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Rotation of a spheroidal particle in Couette flow: effects of fluid and particle inertia TOMAS ROSEN, FREDRIK LUNDELL, MINH DO-QUANG, Linne FLOW Center, KTH Mechanics, Royal Institute of Technology, SE-100 44 Stockholm, Sweden, CYRUS K. AIDUN, G.W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332 — Numerical simulations (Lattice Boltzmann simulations with External Boundary Force) of a single prolate spheroidal particle in a Couette flow have been performed, with the aim to study the transitions in particle rotation rate. The system is controlled by two dimensionless parameters, connected to fluid and particle inertia, respectively. Fluid inertia is controlled by the particle Reynolds number, Re_p and particle inertia is controlled by the Stokes number, $St{=}\alpha Re_p$, where α is the density ratio between particle and fluid. Two transitions have been previously reported and are the main focus for this study. The first transition is that with increasing Re_p, a light (buoyant) particle eventually ceases to rotate. The second is that a heavy particle, at a certain St, undergoes a transition from a long period flipping motion to steady rotation with constant angular velocity. The results map out where particle or fluid inertia is more dominant. It was found that multiple solutions exist at constant Re_p, where both periodic rotation and steady state can occur. This transition is determined by a critical density ratio, α_c, for each Re_p and aspect ratio (length/width) of the particle.

Tomas Rosen
Linne FLOW Center, KTH Mechanics,
Royal Institute of Technology, SE-100 44 Stockholm, Sweden

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