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A physical picture of the inverse Leidenfrost effect holding in the limit of vanishing crispation number Cr STEPHEN MORRIS, University of California, Berkeley, MENG SHI, KAUST — Assuming axisymmetry and zero gravity, computation and asymptotic analysis are used to find the maximum value of the force F with which a heated non–evaporating sphere (radius b) can be pushed against the surface of a volatile liquid. Mass evaporated beneath the sphere flows to the atmosphere as a thin film of vapour, and the pool surface is deformed by the pressure field driving that flow. For $f = F/(2\pi\gamma b) \ll 1$ (surface tension γ), film thickness h increases monotonically with angle θ (measured from the sphere bottom). Once f exceeds a critical value, $h(\theta)$ changes form; a maximum h_0 occurs at $\theta = 0$, and a minimum h_1 at $\theta = \theta_1$. With increasing f, the ratio h_0/h_1 increases, causing an apparent contact line to form at θ_1. For $\theta < \theta_1$, $p(\theta)$ is asymptotically uniform and the pool surface is a spherical cap; for $\theta > \theta_1$, p is atmospheric and the pool surface is the minimal surface tangent to the sphere at θ_1. $p(\theta)$ falls from p_0 to atmospheric across a narrow barrier rim within which $h = O(h_1)$. From this picture, it follows that $F = 2\pi\gamma b \sin^2\theta_1$, and that the maximum force is $2\pi\gamma b$. A formula for the evaporation rate is also provided.

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