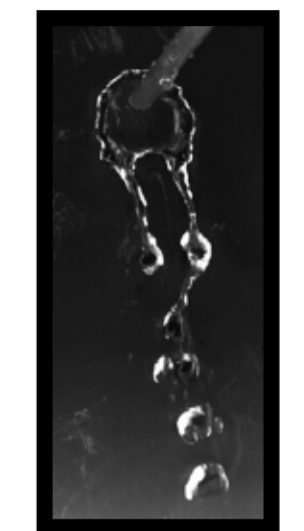


# Hydrophobic jump

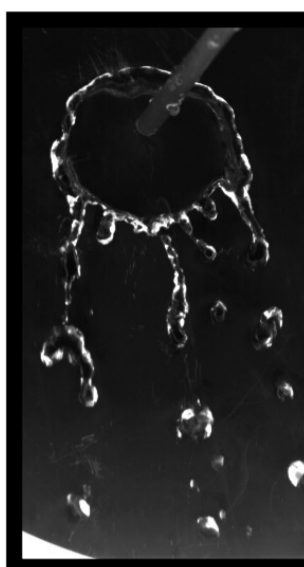


Flow rate  $Q$   
( $\text{cm}^3\text{s}^{-1}$ )

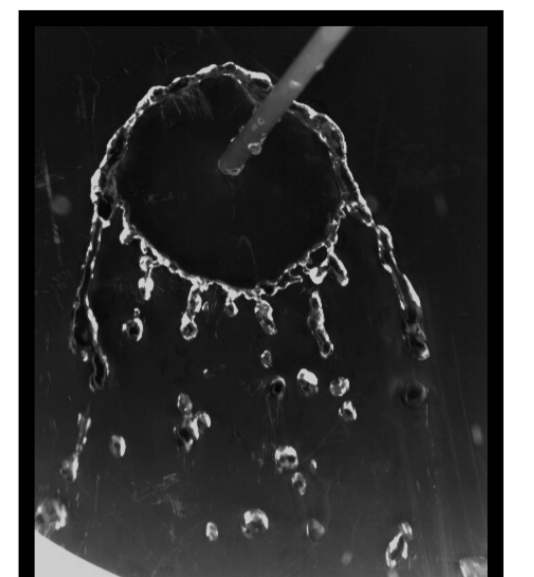
11.9



20.3



28.8



37.2

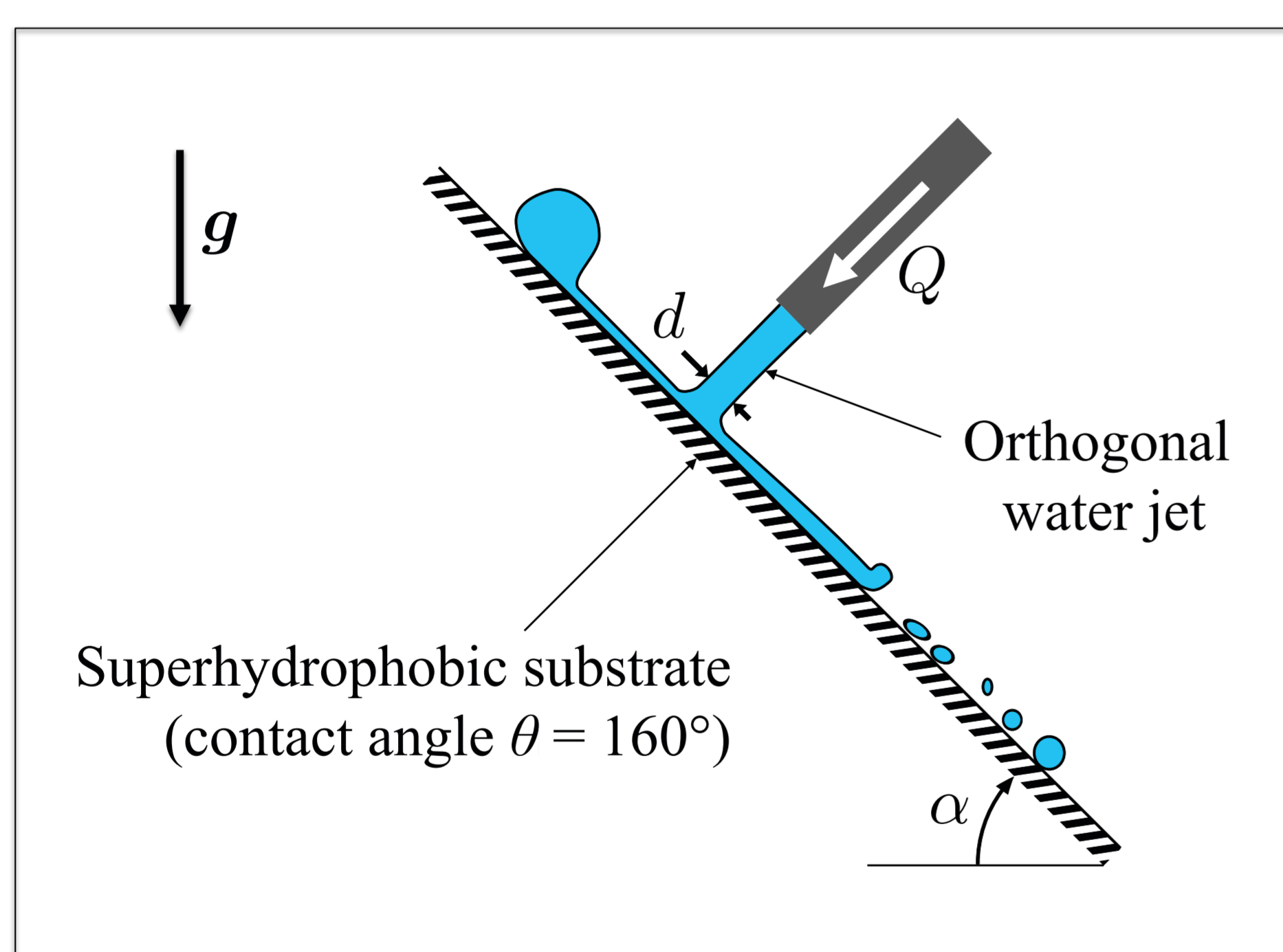


47.8



**Orthogonal impact of a water jet onto a superhydrophobic incline.** The water spreads radially in the form of a sheet, until it ‘jumps’ and collects in a rim. The lowest part of this rim (foreground) is Rayleigh-Taylor unstable: the water locally evacuates through small jets and fragments in droplets. The highest part of the rim (background) is stable: the water drains along the rim and evacuates through two rivulets on the sides. The sheet horizontal radius is  $R = 40$  mm ( $d = 4$  mm,  $Q = 41.4$   $\text{cm}^3\text{s}^{-1}$ ,  $\alpha = 35^\circ$ , see schematic below).

For increasing flow rates, both  $R$  and the number of jets increase ( $d = 4$  mm,  $\alpha = 70^\circ$ ).

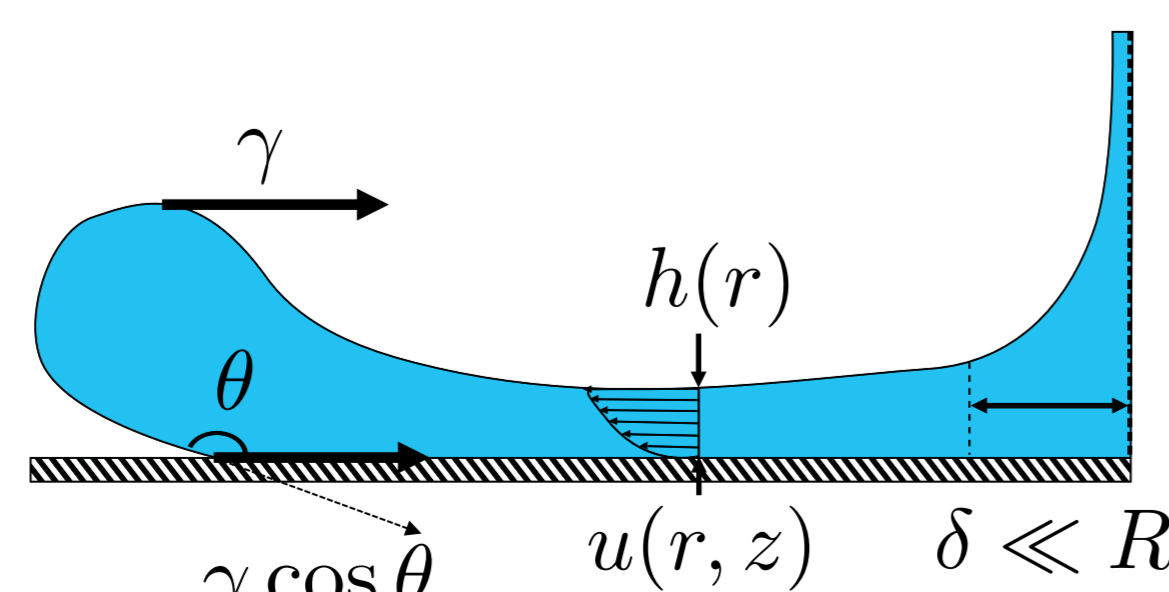
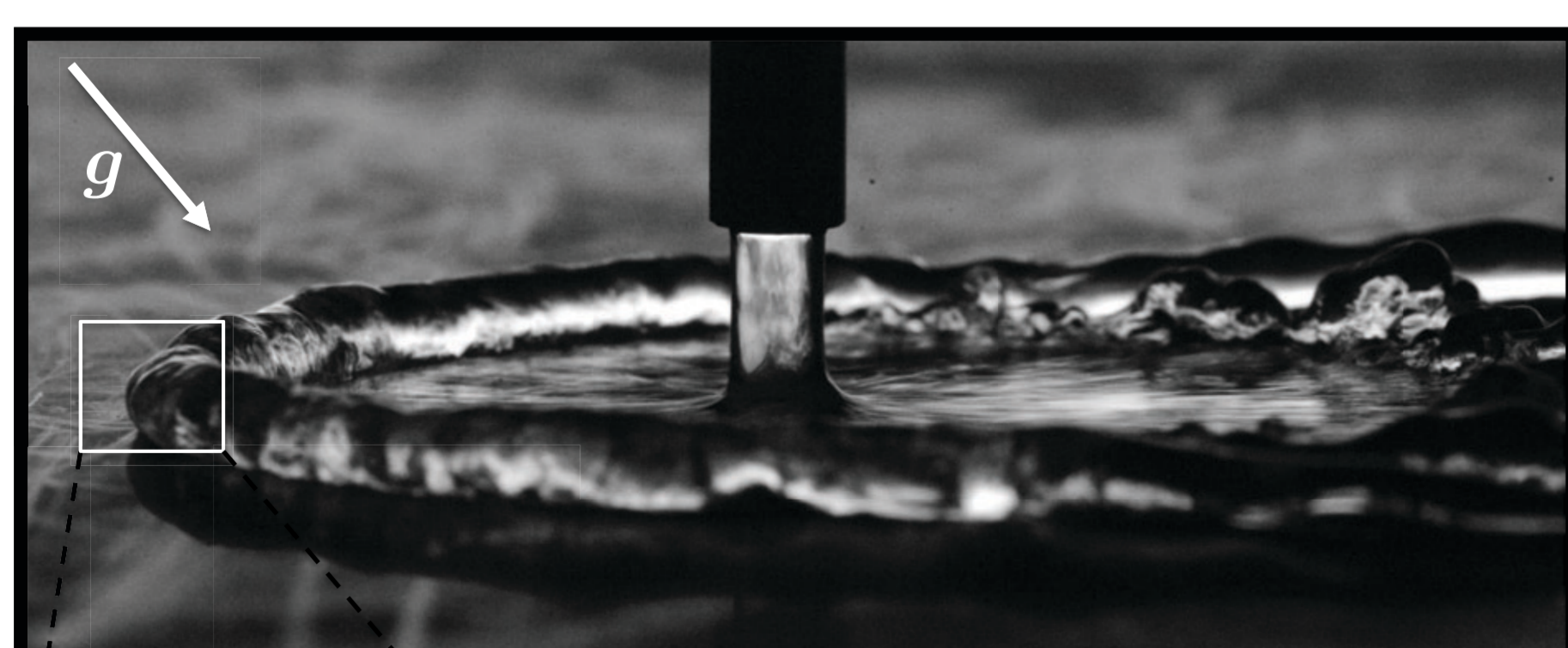


At impact onto a plate, a liquid jet deforms into a thin liquid sheet which flows along the plate. At some distance from the impact point, the flow undergoes a sharp transition, or ‘jump’, where the liquid slows down and the sheet thickens over a short distance.

When the impacted plate is inclined from the horizontal and superhydrophobic, this ‘jump’ can localize at the edge of the sheet. It takes the form of a rim, as observed at the edge of freely suspended sheets (Savart sheets).

As detailed below, the radius of the ‘jump’ can be understood by considering not only the viscous friction on the plate (as for the ‘classical’ hydraulic-jump) but also the capillary-inertial balance at the edge (as for the Savart sheet). The fate of the liquid which is collected in the rim depends on the direction of the flow with respect to the direction of gravity, as illustrated in the main figure above.

[Limat & al, APS-DFD 2013]



For  $d = 2$  mm, a half-Poiseuille flow establishes over a radius  $\delta \ll R$  and gravity is negligible in the horizontal direction. Viscous friction on the plate and mass conservation prescribe the radial momentum flux in the sheet  $\rho \langle u^2 \rangle h$ . The flow stops at the radius where this flux is balanced by capillarity, i.e.

$$\rho \langle u^2 \rangle h = \gamma(1 - \cos \theta),$$

hence the sheet horizontal radius

$$R = \left[ \frac{9}{50\pi^3} \frac{\rho Q^3}{\nu \gamma (1 - \cos \theta)} \right]^{1/4},$$

where  $\rho$ ,  $\nu$  and  $\gamma$  respectively stand for the density, kinematic viscosity and surface tension of the liquid.

$R(Q)$ : measurements vs model

