Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Computational modeling of bacterial dynamics under shear flow[1]

KARTIK JAIN, CHRISTOPH LOHRMANN, CHRISTIAN HOLM, Institute for Computational Physics, University of Stuttgart, Germany — Bacteria can propel, proliferate and accumulate in a number of media and their dynamics are affected by shear flow. In addition to self-propulsion, bacteria can stick to each other and to surfaces where they can create fast growing colonies, called biofilm. Studies have shown that bacteria more commonly accumulate at surfaces and around obstacles. In the present work we modeled dynamics of E.Coli in a water like fluid. In the model the bacteria are represented by molecular dynamics (MD) particles while the fluid is represented by a lattice Boltzmann method (LBM). The MD particles are coupled to the LB fluid using a frictional point coupling that ensures momentum conservation of the total system. We present collective transient dynamics of up to 4000 bacteria in porous configurations. Our results show that the bacteria tend to a state of momentary stasis in regions where the underlying fluid recirculates, and thus result in a sticking behavior near the obstacles of the porous media. Our findings indicate that such a behavior is manifested mainly due to hydrodynamics interactions between a bacterium and the surfaces. Our model of bacterial replication agrees well with experimental data and ongoing work includes coupling of time scales in bacterial life cycle to model biofilms.

[1]Funding provided by the DFG Collaborative Research Center SFB1313

Kartik Jain
Institute for Computational Physics, University of Stuttgart, Germany

Date submitted: 31 Jul 2019 Electronic form version 1.4