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Motion of a vortex ring with swirl MING CHENG, JING LOU, Institute of High Performance Computing, TEE TAI LIM, National University of Singapore, IHPC-NUS COLLABORATION — Motion of vortex rings has been subject of theoretical and experimental studies since the time of Lord Kelvin simply because of its fundamental significance in flow physics and its practical importance in engineering applications. In this paper, we use a lattice Boltzmann method to simulate the motion of a vortex ring with and without swirl in a viscous incompressible fluid. We study the effect of swirl on the dynamics of an isolated three-dimensional vortex ring at a Reynolds number of 800. Our results show that the evolution of the vortex ring is affected by both the magnitude of swirl and the vortex core size. Increasing swirl for a fixed core size causes vortex ring to slow down or even travel backward initially. Increasing core size not only reduces the propagation speed of the ring, it also increases the duration of backward motion when the swirl is sufficient high. Moreover, it is found that while a weak swirl causes vortex filaments to undergo helical winding, a sufficiently strong swirl transforms these windings into convoluted three-dimensional vortex structure with vortex loops trailing behind it. Each of these vortex loops may reconnect with itself, through the process of vortex reconnection, to form a ringlet.

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