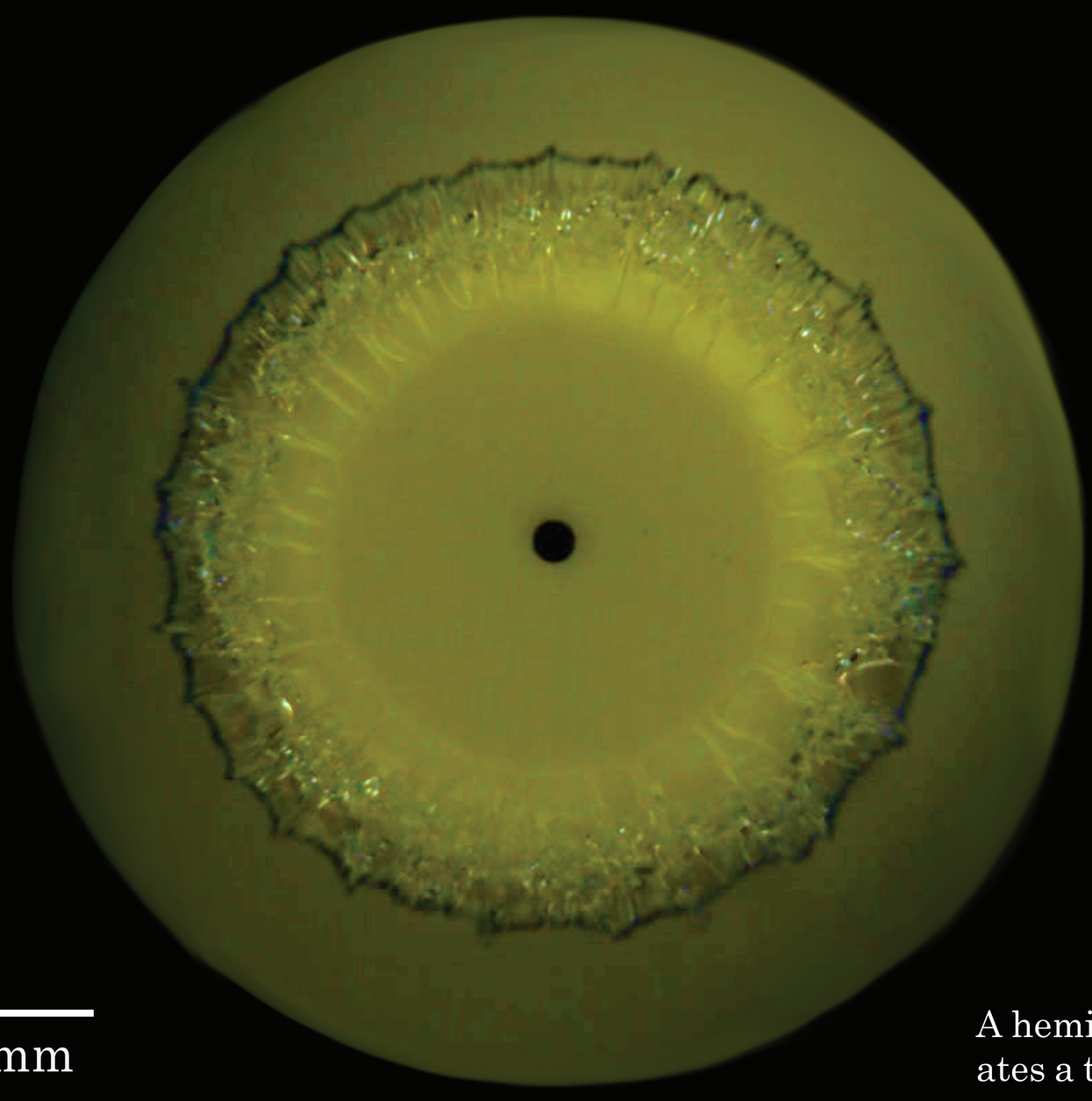
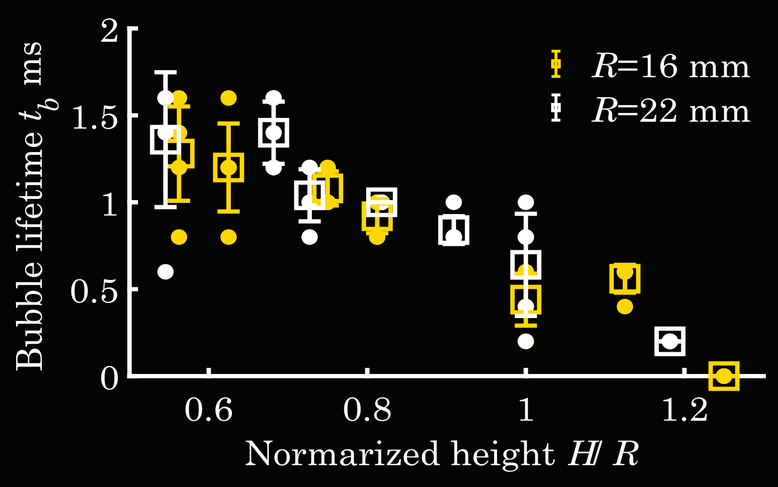
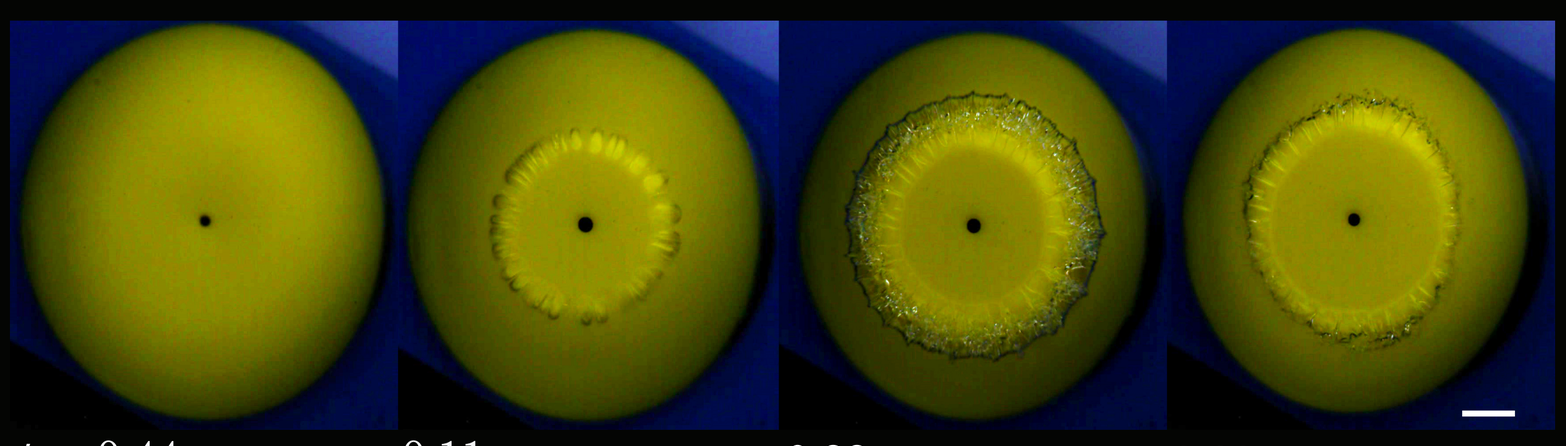
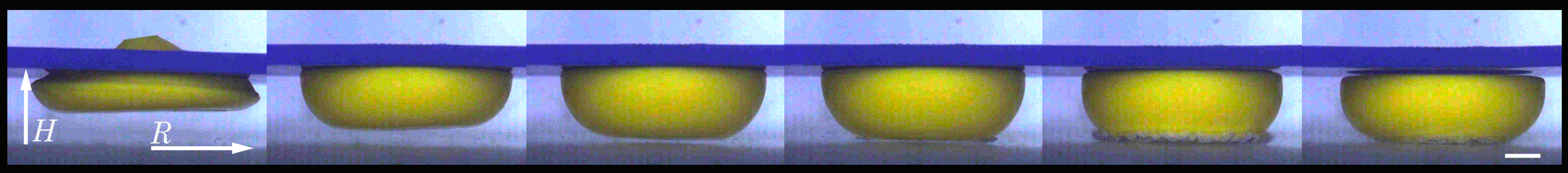
“Pop” Goes the Toroidal Bubble



A hemispherical rubber popper creates a toroidal bubble in 50wt% water-grycerol solution. This image was filmed at t = 0.33 ms after the cavitation onset from the bottom. Sawtooth texture on the interface develops from a popper surface and ends up forming a non-uniform texture on the outer rim.







Side-view images show the cavitation formation process, where the initially inverted popper (t = -6.00 ms) flips downward and nucleates a cavitation in a thin fluid gap beneath the popper surface at t = 0. The bubble is created and stretched radially outward (see t = 0.07 ms and later ones). Bottom-view images show that the popper maintains a partially inverted shape while forming several discretized caviation bubbles (t = 0.11 ms) that lead to one giant toroidal bubble (t = 0.33 & 0.89 ms). It reveals that this toroidal cavitation is a unique form of the attached cavitation occuring on a curved popper surface due to the fast squeezed flow in a thin fluid film. The overall lifetime of a bubble, t_b, is governed by both the initial distance between the popper platform and the substrate, H, and the popper radius, R, as shown in the plot.

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