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Three-dimensional rotation of paramagnetic prolate spheroids in simple shear and uniform magnetic field CHRISTOPHER SOBECKI, Department of Mechanical and Aerospace Engineering Missouri University of Science and Technology, YANZHI ZHANG, Department of Mathematics and Statistics Missouri University of Science and Technology, CHENG WANG, Department of Mechanical and Aerospace Engineering Missouri University of Science and Technology — We present a theoretical investigation on a time-dependent, three-dimensional rotation of an ellipsoidal paramagnetic particle. The particle is placed in an unbounded Newtonian shear flow at zero-Reynolds number and under a uniform magnetic field. In the absence of a magnetic field, the particle will perform periodic rotations known as Jeffery's Orbit. When a magnetic field is applied, we determine the critical field strength that pins the particle's rotation and describe its rotational dynamics towards a stable steady angle when exposed to a strong field (i.e., above the critical field strength). In a weak magnetic regime (i.e., below the critical field strength), we discuss how the paramagnetic particle's polar angle oscillates toward the magnetic field plane, and the time that these oscillations occur has been analyzed. We determine the amplitude of the oscillations and approximate the particle's quasi-steady state of its polar angle. We discuss the relation between the particle's polar angle and the symmetrical rotation of its azimuthal angle, which is affected by the direction of the uniform magnetic field.

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