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On the stability of Leidenfrost drop inner flows EUNOK YIM, LFMI, EPFL, Lausanne, Switzerland, AMBRE BOUILLANT, DAVID QUERE, LadHyX, Ecole polytechnique, Palaiseau PMMH, ESPCI, Paris, France, FRANCOIS GALLAIRE, LFMI, EPFL, Lausanne, Switzerland — Recent experimental observation by Bouillant et al. (Nat. Phys., vol. 14, 2018) revealed that below a certain radius, a Leidenfrost water drop starts to roll. To better describe this internal mode transition, we study experimentally and numerically the global stability of a water drop in a Leidenfrost regime. In experiment, the surface temperature and the internal flow fields of a drop with initial radius $R \approx 3.7$ mm are measured by infrared camera and particle induced velocimetry, respectively, and show the existence of critical radii on successive azimuthal mode (of wavenumber m) transitions. Numerically, the steady base flow is computed assuming non-deformable interface and the heat exchange on the boundary is modeled by an empirical correlation law. In absence of precise knowledge of the surface contamination properties, the surface tension gradient appears as the only tunable parameter to match experimental observations. The stability analysis of nominally axisymmetric base flow shows the dominant unstable azimuthal mode transitions at radii close to the experimental observations. The unstable eigenvectors for the azimuthal wavenumber $m = 3$ and $m = 2$ are reminiscent to the experimental observation while the rolling mode is best described by the $m = 1$ eigenvector.

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