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Stability of trailing vortices with radial stratification JEROME FONTANE, LAURENT JOLY, AURIANE AUDOUIN, Université de Toulouse, ISAE, DAEP — We look at the effects of the radial density stratification on the stability of the q-vortex, a commonly accepted model for aircraft trailing vortices. It has been demonstrated that the 2D Lamb–Oseen vortex develops a Rayleigh–Taylor instability when its core is heavier than the surrounding fluid (Joly, Fontane & Chassaing 2005, Sipp *et al* 2005). The underlying mechanism relies on baroclinic vorticity generation due to any misalignment between the density gradient and the centripetal acceleration field. The instability is triggered provided that the density decreases radially somewhere in the vortex core. This mechanism is also active in the 3D trailing vortex and affects its stability characteristics due to the addition of an axial component in the acceleration field. We show that the unstable center modes of the homogeneous case (Fabre & Jacquin 2004) are promoted in a q-vortex with a heavy core. Their growth rate increases while their m-spiral structure is preserved. For an Atwood number $At = 0.5$, their predicted growth rate can be ten times the ones found in the homogeneous case. Furthermore, the unstable domain is extended far beyond the neutral curve in the homogeneous case, with unstable modes observed for Swirl numbers up to $q = 5$. It is argued here that corresponding density perturbations could eventually lead to the development of new and original strategies to decrease the lifespan of aircraft trailing vortices and greatly reduce their unwanted side-effects on contrails persistence and air traffic regulations.

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