175th MSS Seminar
Wednesday, March 20, 15:30 hrs,
Room 00.156,
Cauerstraße 3, Erlangen.

Institute for Multiscale Simulation MSS

Rheology of elastic capsules in a confined shear flow

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In the last two decades, the lattice Boltzmann method (LBM) has emerged as an attractive choice for modelling complex fluid phenomena, including multiphase/multicomponent flows, particle suspensions, and turbulence. Compared to conventional Navier-Stokes solvers, this method enables simple implementation of complex boundary conditions and is well-suited for highly scalable parallel computing. This presentation will primarily focus on the rheology of a suspension of elastic capsules. A capsule is a liquid droplet core encapsulated by an elastic polymeric membrane with a diameter spanning a few nanometers to a few millimetres. The fluid motion is solved using the lattice Boltzmann method, and the particles are described by a combined finite element/immersed boundary method. We have studied the rheology of strain-hardening spherical capsules, from the dilute to the concentrated regime, under a confined shear flow in three dimensions. We have considered the effect of capillary number, volume fraction, and membrane inextensibility on particle deformation, the suspension's effective viscosity, and normal stress differences. Interestingly, the suspension viscosity exhibits a universal behaviour for the parameter space defined by the capillary number and the membrane inextensibility when introducing the geometrical changes of the particle at the steady state in the definition of the volume fraction [1]. Furthermore, the same reasoning applies to other types of capsules [2].

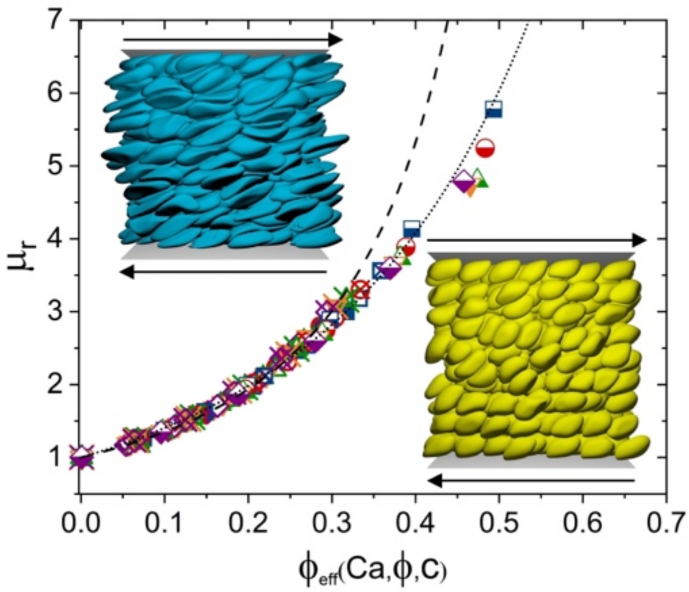

Figure: Suspension viscosity

[1] O. Aouane, A. Scagliarini and J. Harting, J. Fluid Mech 911:A11 (2021)
[2] F. Guglietta, F. Pelusi, M. Sega, O. Aouane and J. Harting J. Fluid Mech 971:A13 (2023)