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Consequences of a double zero eigenvalue for the rotational motion of a prolate spheroid in shear flow TOMAS ROSEN, Linne FLOW Centre and Wallenberg Wood Science Center, KTH Mechanics, Stockholm, Sweden, ARNE NORDMARK, KTH Mechanics, Stockholm, Sweden, CYRUS K. AIDUN, G.W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, GA, FREDRIK LUNDELL, Linne FLOW Centre and Wallenberg Wood Science Center, KTH Mechanics, Stockholm, Sweden — The rotational motion of a single prolate spheroidal particle in a linear shear flow provides fundamental knowledge necessary to understand both rheology and orientation distributions of suspensions including elongated particles. In this work, we present results from both direct numerical simulations using the lattice Boltzmann method and stability analysis using Comsol Multiphysics. It has been found that particle and fluid inertia cause different stable rotational states.[1,2] The transitions between these originate from the fact that the Log-rolling particle (particle aligned with vorticity) has a double zero eigenvalue for a certain choice of particle Reynolds number $Re_p = Re_{PF}$ and solid-to-fluid density ratio $\alpha = \alpha_{DZ}$. The consequence is that particles with $\alpha > \alpha_{DZ}$, will always go to a planar rotation (symmetry axis perpendicular to vorticity), while lighter particles can assume a stable periodic or chaotic state which is non-planar. Since α_{DZ} is decreasing with aspect ratio, we find further that only planar states exist for particles of low aspect ratio (length/width).

[1]Rosén *et al.*, J. Fluid Mech. **738**, 563 (2013).
[2]Rosén *et al.*, J. Fluid Mech., submitted (2014).

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