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Vortex breakdown of a swirling light gas jet discharging into a heavier ambient gas[1] J.M. GALLARDO, C. DEL PINO, R. FERNANDEZ-FERIA, U. Malaga (Spain) — The effect of co-flow in the structure of laminar gas swirling jets with very small jet-to-ambient density ratios has been investigated by solving the high Reynolds number parabolic equations. The study is of interest for the design of Hydrogen swirl combustors. We find that the critical swirl number for vortex breakdown decreases for increasing co-flow ratios, as in a swirling jet discharging into the same ambient gas, but the critical swirl for breakdown in a light gas jet can be significantly larger. As the co-flow increases, the difference between both critical swirl numbers decreases, are equal for co-flow ratio unity, and, for co-flow ratios larger than unity, the critical swirl for a light gas jet becomes smaller than that for a homogeneous jet. These behaviors are explained by the differences in the pressure distributions generated by the swirl when the jet is much lighter than the ambient gas, in relation to a homogeneous jet. The situation becomes more complex when compressibility effects are taken into account, owing to the interplay between temperature, density and pressure differences generated by the swirl. We characterize the critical swirl for vortex breakdown as a function of the density ratio, the co-flow ratio, and the Mach number.

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Ramon Fernandez-Feria
University of Malaga (Spain)

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