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Evolution of an elliptic vortex ring in a viscous fluid JING LOU, MING CHENG, Institute of High Performance Computing, T.T. LIM, National University of Singapore, INSTITUTE OF HIGH PERFORMANCE COMPUTING TEAM — The evolution of a viscous elliptic vortex ring in an initially quiescent fluid or a linear shear is numerically simulated. A wide range of parameters are considered, for aspect ratios (AR) ($1 \leq \text{AR} \leq 8$),radius to ring radius ratios ($\mathbf{0}$) (0.1 $\leq \mathbf{0} \leq 0.3$), Reynolds number (Re) ($500 \leq \text{Re} \leq 3000$)shear rate (K) ($0 \leq \text{K} \leq 0.12$). The study aims to fill the gap in the current knowledge of dynamics of an elliptic vortex ring in a viscous fluid and also to address the issue of whether elliptic ring undergoes vortex stretching and compression during axis-switching. In a quiescent, results show that there exists a critical aspect ratio (ARc), below which an elliptic ring undergoes oscillatory deformation with the period that increases with decreasing AR. Above ARc, the vortex ring breaks up into two or three sub-rings after the first half-cycle oscillation. While higher Reynolds number enhances vortex ring breakup, larger core size has opposite effect. Contrary to an inviscid theory, an elliptic ring does undergo vortex stretching compression during oscillatory deformation. In the presence of a linear shear flow, the vortex undergoes not only oscillatory deformation and stretching but also tilting as it propagates.

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