Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

3D mixing near the surface of actuated beads[1] NEEHAR MOHARANA, MICHEL SPEETJENS, RUBEN TRIELING, HERMAN CLERCX, Eindhoven University of Technology, The Netherlands — Mixing in microfluidic devices is often a challenge because of the absence of turbulence. Here we must instead resort to laminar mixing by chaotic advection. In order to achieve chaotic advection in such devices, we explore a promising future technology for active mixing by actuating microscopic magnetic beads with magnetic fields. The present study addresses the fundamental transport phenomena and associated mixing processes around a piecewise-steadily translating and/or rotating spherical bead. A detailed transport analysis revealed that perturbation of the Stokes flow around the sphere is essential to attain (locally) chaotic mixing. To this end we introduce a nonlinear perturbation that changes the flow in essentially the same way as fluid inertia or bead oscillations. The impact of this perturbation on the mixing properties has been explored for various actuation protocols via symmetry analysis and numerical simulation of three-dimensional (3D) fluid trajectories and computation of Poincaré maps ("stroboscopic maps" of particle positions). We found evidence of intricate coherent structures which are key to 3D mixing in that they geometrically constrain and determine the tracer transport. Parallel to the above study, we have designed and manufactured a macro-scale experiment in order to validate the mixing properties around the sphere by 3D velocity and temperature measurements. Preliminary experimental results will be shown.

[1]This work is supported by the Dutch Technology Foundation STW under grant 10458.

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Date submitted: 31 Jul 2012 Electronic form version 1.4