Velocity inversion in a cylindrical Couette flow

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Velocity inversion in a nano scale cylindrical Couette flow is investigated with Navier-Stokes (NS) equation and molecular dynamics (MD) simulation. With general slip boundary conditions in NS equation, the flow can be classified into five distinct profiles. The condition of velocity inversion is explored in the whole space of four dimensionless variables of beta, slip velocity ratio, radius ratio and angular velocity ratio omega. MD computer simulations are performed to estimate the constitutive coefficient of the slip velocities at the walls. The flow is generated by a rotating inner wall and a stationary outer wall in conformity with the theoretical result. By varying an attraction parameter in Lennard-Jones potential, the slip velocities can be easily controlled. The theoretical predictions are compared with the simulation results. We find that in the intermediate range of attraction parameter the two results are quite comparable to some extent but at both extreme values of attraction parameter they are quite different.