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Nonmonotonic Response of Drop Impacting Liquid Film XIAOYU TANG, ABHISHEK SAHA, DELIN ZHU, Princeton University, CHAO SUN, Tsinghua University, CHUNG K. LAW, Princeton University — Drop impact on liquid film is ubiquitous in both natural phenomena and industrial applications. The dynamics of the gas layer trapped between the drop and the deformed liquid surface play a crucial role in determining the impact outcomes. However, a quantitative measurement of this gas layer dynamics is extremely challenging because it is hidden behind the deformed liquid film. In this study, high-speed white light interferometry enables the measurement of the gas layer dynamics during the drop impact with high resolutions and is complemented by side view shadowgraphy to observe the penetration process below the liquid surface. Drop impacting with different inertia onto liquid film with various thicknesses is systematically studied to obtain a phase diagram of different outcomes in the h/R-We space, where h/R is the liquid thickness normalized by drop radius, and We is the drop Weber number. It is observed that there exists a critical We_C beyond which the drop always merges with the liquid film. However, for *'subcritical'* conditions, there exists a merging peninsula in otherwise globally bouncing region. Across this peninsula, as the liquid film thickness increases, the impact outcome transits from bouncing to merging and to bouncing again. The merging time within this peninsula is longer compared to its *'supercritical'* counterpart, indicating different merging mechanisms. Based on scaling analysis, the boundaries between different zones are identified and compared with experiments.

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