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Leidenfrost effect: accurate drop shape modeling and new scaling laws BENJAMIN SOBAC, ALEXEY REDNIKOV, Université Libre de Bruxelles, TIPs - Fluid Physics, STÉPHANE DORBOLO, Université de Liège, GRASP, Physics Departement, PIERRE COLINET, Université Libre de Bruxelles, TIPs - Fluid Physics — In this study, we theoretically investigate the shape of a drop in a Leidenfrost state, focusing on the geometry of the vapor layer. The drop geometry is modeled by numerically matching the solution of the hydrostatic shape of a superhydrophobic drop (for the upper part) with the solution of the lubrication equation of the vapor flow underlying the drop (for the bottom part). The results highlight that the vapor layer, fed by evaporation, forms a concave depression in the drop interface that becomes increasingly marked with the drop size. The vapor layer then consists of a gas pocket in the center and a thin annular neck surrounding it. The film thickness increases with the size of the drop, and the thickness at the neck appears to be of the order of 10-100 μm in the case of water. The model is compared to recent experimental results [Burton et al., Phys. Rev. Lett., 074301 (2012)] and shows an excellent agreement, without any fitting parameter. New scaling laws also emerge from this model. The geometry of the vapor pocket is only weakly dependent on the superheat (and thus on the evaporation rate), this weak dependence being more pronounced in the neck region. In turn, the vapor layer characteristics strongly depend on the drop size.

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