THE UNDERSIDE OF A LEIDENFROST DROP ON A BATH

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The Leidenfrost effect, when a drop levitates on its own vapor over a hot solid surface, can also be observed over hot baths of non-volatile liquids [1-2]. Compared to the classical Leidenfrost effect on solid substrates, the liquid bath presents three major differences: the substrate is atomically smooth, deformable, and fluid. As a consequence of such fluidity, heat transfer through the bath to the drops is most certainly dominated by convection and not by just conduction as in the solids. Here, we undertake an experimental and numerical study of the flow in the bath of silicone oil V20 induced by an overlying Leidenfrost drop. We highlight that the structure of this flow is far from being universal. In particular, the sense of circulation in a toroidal vortex formed under the drop is found experimentally and confirmed theoretically to depend on the nature of the liquid that makes the drop. We show that this is due to a shift in a complex and delicate interplay between three mechanisms pulling in different directions: the local cooling of the bath by the drop gives rise to both (i) a buoyancy action and (ii) Marangoni stresses, whereas the vapor escaping from the gap between the drop and the bath exerts (iii) a shear action on the bath surface. Whatever the structure of the convection, its efficiency for heat transfer through the bath is readily confirmed in numerical simulations.

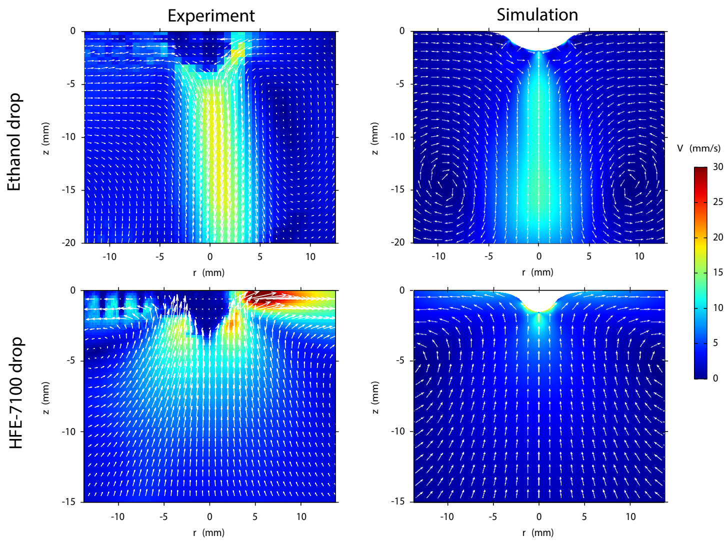

Figure: Experimental (left) and numerical (rigth) flow fields in the bath under levitating ethanol (top) and HFE-7100 (bottom) Leidenfrost drops, both of radius R/lc=2 and subject to a superheat ΔT=19°C.

REFERENCES:

1. Maquet L., Sobac B., Darbois-Texier B., Duchesne A., Brandenbourger M., Rednikov A., Colinet P. and Dorbolo S. 'Leidenfrost drop on a heated liquid pool' *Physical Review Fluids*, **2016**, 053902.
2. van Limbeek M. A. J., Sobac B., Rednikov A., Colinet P. and Snoejier J. 'Asymptotic theory for a leidenfrost drop on a liquid pool', *Journal of Fluid Mechanic*, **2019**, *863*, 1157-1189.