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Numerical analysis of the inertial migration of a spherical particle in circular tube flows TAKUYA YABU, TOMOAKI ITANO, MASAKO SUGIHARA-SEKI, Kansai Univ. — In a study of dilute suspension flow through circular tubes, Segré & Silberberg (1961) reported lateral migration of neutrally buoyant spherical particles to an equilibrium radial position at low Reynolds numbers (Re). A later experimental study by Matas et al. (2004) found that another equilibrium annulus (inner annulus) emerges closer to the tube center at elevated Re. Since existing theoretical studies based on the matched asymptotic expansion could not account for the appearance of the inner annulus, the present study aimed to investigate numerically the equilibrium positions of a rigid spherical particle suspended in a Poiseuille flow for $100 < Re < 1{,}500$. In the case of particle to tube diameter ratios $\tilde{0}.1$, the flow field around the particle was computed by the immersed boundary method to calculate the lateral force exerted on the particle. It was found that for $Re < 1{,}000$, the lateral force vanishes at a single radial position, corresponding to the so-called Segré-Silberberg annulus, whereas beyond this Re, a new equilibrium position appears closer to the tube center, possibly representing the inner annulus. In addition, it was predicted that for $Re > 1{,}200$, the Segré-Silberberg annulus disappears and only the inner annulus retains.

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