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The dynamics of orientable particles in simple shear flow NAVANEETH KIZHAKKE MARATH, GANESH SUBRAMANIAN, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore — In simple shear flow, in the Stokes limit, a spheroid rotates indefinitely in any of an infinite single parameter family of periodic orbits, called Jeffery orbits. We have recently used an analytical framework based on spheroidal harmonics to show that weak particle inertia at O(St) and weak fluid inertia at O(Re), St and Re being, respectively, the Stokes number and Reynolds number, lead to an irreversible drift across Jeffery orbits. The spheroid eventually adopts a tumbling or spinning mode, and for an oblate spheroid, the choice of mode depends on its initial orientation. The leading-order inertial corrections leave the time period of rotation (Tp) unchanged. We consider the effects of particle inertia at $O(St^2)$ and fluid inertia at $O(Re^{3/2})$ on Tp using a reciprocal theorem formulation. It is shown that particle inertia at $O(St^2)$ results in a decrease in Tp. The fluid inertial contribution is singular in character, arising from the outer region at length scales of $O(Re^{-1/2})$.This allows for a Fourier-space formulation, and the results for moderate- aspect-ratio spheroids show an increase in the Tp. The theoretical predictions are consistent with the results of recent simulations.

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