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Co-rotating Batchelor vortex merging PAULO FERREIRA DE SOUSA, New Mexico State University, JOSE CARLOS FERNANDES PEREIRA, Instituto Superior Tecnico — The dynamics of co-rotating vortex pairs without axial flow has been recently thoroughly studied through theoretical, experimental and numerical studies, which revealed different instabilities contributing to the decay of the vortices. In this paper the objective is to extend the analysis to the case of co-rotating vortices with axial flow at low Reynolds numbers. A high-order incompressible Navier-Stokes flow solver is used. The momentum equations are spatially discretized on a staggered mesh by finite differences and all derivatives are evaluated with 4th order compact finite difference schemes with RK-4 temporal discretization. The initial condition is a linear superposition of two co-rotating circular Batchelor vortices with q = 1. It is found that there is an initial evolution that resembles the evolution that single q = 1 vortices go through. Azimuthal disturbances grow and result in the appearance of large-scale helical sheets of vorticity. With the development of these instability waves, the axial velocity deficit is weakened. The redistribution of both angular and axial momentum between the core and the surroundings drives the vortex core to a more stable configuration, with a higher q value. After these processes, the evolution is somewhat similar to a pair of co-rotating Lamb-Oseen vortices. A three-dimensional instability develops, with a large band of unstable modes, with the most amplified mode corresponding scaling with the vortex initial separation distance.

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