Splash of milk streams impacting on a solid surface

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In recent years, droplet impact on solid and liquid surfaces has been significantly addressed in the literature which is very important in several applications such as inkjet printing, surface coating,

FIG. 1. Impact of two streams of milk (liquid jet) from sides on a person's face (curved solid surface). For the poster associated with this image see <https://doi.org/10.1103/APS.DFD.2017.GFM.P0053>

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FIG. 2. Time evolution of milk streams (liquid jet) impacting a person's face (solid surface), showing the splashing behavior.

and impingement cooling [1,2]. The impact of a fluid jet against a solid surface is frequently in the form of the ejection of a high speed jet emerging out of the interface into the air. When a liquid jet impacts a solid surface, the liquid spreads out radially and forms a thin film of liquid on the surface, which is called a lamella. Three possible outcomes of liquid jet impingement are lamella deposition, lamella detachment, and a hydraulic jump [3]. The lamella liftoff is completely affected by the surface shape, jet velocity, and the wetting properties of the surface. For a low speed jet hitting a flat surface, no lamella detachment occurs and liquid leaves the surface by droplet spattering, which is caused by turbulence and surface instabilities in the jet [4]. On the other hand, it is observed that on a moving [5] or curved solid surface [6], the lamella can detach from the substrate.

In this study, two streams of milk (liquid jet) impact on a person's face (curved solid surface) from both sides as shown in Fig. 1 to create a unique lamella detachment. By careful positioning of the jets to hit the cheeks only, the face can be assumed to be a rigid surface, which is a good approximation as long as the impact velocity is not too high. Many parameters such as the density, viscosity, and compressibility of the liquid; impact velocity; and surface shape play important roles in the radius, thickness, and detachment of lamella, which were not investigated here. Instead, the simple science

and beauty of fluid motion are illustrated by aesthetic pictures. A sequential time series of the milk jets impinging on the surface can be observed in Fig. 2. Images are captured by a Canon 5D camera, Mark III, with a 50-mm lens. The images are shot with two external flashes, at aperture of $f/5.6$, shutter speed of $1/125$ of a second, and ISO 500.

This series of images shows the initial jets of milk [Fig. 2(a)], impingement [Fig. 2(b)], and the subsequent radial spread of the detached liquid [Fig. 2(c)]. At this impact speed, a smooth motion of the liquid results in the formation of a thin milk disk or the lamella which expands very quickly and reaches a maximum radius within a short time [Fig. 2(c)]. Subsequently, the jetting motion leads to further disintegration of the liquid from the surface. The kinetic and surface energy of the jet are dissipated by viscous processes in the thin sheet of liquid, and splash occurs which includes the separation of tiny droplets from the unstable rim of the lamella in the last stages of spreading in radial direction [Fig. 2(d)], until the gravity is dominant [Fig. 2(e)]. As shown in Fig. 2(f), the resulting splash can soak you!

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