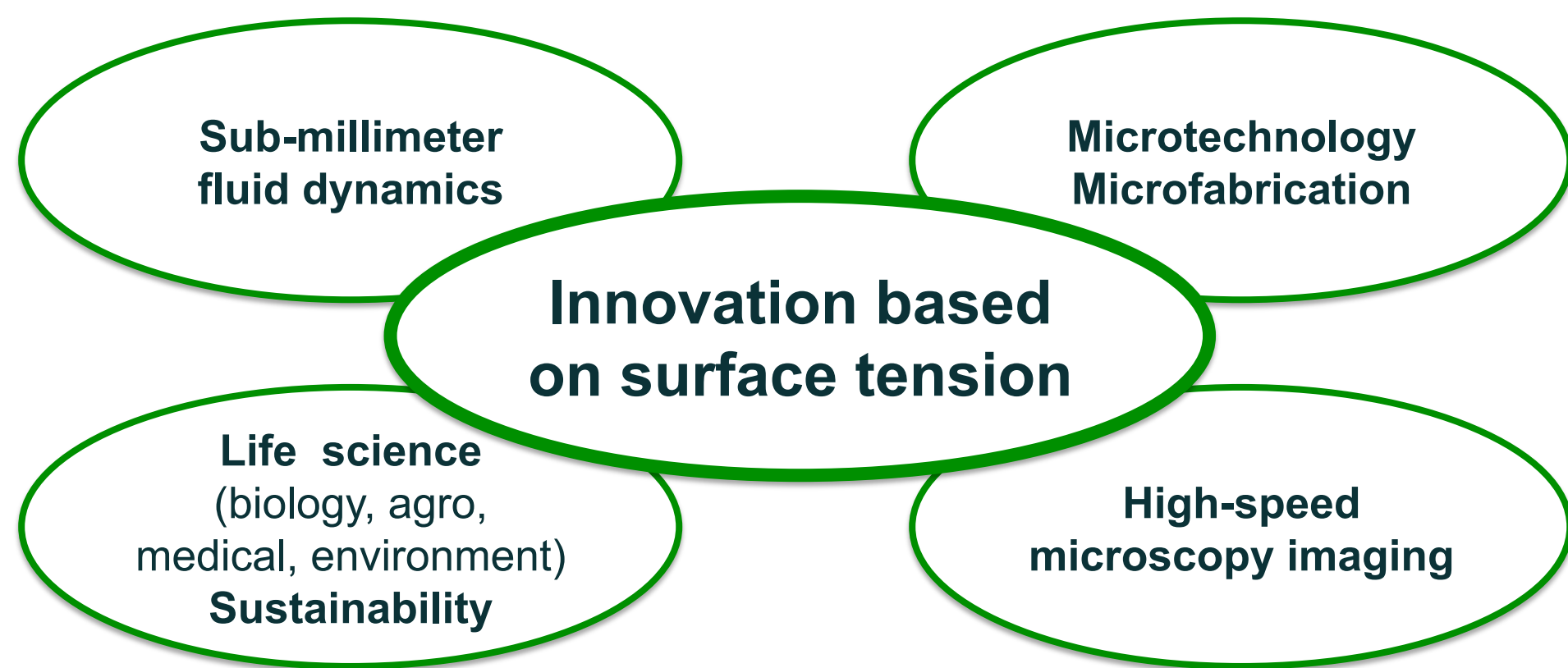


MICROFLUIDICS LAB

Research focus



How does small scale fluid motion affect our lives ?
How could we engineer at this scale ?

Drop impacts

Superhydrophobicity

Applications: Self-cleaning, drag reduction, underwater breathing

Principle: Microstructures + coating → air trapped



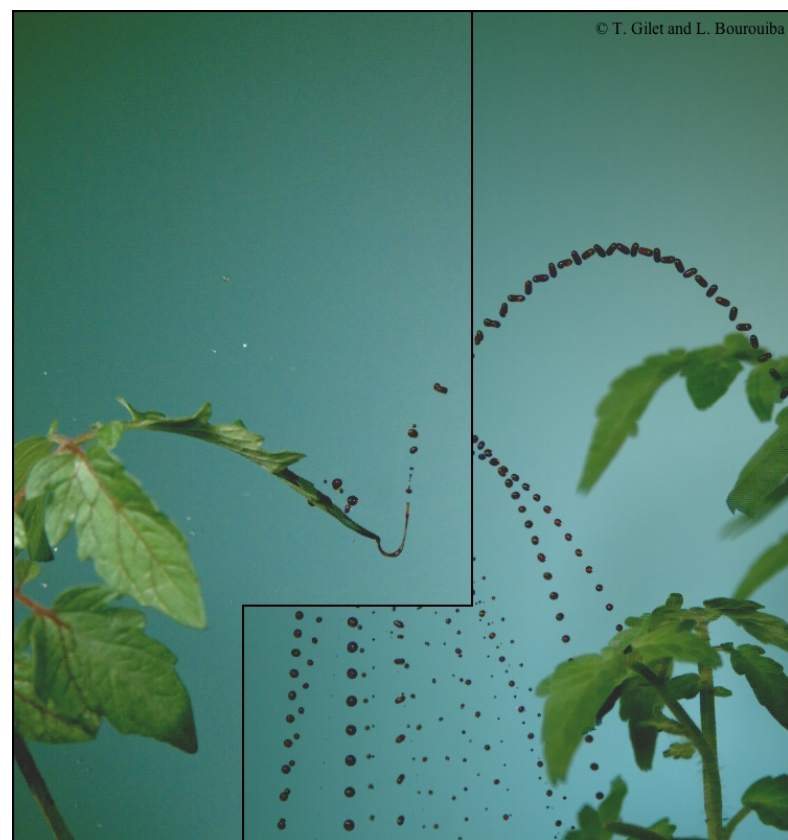
Superhydrophobic Salvinia leaves



Liquid break-up



Stalagmite growth



Leaf biomechanics shapes disease dispersal

Cave formation

Goal: Stalagmite shape → paleoclimate

Application: Groundwater management

Principle: Splashing drop

→ calcite deposition → growth rate

Liquid break-up vs. plant biomechanics

Application: Disease spreading in agriculture

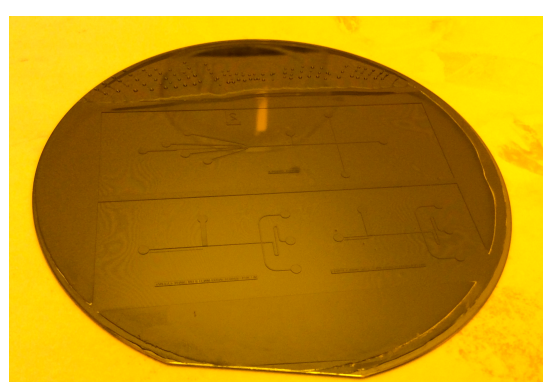
Principle: Raindrops impact leaves

→ ejected droplets disperse foliar pathogens

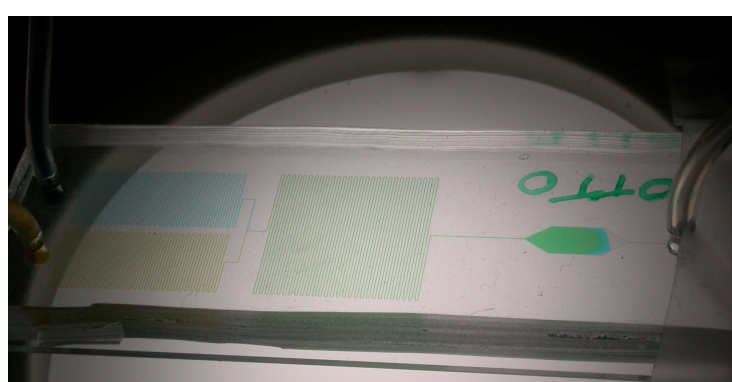
Microfluidics

Goal: miniaturize and automate fluid handling, e.g. in bioassays

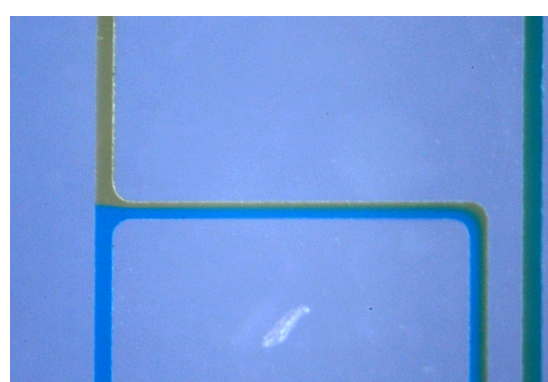
Applications: diagnostics, drug discovery, cancer research, neonatology



Master in photoresist on wafer



Microfluidic mixer

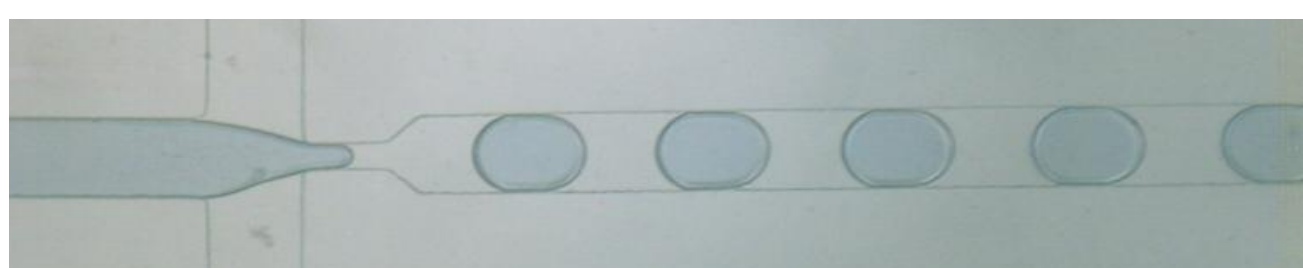


Laminar mixing

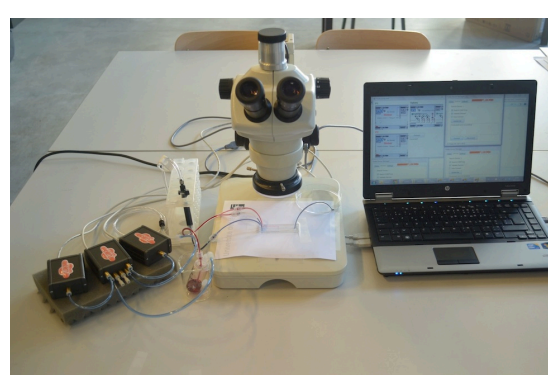
Principle: Off-chip active pumping OR on-chip passive capillary pumping

Droplets = conveyors & micro-reactors (content = e.g. chemicals, living cells)

Microchannel **networks** → Traffic control



Droplet production in microchannels



Microchip interfacing

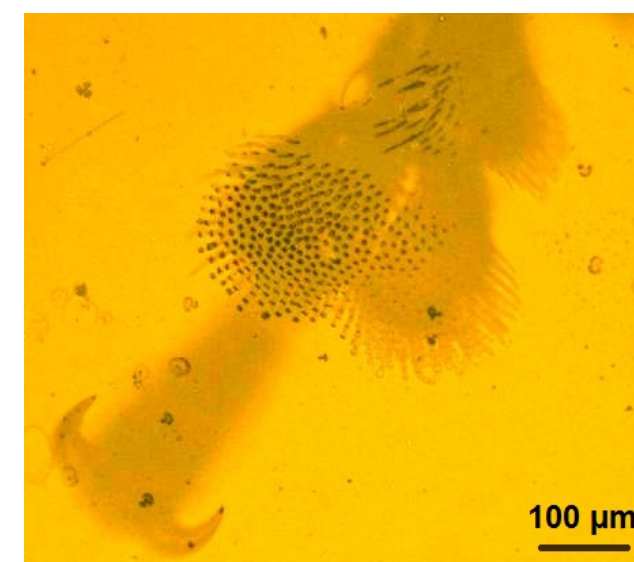
Bio-inspired adhesion

Applications: Prehension in micro-robotics. Passive liquid dispensing.

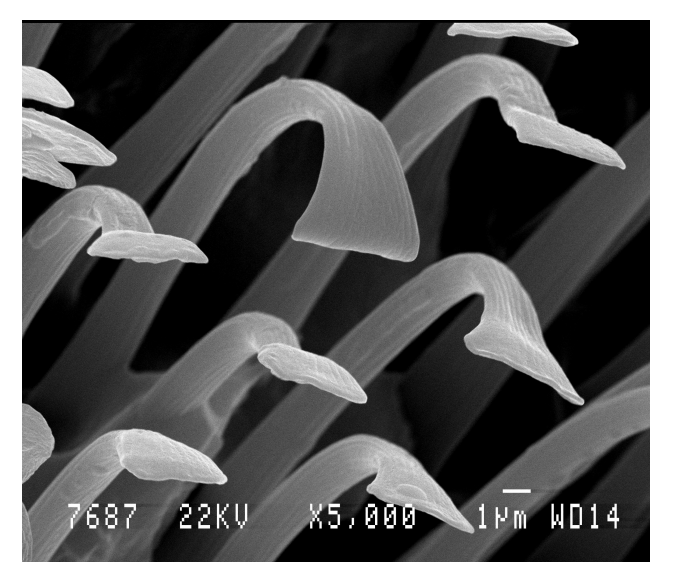
Principle: Hexapod walking → feet covered with micron-scaled hairs (setae). Adhesion provided by liquid bridge at their tip.



Beetle walking on a smooth glass plate – setae and liquid footprints



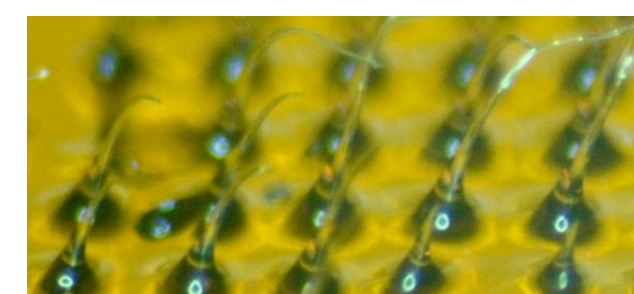
Bioinspired microhairs



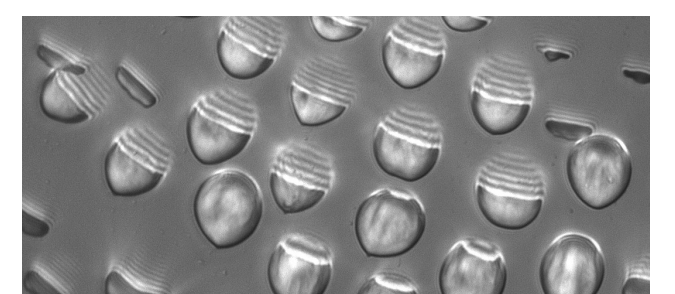
Seta tips by SEM imaging



Tracked beetle kinematics



Various tip geometry → mechanics



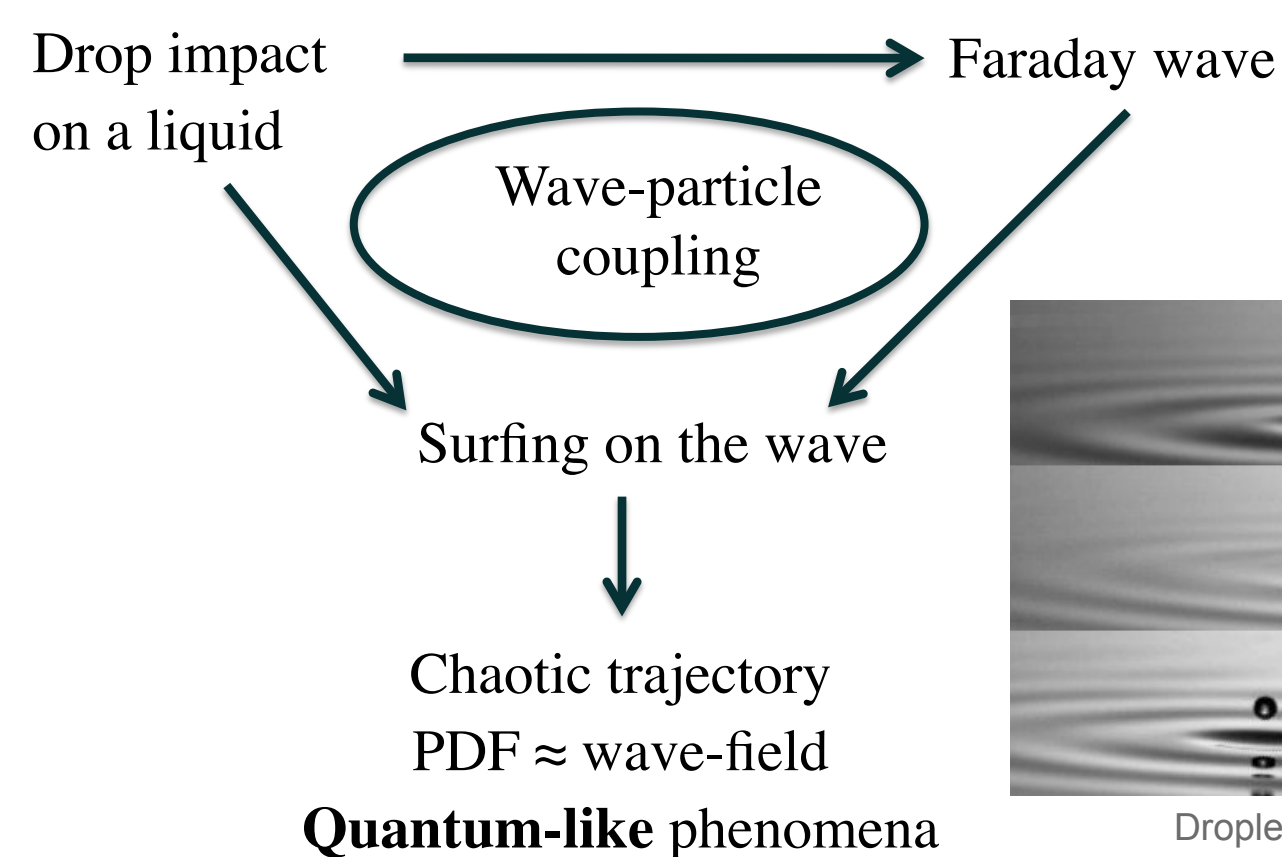
Various tip geometry → mechanics

Vibration-induced drop motion

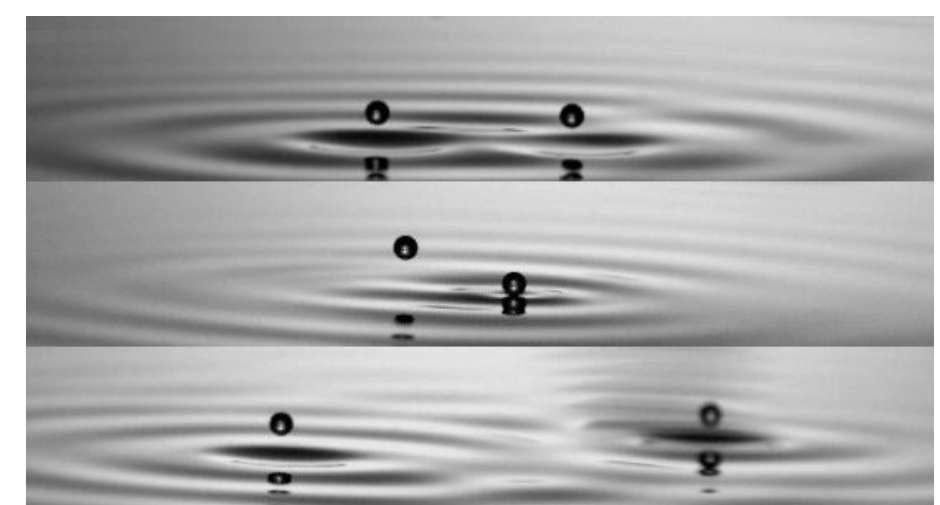
Goal: Macroscopic analog of quantum mechanics

Application: Philosophy of science

Principle: Self-propulsion of bouncing droplets on a vibrated bath



Faraday (capillary) waves



Droplets surfing on Faraday waves

Resources

Methodology & expertise

- Bioinspired microstructures (Length scale $\sim 30\mu\text{m}$) → microfabrication
- High-speed imaging, light microscopy → image processing, motion analysis
- Modeling: scaling laws, lumped-elements → design rules

Researchers

Master's thesis
Research Eng.
PhD students
Post-docs

Assistant professor
Alumni

(Jan. 2016)

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Loïc Tadrist (PhD Polytechnique Paris)
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Matthias Mayser (PhD U. Bonn)

Main collaborations

- ULg: GRASP, ARC Quandrops, MicroSys, GIGA cancer, CHR neonatology, CIP, Funct. & Evol. Morph. Lab.
- ULB: Pierre Lambert → IAP microMAST
- MIT: Lydia Bourouiba, John W.M. Bush
- U. Cambridge: Walter Federle
- Companies: Unisensor, M4KE.IT

Note: All the pictures on this poster have been taken by group members.