Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Understanding thin air film entrapment in drop-pool impact events via numerical simulations[1] SHAHAB MIRJALILI, ALI MANI, Stanford University — Experiments have shown that when an O(1mm) water drop impacts a water pool with O(1m/s) velocity, hundreds of micro-bubbles can be entrained in a process known as Mesler entrainment. These bubbles are remnants of a thin extended air film that is entrapped between the two liquid bodies prior to their contact. Despite such observations, neither the details of the mechanism of Mesler entrainment, nor the requirements for it to happen have been established. In this work, we numerically study the impact of a drop on a deep pool to understand the evolution of the liquid surfaces and air film. Our simulations, alongside analytical arguments, lead to the discovery of a capillary transition in the dynamics of the thin air film that allows for formation of high aspect ratio films that can shed micro-bubbles. Based on this observation, we claim that the occurrence of this transition is a trade-off between capillary forces and Van der Waals forces, leading to a criterion for delineating the boundaries of the Mesler entrainment regime in the parameter space. By discovery of scaling laws governing the film thickness after transition, we pave the path for quantitative prediction of the micro-bubbles that are shed as the film retracts after rupture.

[1]Supported by ONR

Shahab Mirjalili
Stanford University

Date submitted: 01 Aug 2019 Electronic form version 1.4