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The lift force on an oblate bubble rising in a shear flow JACQUES MAGNAUDET, RICHARD ADOUA, DOMINIQUE LEGENDRE, IMFT/CNRS —
The flow about an oblate spheroidal bubble set fixed in a simple shear flow is studied using DNS. The bubble has a prescribed shape and its aspect ratio is varied from 1 to 2.5, while the Reynolds number is varied from some units to 2000. The dimensionless shear rate is also varied by one order of magnitude. The results indicate that for large enough aspect ratios, the lift force passes through a pronounced minimum for a Reynolds number of some hundreds. Within a finite range of Reynolds number about this minimum, the lift force may even be negative, making the bubble migrate in a direction opposite to that predicted by inviscid theory. In contrast, the positive value of the lift force predicted by this theory is recovered at large enough Reynolds number. An analysis of the flow field reveals that the asymmetry of the separated near wake (which for a clean bubble exists only for large enough aspect ratios) is responsible for the lift reversal. Within a certain range of Reynolds number the wake is unstable, so that the lift force due to the shear combines with that due to the wake instability, resulting in an oscillating total lift force.

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