab Chip, 2011