Stability of giant soap films

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ABSTRACT

In many artistic performances, artists use giant bubbles and soap films. Nevertheless, in the literature, the studies concerning these films are scarce [1] since most systematic experiments mostly concern small films, created by pulling a frame out of a bath of surfactant solution at small velocities [2,3]. Their thickness at the bottom is well predicted by a visco-capillary balance [4], the Frankel's law.

We developed an experiment to generate giant soap films up to 2 meters (Figure 1), which are pulled out of a liquid bath at velocities comparable to those of the artists, from centimeters to a few meters per second. This allows us to explore the high velocity regime in the presence of gravity. In this regime, the measured thicknesses are in the micrometer range. This is surprisingly small in comparison with Frankel's model, which predicts thicknesses of the order of few hundred micrometres for these velocities. We have mapped the thickness as a function of the altitude and demonstrated a thickening of the films during their generation. This surprising feature can even continue after the film generation.

Evaporation is known to play a major role in the stability of soap films. Thus, we will also present statistical measurements of lifetime and maximum length of the films during their generation as a function of ambient humidity.

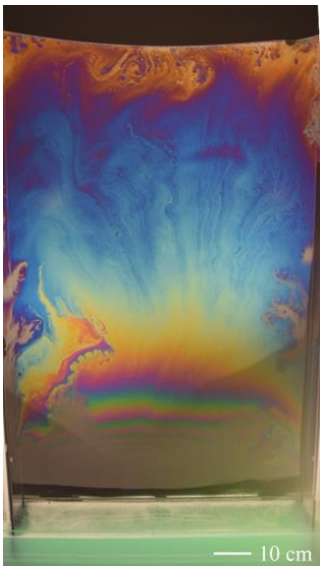

Figure 1: Soap film after a pulling at 100 $cm.s^{-1}$. The interferences colours indicate a non-uniformity of the film thickness.

[1] S. Frazier, X. Jiang, and J. C.Burton. Physical Review Fluids. 2020

[2] L. Saulnier, F. Restagno, J. Delacotte, D. Langevin, and E. Rio. Langmuir. 2011

[3] L. Saulnier, L. Champougny, G. Bastien, F. Restagno, D. Langevin, and E. Rio. Soft Matter. 2014

[4] K.J. Mysels, K. Shinoda, S.Frankel. Pergamon, New-York. 1959