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Subcritical Hopf bifurcations in low-density jets YUANHANG ZHU, VIKRANT GUPTA, LARRY K. B. LI, The Hong Kong University of Science and Technology — Low-density jets are known to bifurcate from a steady state (a fixed point) to self-excited oscillations (a periodic limit cycle) when the Reynolds number increases above a critical value corresponding to the Hopf point, Re_H. In the literature, this Hopf bifurcation is often considered to be supercritical because the self-excited oscillations appear only when $Re > Re_H$. However, we find that under some conditions, there exists a hysteretic bistable region at $Re_{SN} < Re < Re_H$, where Re_{SN} denotes a saddle-node bifurcation point. This shows that the Hopf bifurcation can also be subcritical, which has three main implications. First, low-density jets could be triggered into self-excited oscillations even when $Re < Re_H$. Second, in the modeling of low-density jets, the subcritical or supercritical nature of the Hopf bifurcation should be taken into account because the former is caused by cubic nonlinearity whereas the latter is caused by square nonlinearity. Third, the response of the system to external forcing and noise depends on its proximity to the bistable region. Therefore, when investigating the forced response of low-density jets, it is important to consider whether the Hopf bifurcation is subcritical or supercritical.

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