THE HEARTBEAT OF MARANGONI BUBBLES

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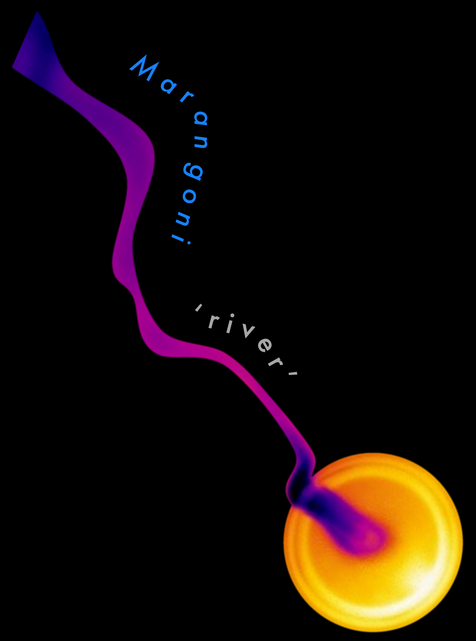
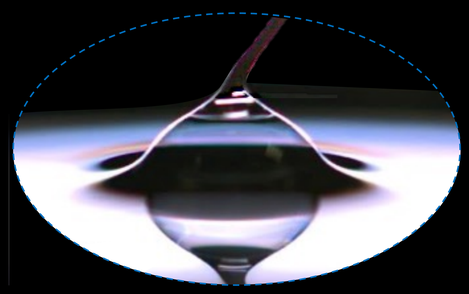
When the 'tears' of Marangoni won't let bubbles die Young . . .

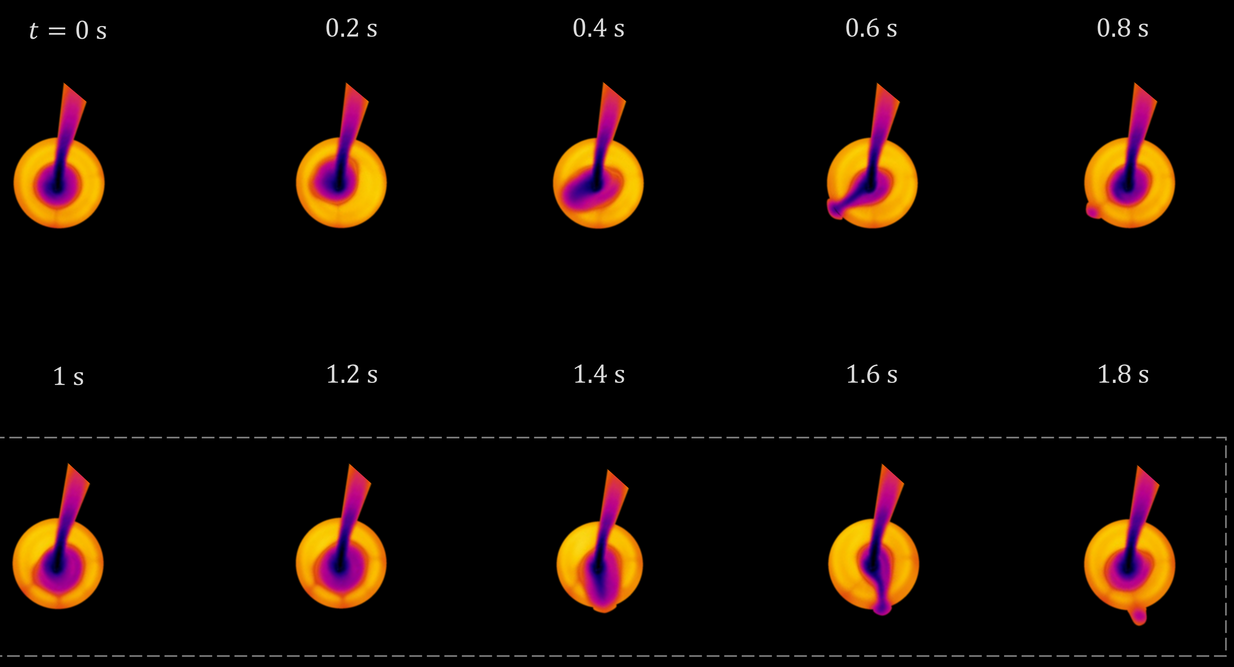




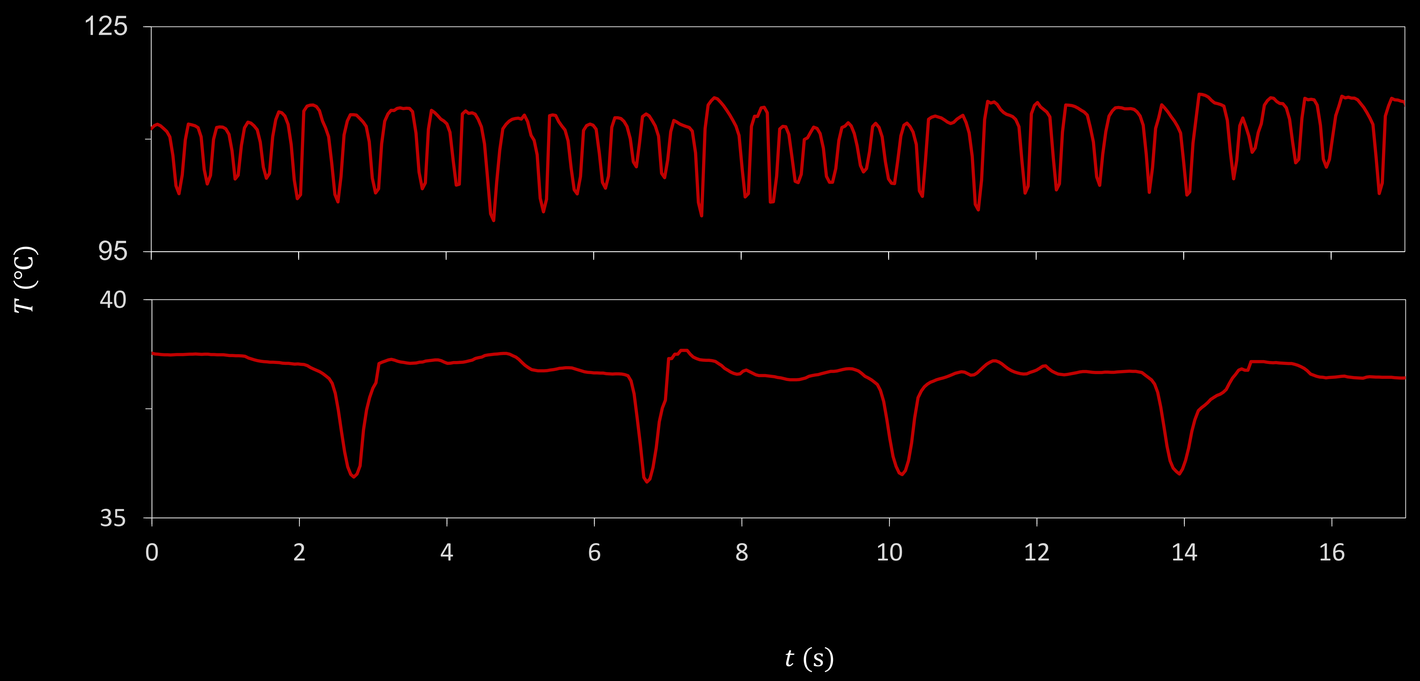
Injecting air into a liquid typically leads to the formation of ephemeral bubbles at the surface of the pool. Here we show that bubbles at the surface can, however, survive for tens of minutes or longer in a pure yet hot silicone oil. Top-down infrared visualization reveals that the bubble's "North Pole" is ~ 10 °C colder than the "Equator." This temperature differential generates a surface tension gradient driving a Marangoni flow upwards that opposes gravitational drainage and thus stabilizes the bubble. The drawn liquid accumulating transiently at the top can be seen flowing down the side of the bubble as a cold blue Marangoni "river."

However, touching the bubble with a thin wire atop transforms the continuous "river" into discrete drips: oil accumulates as a meniscus around the wire, until it becomes too heavy to be held by capillarity, when it falls as a "teardrop" or drip into the bulk bath. With every drip, the mean bubble temperature fluctuates with a period that corresponds to the time taken by oil to climb, thus leaving a signature of the Marangoni flows on the temperature-time plot as –

the "heartbeat" of Marangoni bubbles.



Marangoni drip



Marangoni 'heartbeat'