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USING DROP IMPACTS TO STUDY THE DYNAMICS OF SUB-MICRON LIQUID STRUCTURES

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We use ultra-high-speed video imaging, at frame-rates up to 1 million fps, to study the dynamics and breakup of both submicron sheets of liquid and submicron films of air. When a drop impacts onto a pool surface at sufficiently high impact velocity, it produces a fast-moving horizontal ejecta sheet, which emerges from the neck connecting the drop to the pool. This sheet can stretch to become as thin as 0.2 microns, before it breaks up into a myriad of secondary droplets. We show the rich dynamical evolution which can emerge, where this sheet can interact with the drop or the pool surface. We also identify a transition to random splashing, which is associated with a vortex shedding instability.

When the drop impacts at very low velocities, the air under it can cushion the impact and prevent direct contact between the drop and the pool. The thin air layer under the drop is then stretched into a hemisphere and only ruptures when it becomes of the order of 100 nm thick. The breakup of this air is extremely rapid, but the high-speed imaging allows for well controlled studies of the air film puncturing and resulting entrapment of micro-bubbles.