EMBEDDING, REBOUND AND TUNNELING OF LIQUID DROPLETS IMPACTING ONTO FREELY SUSPENDED FLUID FILMS

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We have demonstrated experimentally that microdroplets shot onto freely suspended smectic films can interact with the films in three different ways, depending on the impact speed [1,2]. They are trapped and embedded in the film when they are sufficiently slow. At intermediate impact speeds they are reflected, and at high speeds they tunnel the film, become encapsulated with a thin closed layer of film material. They leave the film intact in all three scenarios. The tunneling of thin smectic films can be employed to create smectic shells, i. e. micrometer sized droplets of an immiscible liquid encapsulated by a thin smectic layer, which can be collected in another liquid [2].

Extending these experiments to millimeter sized droplets, we are able to study droplet impact on smectic films over huge parameter ranges, varying the Weber, Bond and Reynolds numbers over nearly three orders of magnitude, kinetic energies over 6 orders of magnitude and time scales over four orders of magnitude, thus providing a comprehensive description of droplet impact and interactions for different droplet and film materials.

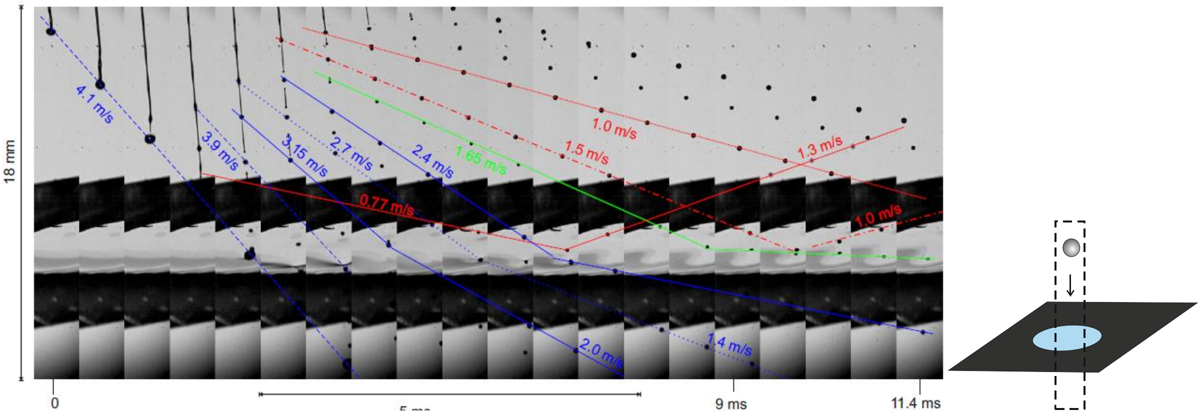

Figure 1: Time series of large droplets impacting on a freely suspended smectic film. The drawing at the right hand side schematically sketches the geometry, the dashed rectangle indicates the region that was selected for the image series. The images show droplets of different sizes in the range of few hundred microns to about one millimeter, impacting on a smectic film with different velocities. Fast droplets can tunnel the film, slow ones are reflected. The trapping and embedding regimes exchange their roles for these large droplets as compared to microdroplets.

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REFERENCES:

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