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Experiments on the global instability of axisymmetric low-density buoyant jets subjected to acoustic forcing LARRY LI, MATTHEW JUNIPER, University of Cambridge — Results are presented from an experimental study into the effect of acoustic forcing on the near-field development of an axisymmetric, low-density (helium) jet issuing into ambient air. The Reynolds number, Richardson number, and density ratio of the jet were respectively 630, 0.18, and 0.14. The Richardson number is sufficiently large that buoyancy cannot be ignored. Without forcing, hot-wire and pressure measurements revealed self-excited, periodic oscillations at a fundamental frequency of $f_o \approx 36$ Hz, corresponding to a Strouhal number of 0.31. High-speed Schlieren videos showed that this spectral component corresponded to a varicose motion. This varicose motion enhanced local entrainment of ambient fluid into the jet core, leading to the formation of large-scale toroidal vortices. When forcing was applied around the fundamental mode and at low amplitudes, beating was observed until, at a critical amplitude, the oscillations locked into the forcing frequency and completely supressed the jet's natural spectral components. For forcing frequency deviations up to $\Delta f/f_o \approx 0.24$, the critical amplitude increased linearly with frequency deviation although lock-in occured more readily when the forcing frequency was larger than the fundamental frequency. The self-excited, pure-tone nature of the jet oscillations and their relative insensitivity to external perturbations are strong evidence of a global mode.

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