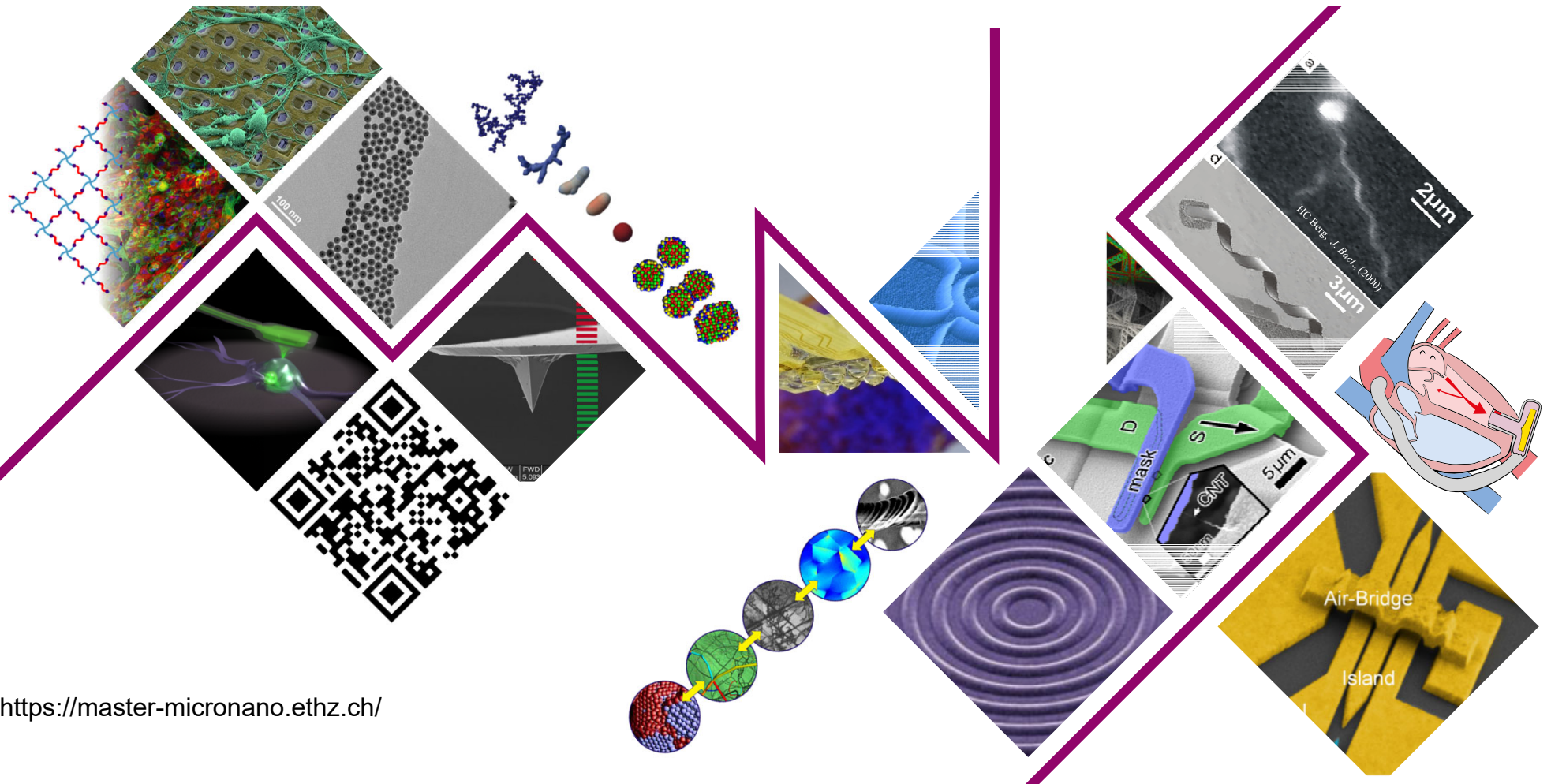


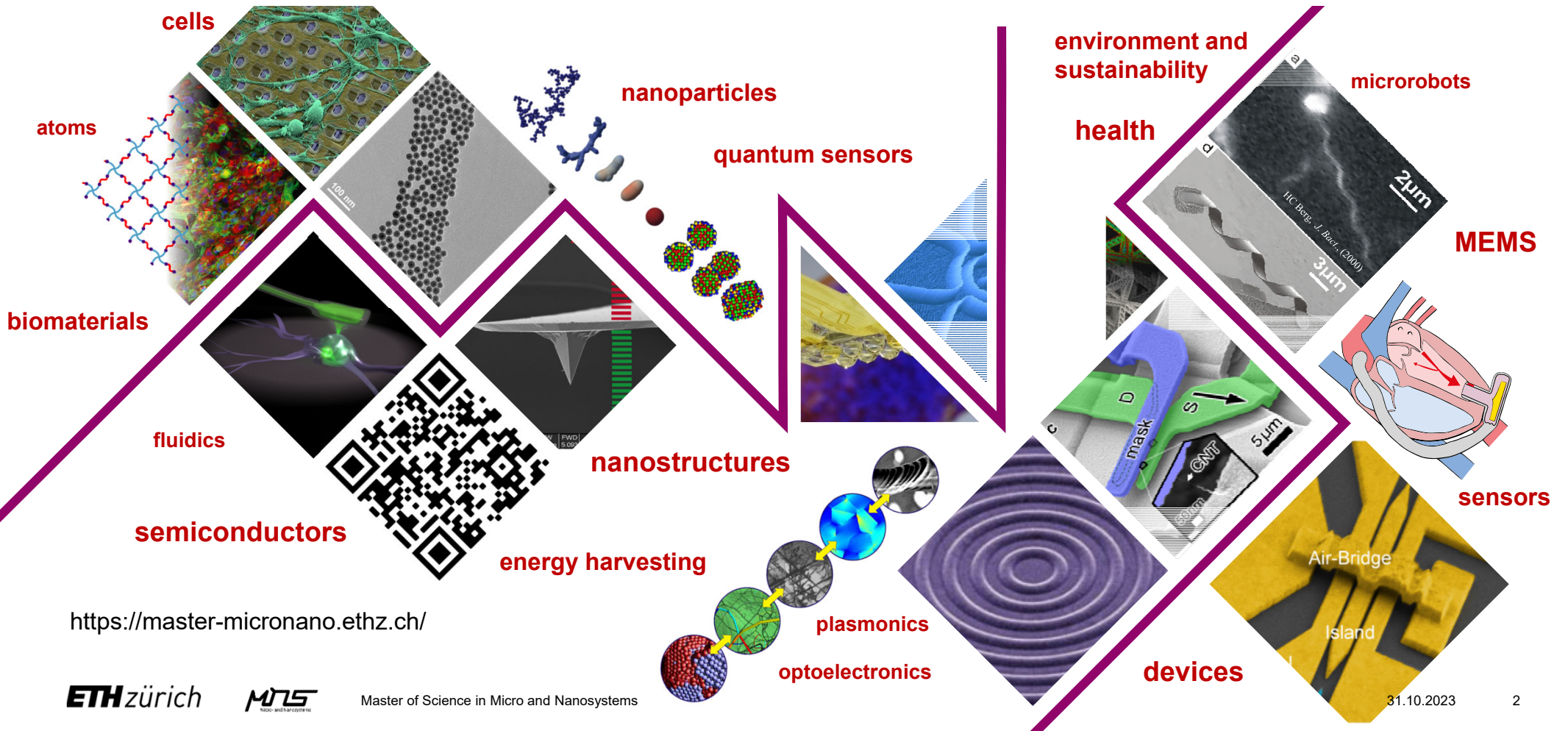
# MSc in Micro and Nanosystems

From what you can't see ..... to what you can touch.



# MSc in Micro and Nanosystems

From what you can't see ..... to what you can touch.



<https://master-micronano.ethz.ch/>

# Tutors in Micro and Nanosystems

- D-MAVT

- Daniel Ahmed
- Andreas Güntner
- Christofer Hierold
- Dennis Kochmann
- Brad Nelson
- David Norris
- Salvador Pané i Vidal
- Sotiris Pratsinis
- Romain Quidant
- Thomas Schutzius
- Mark Tibbitt



- D-ITET

- Jürg Leuthold
- Mathieu Luisier
- Janos Vörös
- Vanessa Wood

- D-PHYS

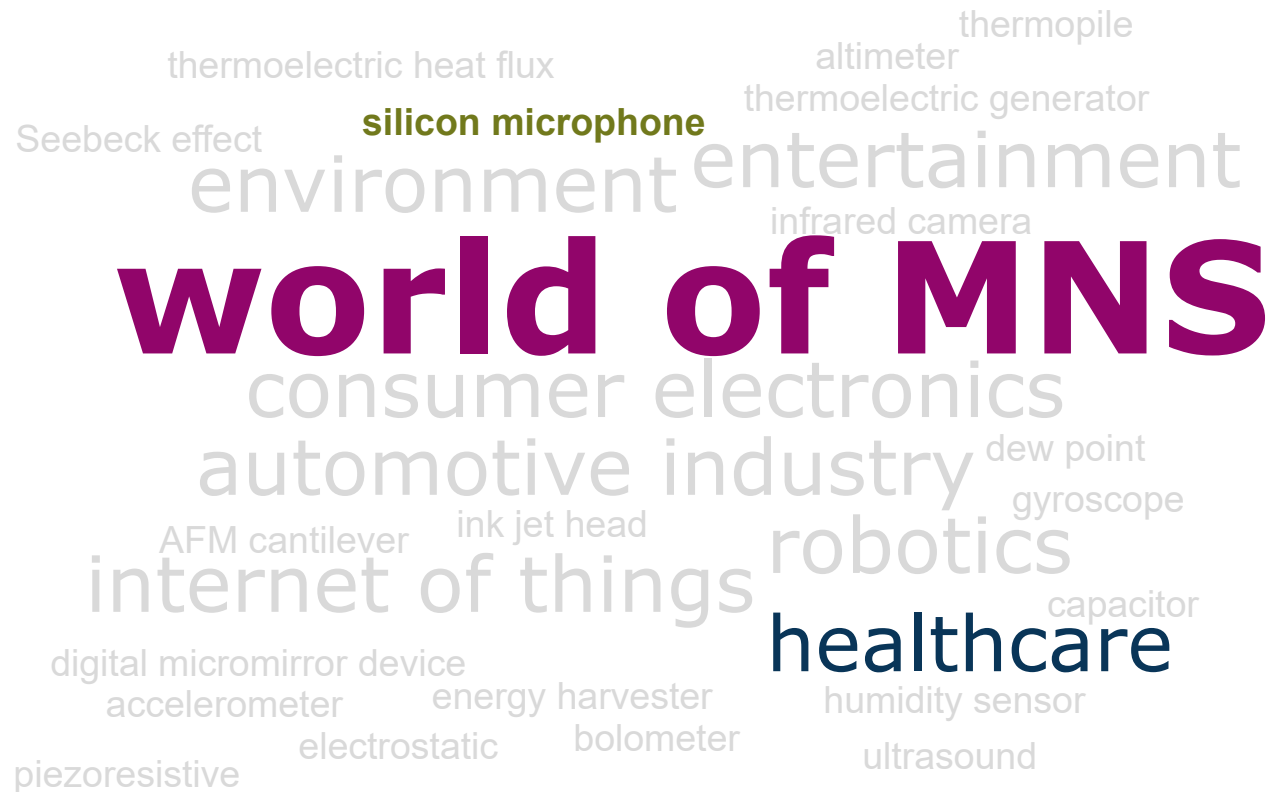
- Klaus Ensslin
- Thomas Ihn

- D-BSSE

- Andreas Hierlemann

# The world of MNS

Micro and Nanosystems are all around us





# The world of MNS

## MNS in Healthcare -- Digital Twins for Predicting Disease Progression

Edge AI-deployed DIGItal Twins for  
PREDICTing disease progression  
and need for early intervention in  
infectious and cardiovascular  
diseases beyond COVID-19

**Micro and Nanosystems enable the  
collection of data, i.e. digital biomarkers,  
to correlate the status of individuals or  
patients with their health conditions.**

The project combines the latest advances in  
digital biomarkers, organ-on-chip (OoC) and  
artificial intelligence at the edge, and aims to  
build a new interdisciplinary community in Europe  
focused on digital twins.



*Two weeks after its launching the  
European Commission published an  
article to present the project*

[» Read the article](#)

<https://www.digipredict.eu/>

# The world of MNS

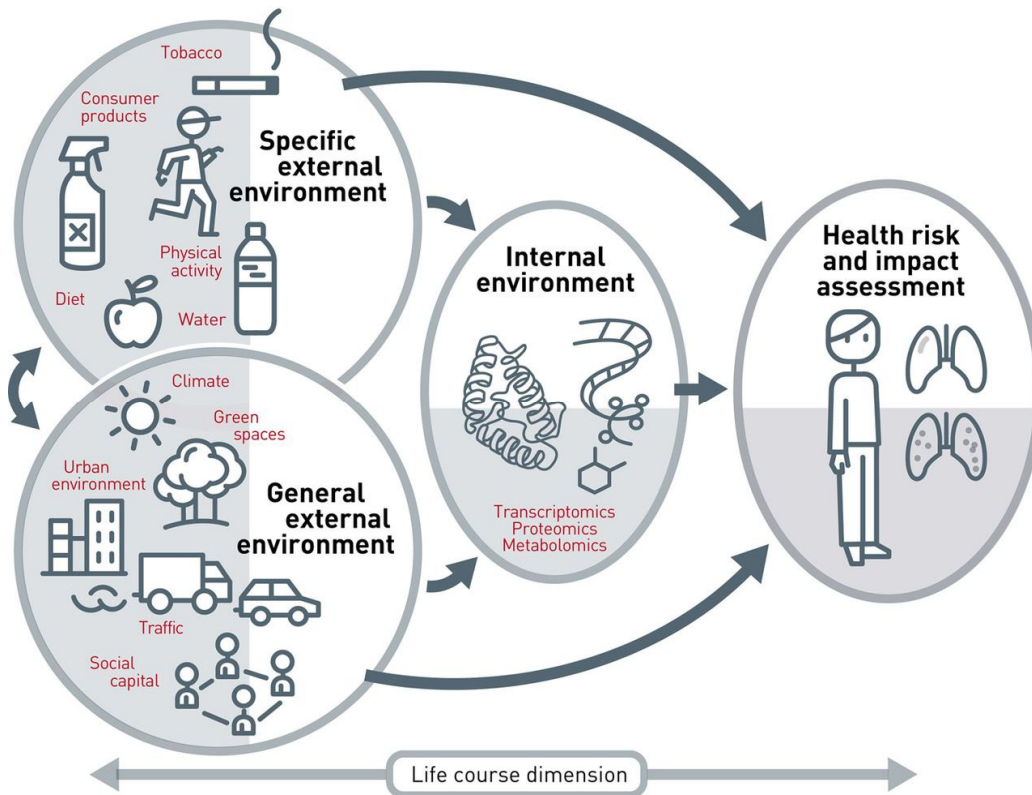
## MNS in Healthcare -- The 'Exposome' Concept

“each individual has a unique disease process different from any other individual (“the unique disease principle”)”

‘Exposome’ ≈ the totality of human environmental (meaning all non-genetic) exposures

**Micro and nanosystems enable**

- (1) accurate and reliable measurement of many exposures in the *external environment***
- (2) measurement of a wide range of biological responses in the *internal environment***
- (3) addressing the dynamic, life course nature of the Exposome**



# The world of MNS

## MNS in Healthcare -- Wearable Electronics

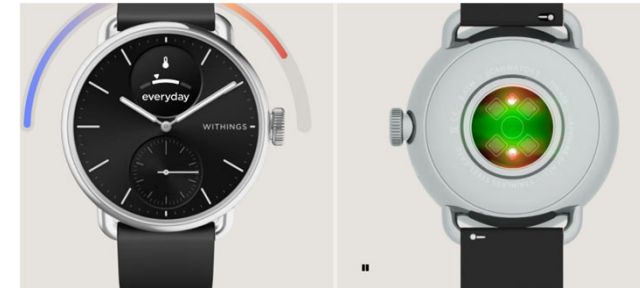


**Smart watches** and smart wrist bands keep track of our activities and can monitor physiological and environmental properties.

**Accelerometers** can track the physical motion.  
**Thermoelectric heat flux sensors** measure core body temperature.



© PulseOn

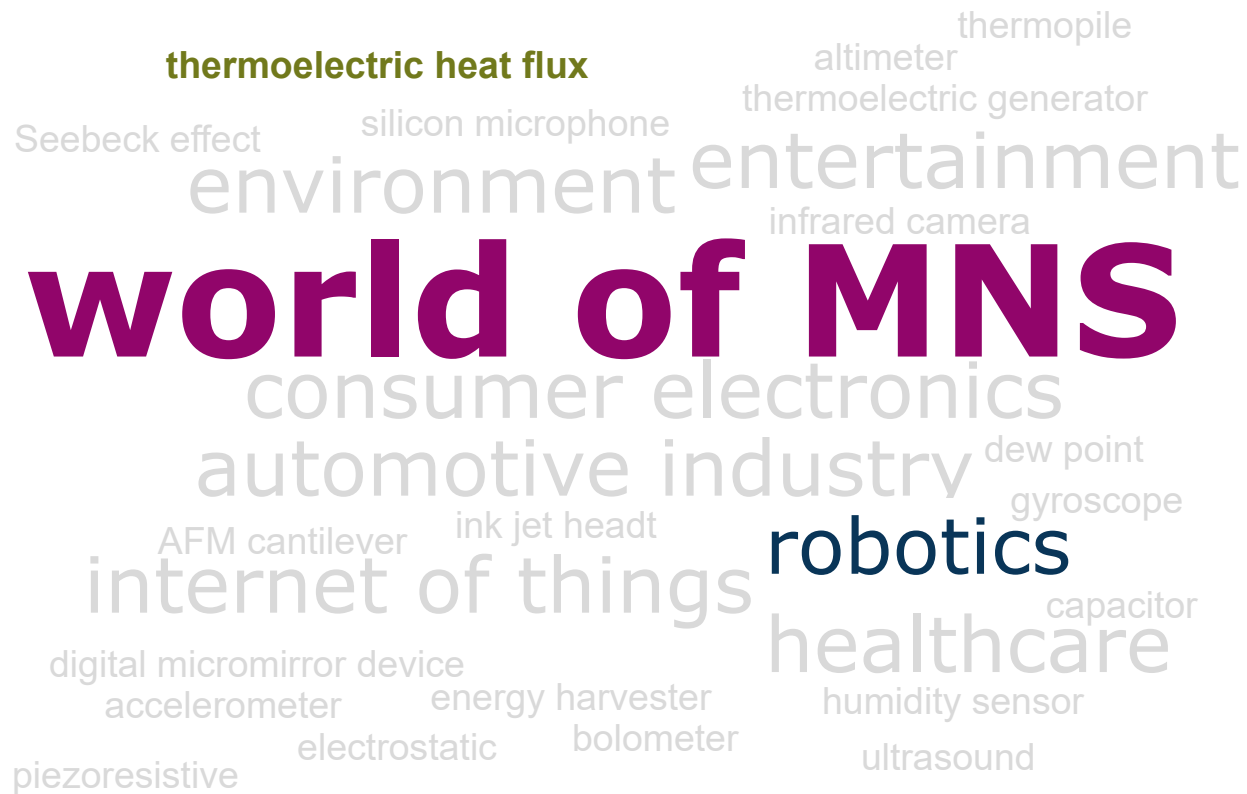


spinoff 

 greenTEG

# The world of MNS

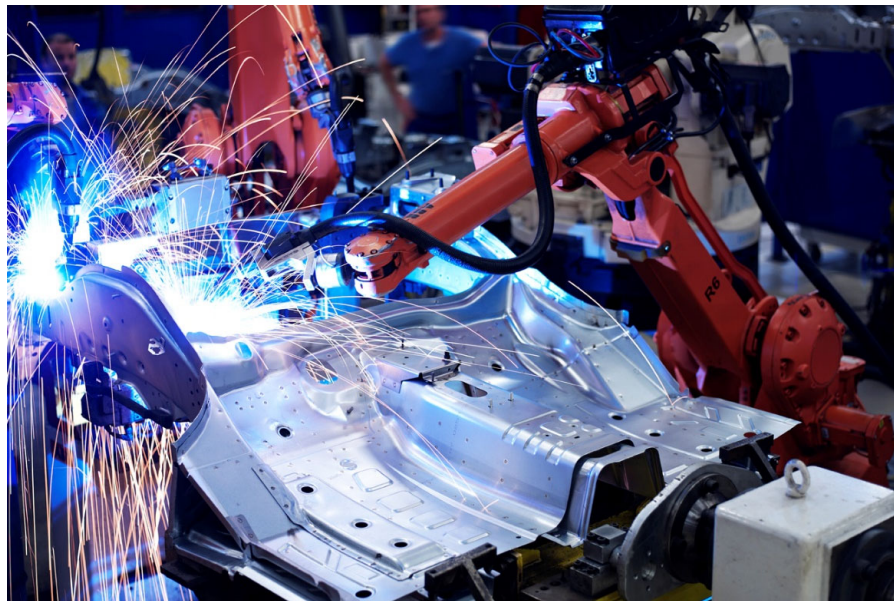
Micro and Nanosystems are all around us





# The world of MNS

## MNS in Robotics – Heat Flux Sensors



**Robotic laser welding** enables joining an extended range of materials with high quality and low weld footprint.

**Thermoelectric heat flux sensors** measure laser power, enabling more reliable operation.



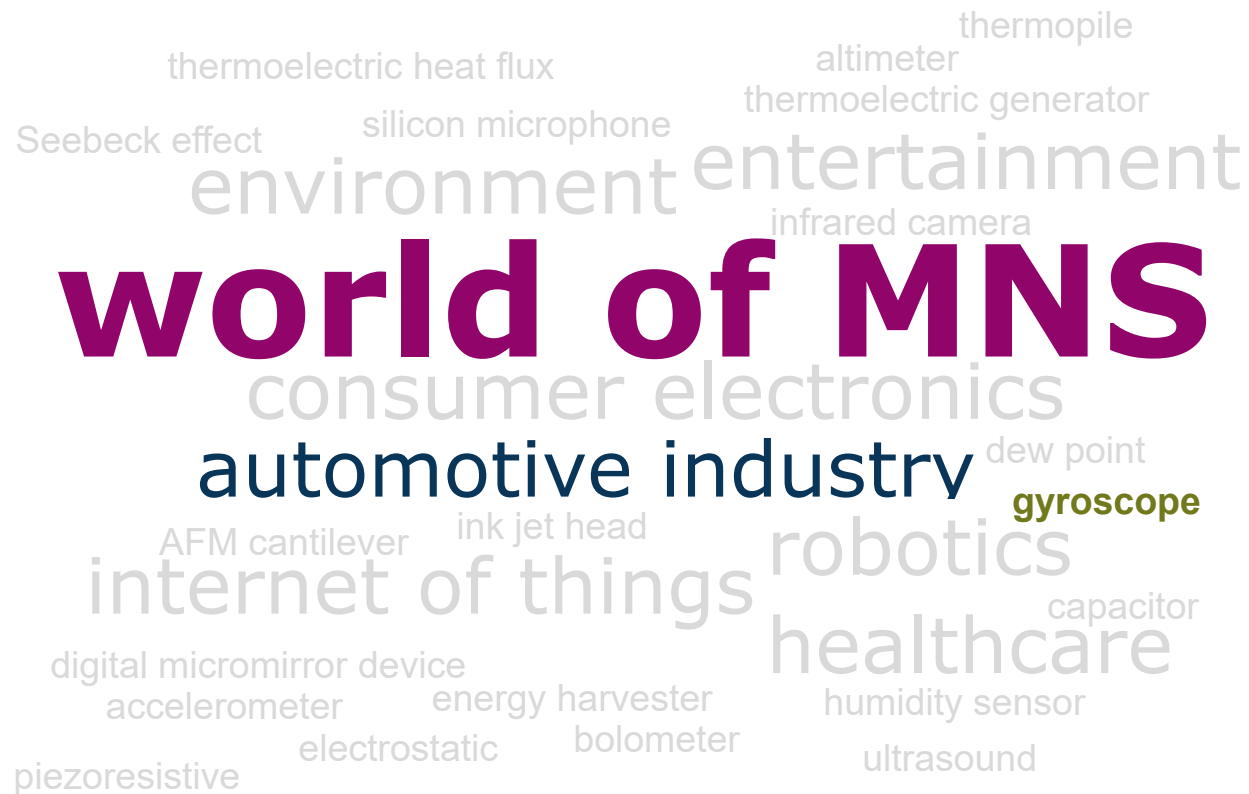
spinoff 

 greenTEG

greenTEG gRAY Laser Power Detector Series

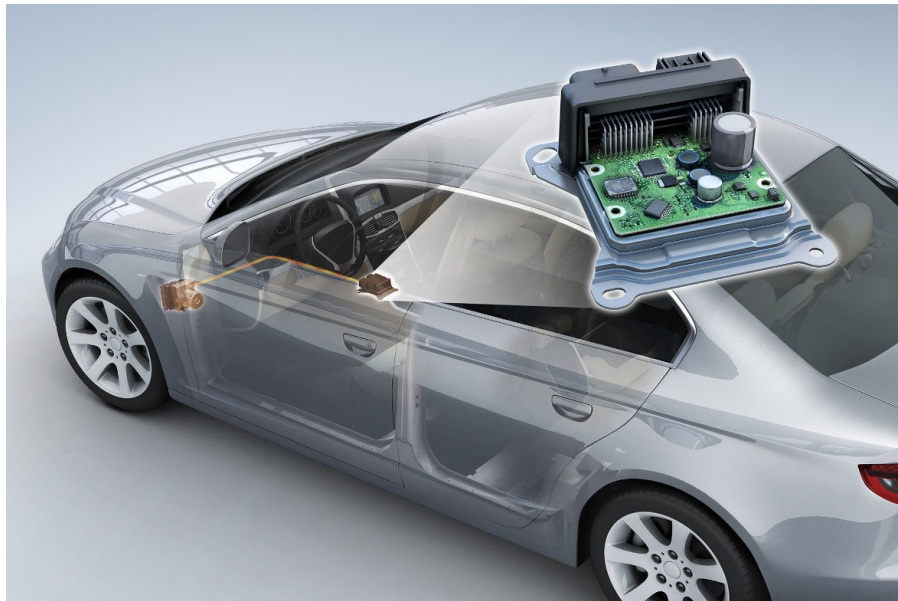
# The world of MNS

Micro and Nanosystems are all around us



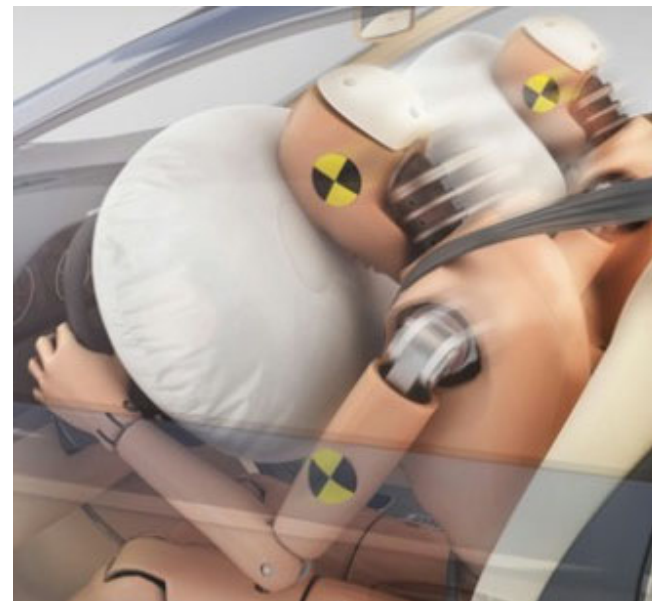
# The world of MNS

## MNS in Automotive Industry - Gyroscope



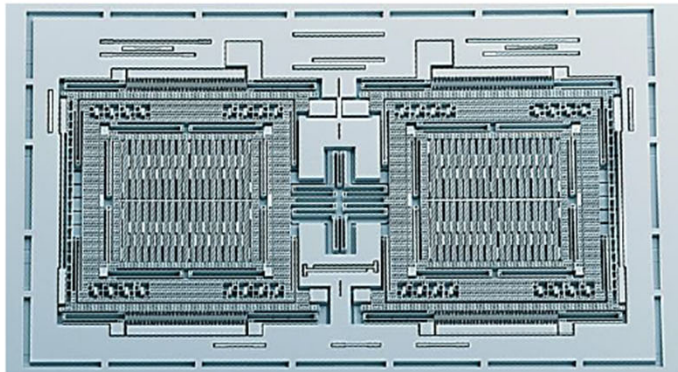
**Airbag control systems** combine multiple sensor devices to predict accidents and significantly increase passenger safety.

**Micromachined gyroscopes** and accelerometers are key elements in airbag control systems.



# Technology at the Edge in Everyday Sensors (Gyroscope) High Precision in MEMS Processing

Free floating MEMS structure



Gap structure to substrate:  $1.6\mu\text{m} \pm 11\text{nm}$

Structure thickness:  $20\mu\text{m} \pm 150\text{nm}$

Free floating steel-plate over lawn



Gap plate to lawn:  $10\text{cm} \pm 0.7\text{mm}$

Structure thickness:  $1.25\text{m}$

corresponding  
steel plate over  
stadium play ground



# The Case for a Specialized Master in Micro and Nanosystems

- Be prepared for the ever-changing academic and industrial landscape by an **transdisciplinary education**.
- Have access to a broad and interconnected spectrum of research areas.
- **Study together with other highly qualified students with similar interests and varying backgrounds**

# Student commission Micro- and Nanosystems (MNS@AMIV)

What we do?

- ❖ **Apéros** to connect MNS students & researchers
- ❖ **Social events** for prospective & current students
- ❖ **Steady virtual exchange** about academics & industry



- ❖ Like to get involved and plan events?
  - ❖ Want to connect with MNS students?
  - ❖ Have questions or looking for advice?
- **Contact us!** [mns@amiv.ethz.ch](mailto:mns@amiv.ethz.ch)



Daniel Reperant

# Excursions

- **2011, 2015, 2018, 2021 Sensirion**, Stäfa: Pressure and flow sensors, design, fabrication, shipping
- **2012 Kistler**, Winterthur: Sensor design, fabrication and characterization facility.
- **2013, 2023 (spring) ABB**, Lenzburg: Power semiconductors and wafer fabrication process.
- **2014 Siemens Building Technologies**, Zug: Building automation, security
- **2016 Sonova, Phonak**, Stäfa; Hearing aids
- **2017, 2019 Innovative Sensor Technology IST AG**, Ebnet-Kappel: Sensors
- **2022 greenTEG AG**, Rümlang; heat flux sensors
- **2023 Belimo AG**, Hinwil: Building automation

**SENSIRION**  
THE SENSOR COMPANY

**KISTLER**  
measure. analyze. innovate.

**SIEMENS** **ABB**  
**IST** **PHONAK**

 greenTEG

**BELIMO**



# Industry Support for the Master in Micro and Nanosystems

Companies supporting the master program:



Binnig and Rohrer Nanotechnology Center, the new nanoscience center of **IBM** and **ETH**

ETH  
Eidgenössische Technische Hochschule Zürich  
Swiss Federal Institute of Technology Zurich





# List of more than 100 Companies and Institutes for Internships (non exhaustive)

<https://micro.mavt.ethz.ch/the-group/open-positions/useful-links.html>



67%

## Looking for an internship?

Below you may find a list of Companies and Institutions in Switzerland, related to MEMS technology, which may offer internship opportunities. The same list, compiled thanks to a student project, is also available as a PivotTable in [Microsoft Excel file \(XLSX, 2 MB\)](#) ↓, that should make filtering operations easier for you. Please note that we do not claim this list to be complete, or take any responsibility for the content of the linked web pages.

### ABB

**Technology leader in many fields and platforms like robotics & discrete Automation, Electrification, Industrial Automatisation etc**

Semiconductors development and innovation, comprehensive range of products, systems

*Location:*

*ABB Ltd*

*Affolternstrasse 44*

*8050 Zürich*

<https://new.abb.com/semiconductors> ↗

Job offerings: <https://new.abb.com/ch/karriere> ↗

<https://micro.mavt.ethz.ch/the-group/open-positions/useful-links.html>

# The Case for a Specialized Master in Micro and Nanosystems

**Set yourself apart by a further and specialized education:**

- **Transdisciplinary education, team oriented**
- **Modern technology for innovations**
- **System integration and applications**

# Curriculum

| Category                            | ECTS      | Description  |
|-------------------------------------|-----------|--|
| <b>Core Courses</b>                 | <b>36</b> | <ul style="list-style-type: none"><li>• Foundation of the Master's Program</li><li>• Core knowledge in the area of interests</li></ul> |
| <b>Multidisciplinary Courses</b>    | <b>6</b>  | <ul style="list-style-type: none"><li>• Deepen degree-specific knowledge</li></ul>   |
| <b>Science in Perspective (SiP)</b> | <b>2</b>  | <ul style="list-style-type: none"><li>• Courses in humanities, social and political sciences offered by ETH</li></ul>                  |
| <b>Semester Project</b>             | <b>8</b>  | <ul style="list-style-type: none"><li>• Experience in the solution of a specific engineering problem</li></ul>                         |
| <b>Industrial Internship</b>        | <b>8</b>  | <ul style="list-style-type: none"><li>• 12-week internship in a company</li></ul>  |
| <b>Master's Thesis</b>              | <b>30</b> | <ul style="list-style-type: none"><li>• Independent scientific work</li></ul>  |

<http://www.mastermicronano.ethz.ch/>

# Tutor System and Learning Agreement

- The Master program is *tutor-driven*
- Each student is entitled to a tutor
- Tutor and student define an **individualized curriculum**
- Tutor coaches students in course planning, research, mobility, industrial training and monitors progress
- Changing the tutor is possible

## Prepare your Learning Agreement on the basis of your interests

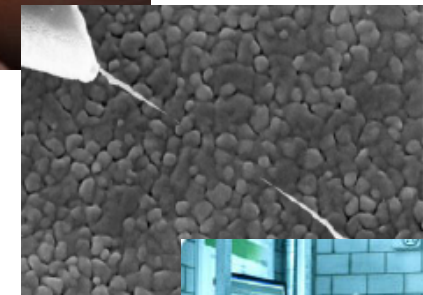
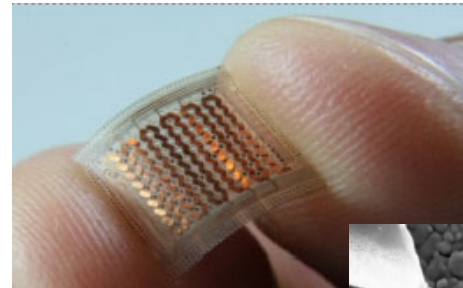
- Submission: within 3 weeks of the start of the semester
- **Updates:** possible with tutor's approval
- **Final version:** before starting the Master's Thesis

|   |  |   |     |                         |        |
|---|--|---|-----|-------------------------|--------|
| Programme regulations   | Master's Degree Programme in Mechanical Engineering  |   |     |                         |        |
| Tutor   | Prof. Dr. C. Onder   |   |     |                         |        |
| <b>Programme Information</b>  |  |   |     |                         |        |
| Together with the students, tutors define the courses in the category Core Courses.   |  |   |     |                         |        |
| The Learning Agreement must be submitted in myStudies and approved by the tutor within 3 weeks after the start of the semester. |  |   |     |                         |        |
| It can be updated during the study period. The final version must be submitted before enrolling in the Master's thesis.         |  |   |     |                         |        |
| Course  | <input type="radio"/> Not registered <input checked="" type="radio"/> Registered <input checked="" type="radio"/> Passed <input type="radio"/> Repetition failed <input type="radio"/> No more available |   |     |                         |        |
| Sem   | Semester A: Autumn Semester S: Spring Semester   |   |     |                         |        |
| Completion of mandatory courses   | Declare how mandatory courses will be or have been completed: Yes: In this programme Bachelor: In the Bachelor or another ETH prog courses   |   |     |                         |        |
| Not regular   | Category assignment differs from that in the Course Catalogue.   |   |     |                         |        |
| Changes   | New: Newly added, Moved: Moved to another category, Modified: Text modified, for external course units only.   |   |     |                         |        |
| Category  |  |   |     |                         |        |
|   | Number   | Course Title  | Sem | ECTS credits<br>Planned | Needed |
| <b>Core Courses</b>   |  |   |     | 36                      | 36     |
|   | 151-1115-00L   | <input checked="" type="radio"/> Aircraft Aerodynamics and Flight Mechanics                         | S   | 4                       |        |
|   | 151-0854-00L   | <input checked="" type="radio"/> Autonomous Mobile Robots   | S   | 5                       |        |
|   | 227-0124-00L   | <input checked="" type="radio"/> Embedded Systems   | A   | 6                       |        |
|   | 151-0567-00L   | <input checked="" type="radio"/> Engine Systems   | A   | 4                       |        |
|   | 151-0623-00L   | <input checked="" type="radio"/> ETH Zurich Distinguished Seminar in Robotics, Systems and Controls | A   | 1                       |        |
|   | 151-1116-00L   | <input checked="" type="radio"/> Introduction to Aircraft and Car Aerodynamics                      | A   | 4                       |        |
|   | 151-0310-00L   | <input checked="" type="radio"/> Nonlinear Model Predictive Control of Mechatronic Systems          | S   | 4                       |        |
|   | 151-0573-00L   | <input checked="" type="radio"/> System Modeling  | A   | 4                       |        |
|   | 151-0569-00L   | <input checked="" type="radio"/> Vehicle Propulsion Systems   | A   | 4                       |        |
| ← Back  |  |   |     |                         |        |



# Master's Thesis (30 ETCS)

- ~ 6 months full-time work
- Subject with project plan
- Approved by the tutor
- Project at ETH and/or abroad
- Deadlines have to be respected



## In order to start the Master's Thesis, students must have

- fulfilled all specific admission requirements;
- obtained at least 32 credit points in the category Core Courses;
- obtained the 8 credit points for the Semester Project



# Tutors in Micro and Nanosystems

- D-MAVT

- Daniel Ahmed
- Andreas Güntner
- Christofer Hierold
- Dennis Kochmann
- Brad Nelson
- David Norris
- Salvador Pané i Vidal
- Sotiris Pratsinis
- Romain Quidant
- Thomas Schutzius
- Mark Tibbitt



- D-ITET

- Jürg Leuthold
- Mathieu Luisier
- Janos Vörös
- Vanessa Wood

- D-PHYS

- Klaus Ensslin
- Thomas Ihn

- D-BSSE

- Andreas Hierlemann

# Prof. Daniel Ahmed

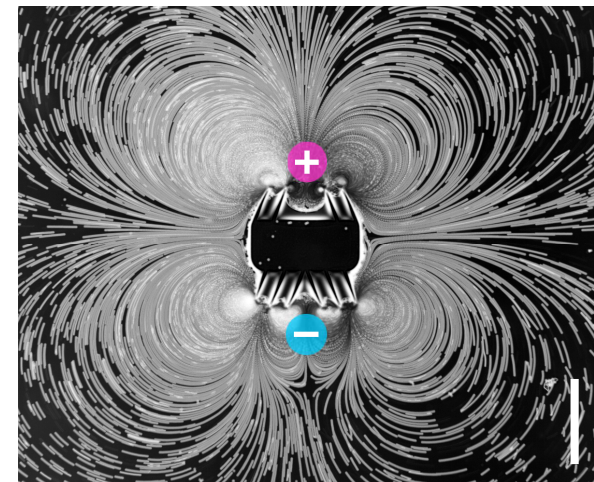
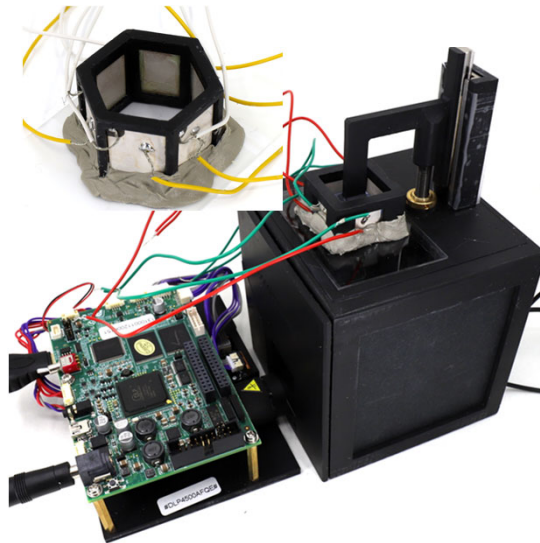
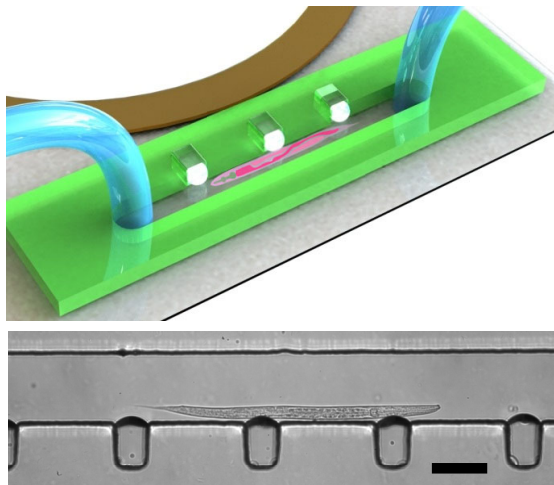
D-MAVT, Institute of Robotics and Intelligent Systems

[www.arsl.ethz.ch](http://www.arsl.ethz.ch)



## Main Research Interests:

- Microfluidics and acoustofluidics devices to manipulate microparticles inside model organisms
- Acoustic 3D printing
- Acoustic-powered micro/nanorobots

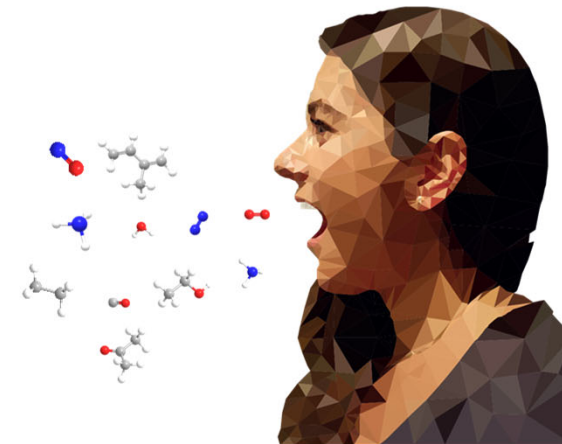
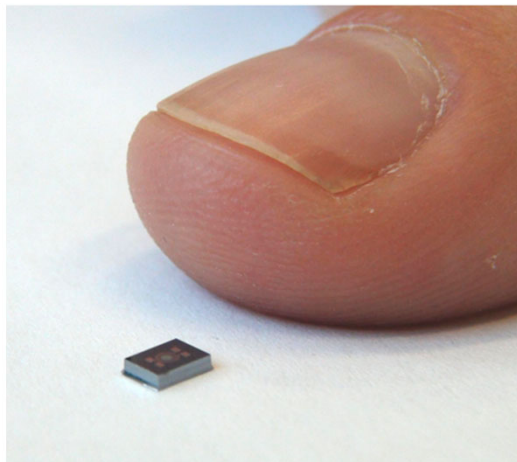
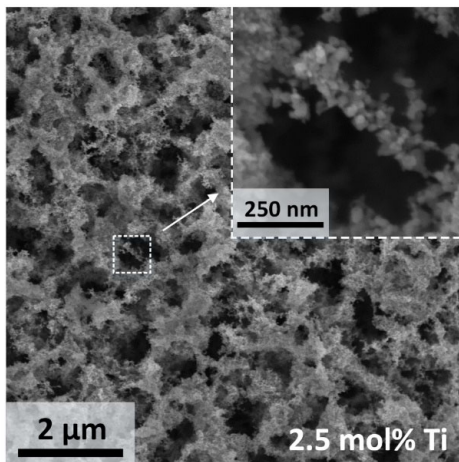






## Main Research Interests:

- Nanoparticle & surface engineering
- Molecular sensing
- Medical diagnostics, air quality monitoring, food safety



# Prof. Christofer Hierold

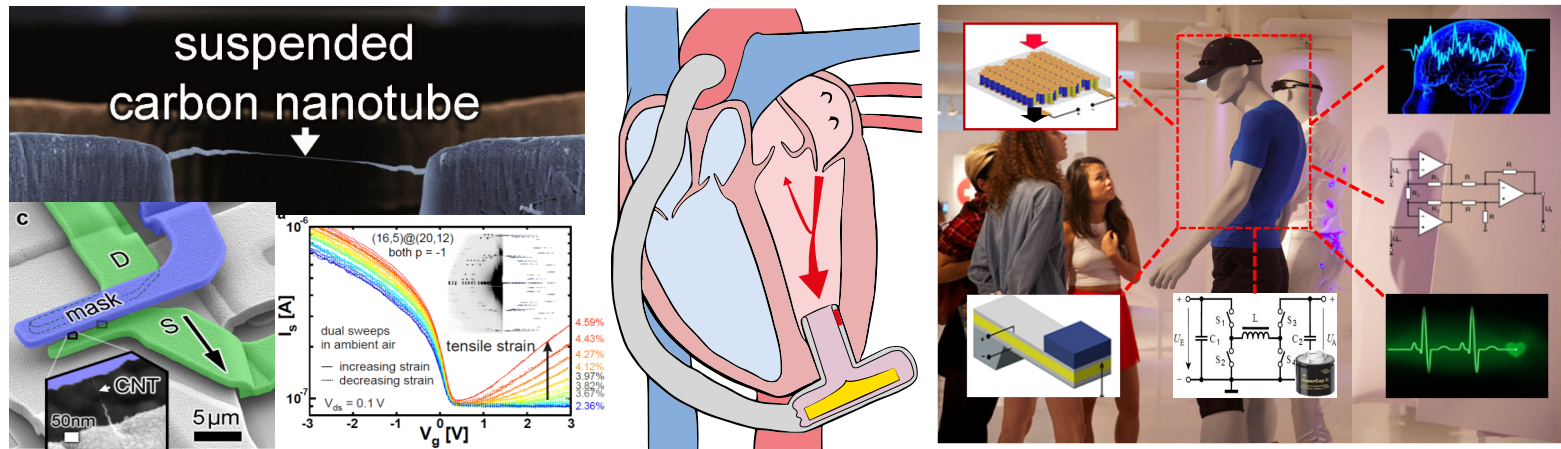
D-MAVT, Micro and Nanosystems

[www.micro.mavt.ethz.ch](http://www.micro.mavt.ethz.ch)



## Main Research Interests:

- Advanced microsystems:  
e.g. thermoelectric generators, acoustic sensors, and microsystems for medical applications
- Nanotransducers and nanosensors:  
e.g. ultra low power carbon based sensors





# Prof. Dennis M. Kochmann

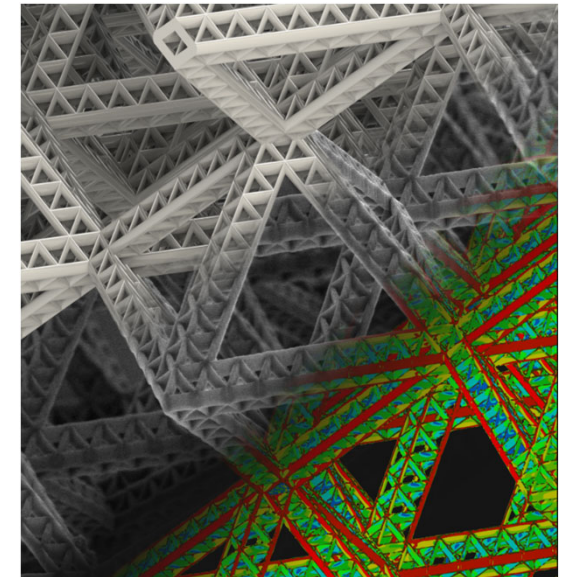
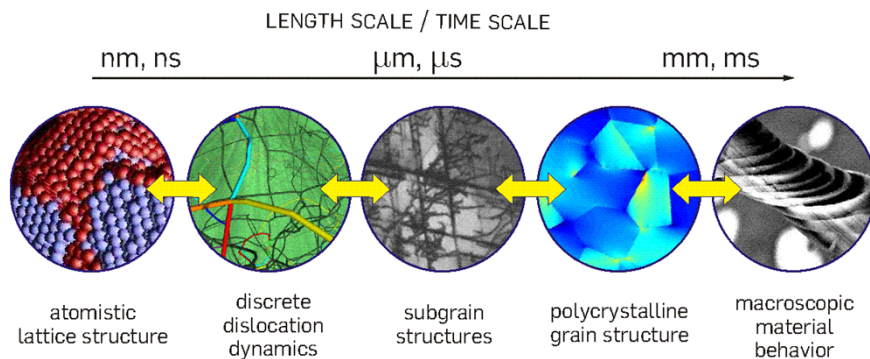
D-MAVT, Mechanics & Materials

[www.mm.ethz.ch](http://www.mm.ethz.ch)



## Main Research Interests:

- modeling across length and time scales: bridging from atoms to devices
- engineered (meta)materials with controllable properties
- materials by design: linking microstructure to properties



# Prof. Brad Nelson

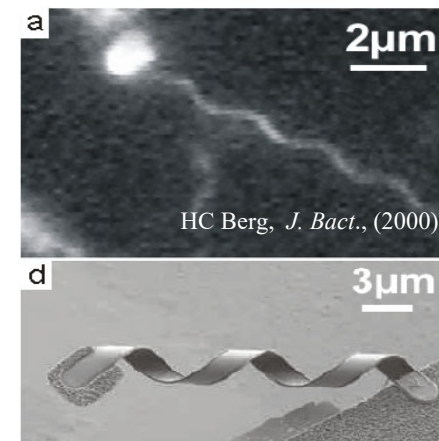
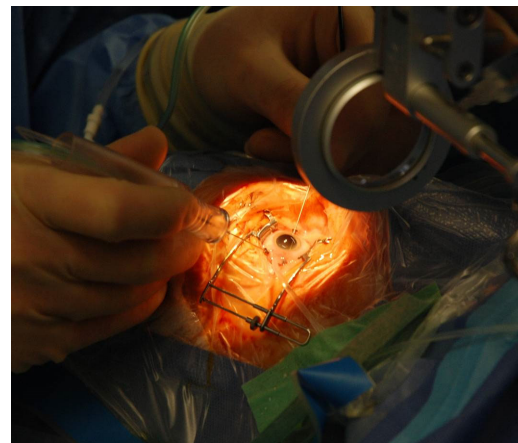
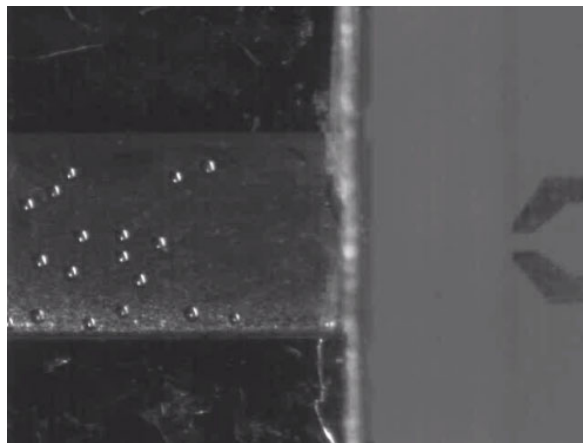
D-MAVT, Institute of Robotics and Intelligent Systems

[www.iris.mavt.ethz.ch](http://www.iris.mavt.ethz.ch)



## Main Research Interests:

- Making sub-mm intelligent machines
- Manipulating sub-mm scale objects



# Prof. David Norris

D-MAVT, Optical Materials Engineering Laboratory

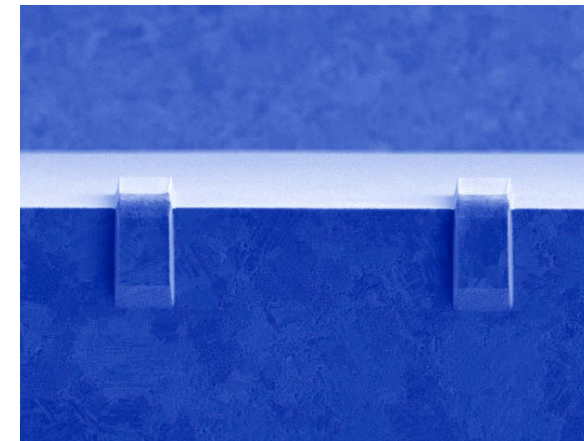
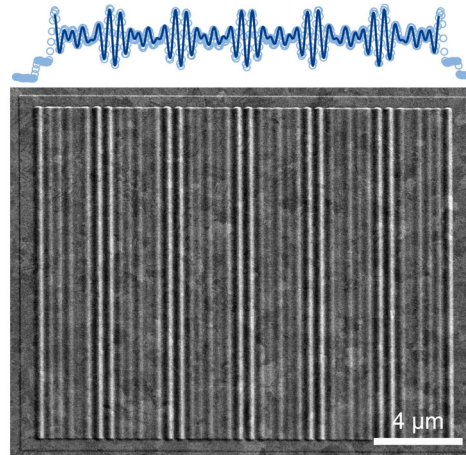


[www.omel.ethz.ch](http://www.omel.ethz.ch)



## Main Research Interests:

- Synthesis / characterization of quantum materials
- Nanophotonics
- Plasmonics





# Prof. Salvador Pané

D-MAVT, Institute of Robotics and Intelligent Systems, Multi-Scale Robotics Lab

[www.msrl.ethz.ch](http://www.msrl.ethz.ch)

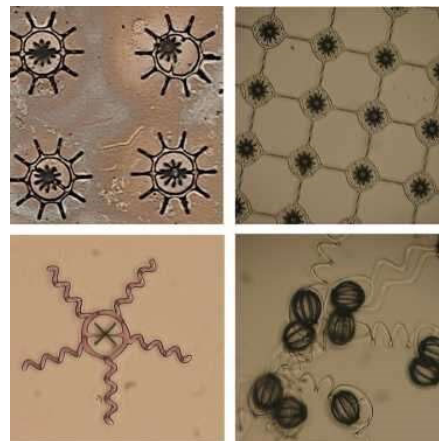
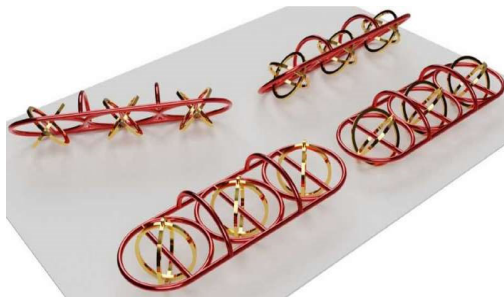


## Main Research Interests:

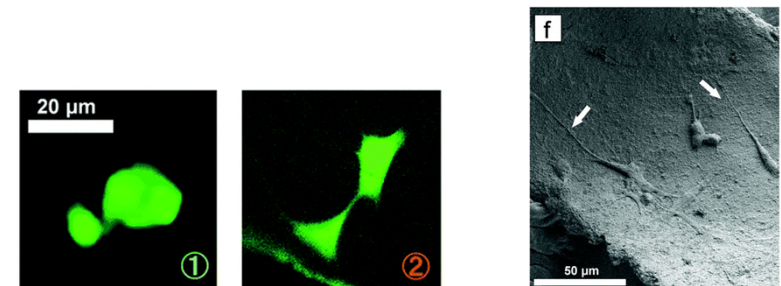
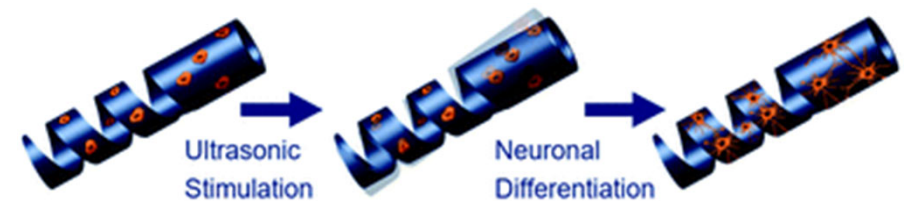
- Development and processing of material for robotics
- Small-scale Robotics for Water Cleaning
- Micro- and nanorobotics for therapeutic delivery and cell stimulation

*Soft microrobots for neuron delivery & neuronal differentiation*

*Mechanically Interlocked 3D Multimaterial Magnetic Microrobots*



*Nature Communications* (2020). DOI: [10.1038/s41467-020-19725-6](https://doi.org/10.1038/s41467-020-19725-6)



*Materials Horizons* (2020). DOI: [10.1039/C9MH00279K](https://doi.org/10.1039/C9MH00279K)

# Prof. Sotiris Pratsinis

D-MAVT, Particle Technology Laboratory

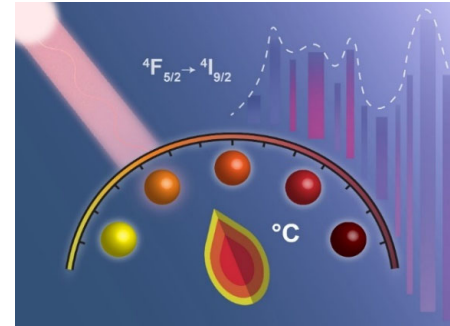
www.ptl.ethz.ch



## Fundamentals



Joy of understanding  
Enable Process Scale-up  
Facilitate Product Innovation



Nd-doped BiVO<sub>4</sub>

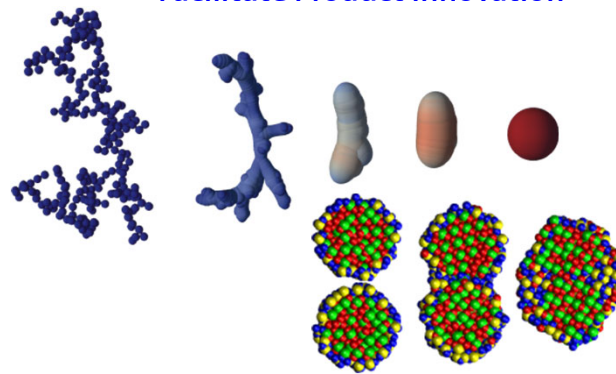
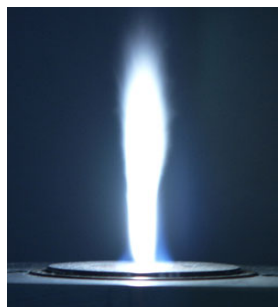
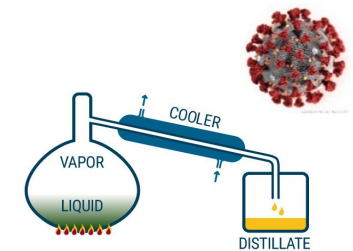


Biomaterials: Luminescent Nanothermometers

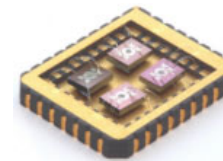
## Devices: Gas Sensor Systems



Detect poisonous methanol even in antiseptics!



Carbon black, Pigmentary TiO<sub>2</sub>, Fumed SiO<sub>2</sub>, Catalysis, Biomaterials, Nutrition



## Applications



# Prof. Romain Quidant

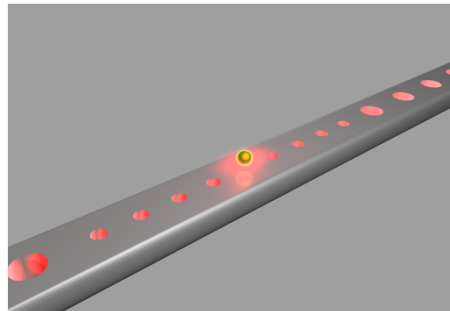
D-MAVT, Nanophotonic Systems Laboratory (NSL)

[www.light.ethz.ch](http://www.light.ethz.ch)



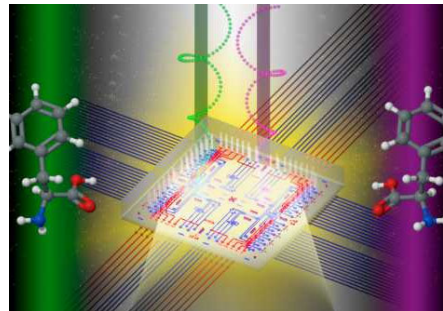
## Main Research Interests

### Optomechanics



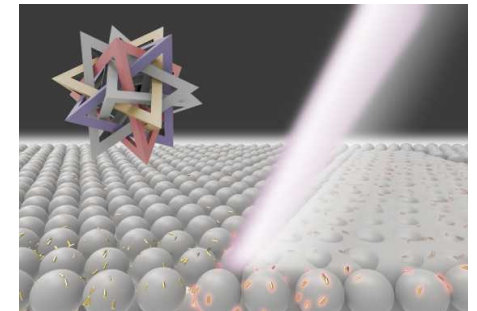
- Optical and electrostatic trapping
- Inertial and force sensing
- Reconfigurable metasurfaces

### Bionanophotonics



- On chip biosensors
- Advanced optical imaging
- Microfluidics

### Microscale heat control



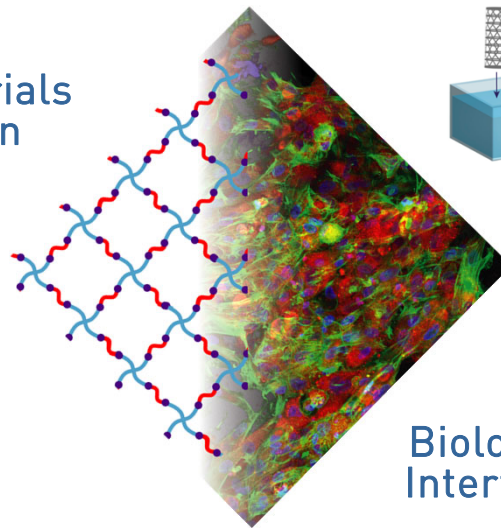
- Hyperthermia
- Reconfigurable planar optics
- Catalysis



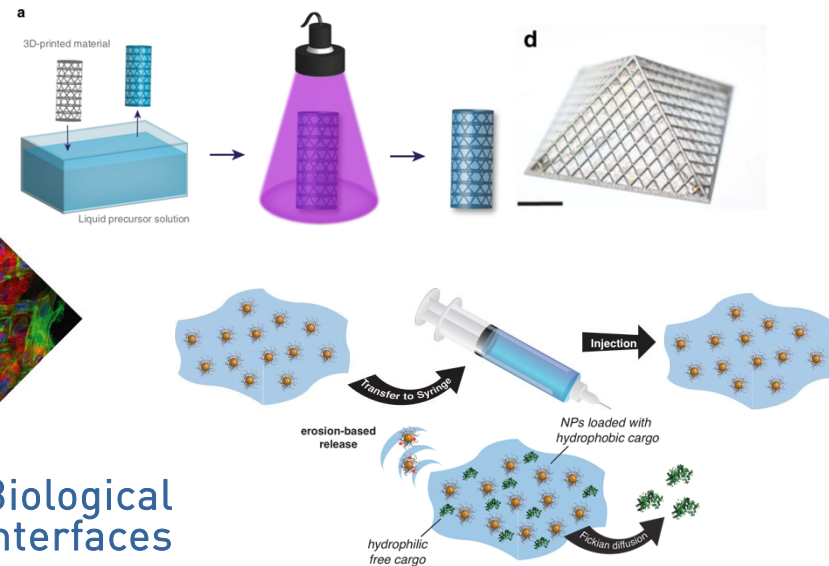
## Main Research Interests:

- Soft materials design with a focus on biomedical applications
- Additive manufacturing of multicomponent biomaterials
- Injectable drug delivery systems

Materials Design



Biological Interfaces



# Prof. Jürg Leuthold

D-ITET, Institute of Electromagnetic Fields (IEF)

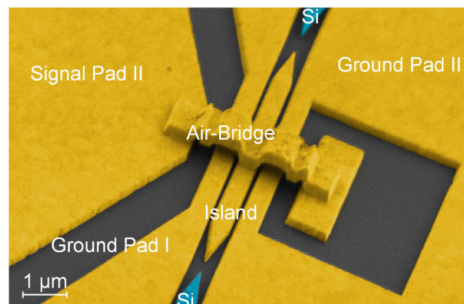
[www.ief.ethz.ch](http://www.ief.ethz.ch)



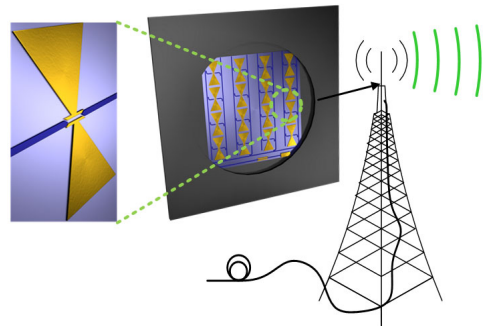
## Main Research Interests:

- Design – Fabrication – System-level testing
- Optoelectronic devices for communications
  - Sources and detectors for sensing
  - Plasmonic devices

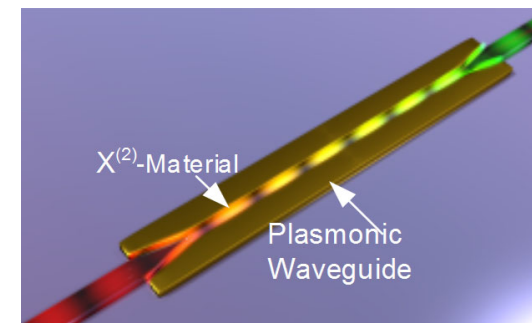
100 Gbit/s plasmonic transmitter.



Wireless antenna using nanotechnological devices



Novel nonlinear light sources



# Prof. Mathieu Luisier

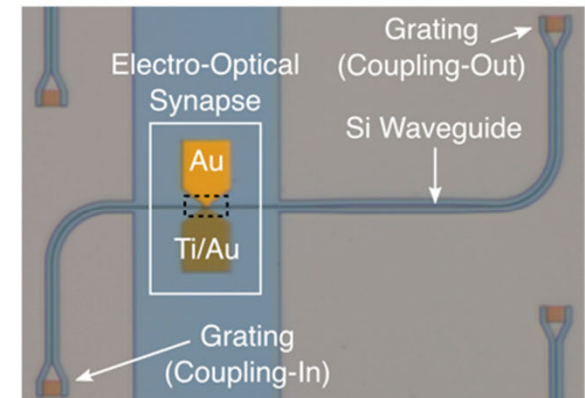
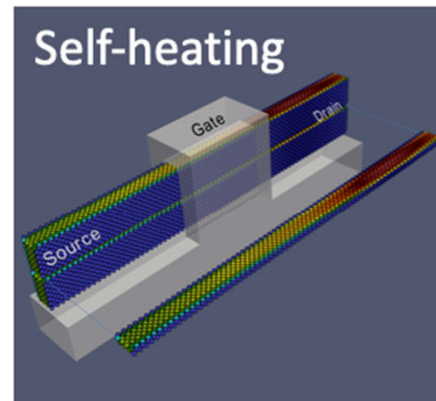
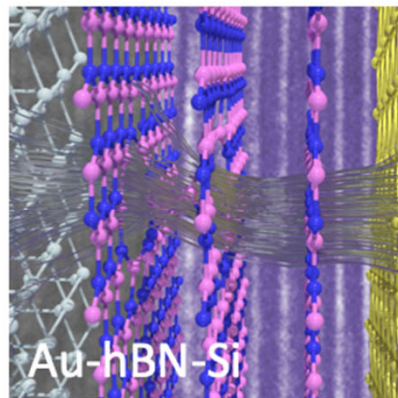
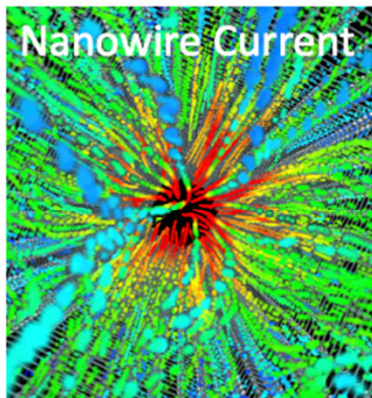
D-ITET, Computational Nanoelectronics

<http://www.iis.ee.ethz.ch>



## Main Research Interests:

- Development of Advanced Physical Models (Quantum Transport)
- Parallel Numerical Algorithms and High Performance Computing
- Device Simulation (2-D Materials, Transistors, Memory Cells)
- Neuromorphic Computing (Fabrication of Solid-State Synapses)





# Prof. Janos Vörös

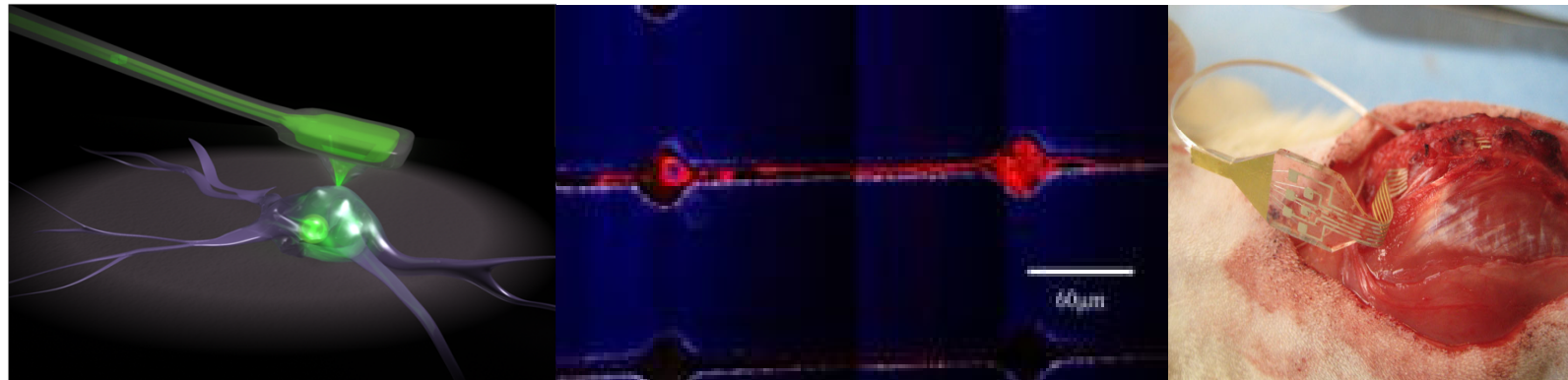
D-ITET, Laboratory of Biosensors and Bioelectronics

[www.lbb.ethz.ch](http://www.lbb.ethz.ch)



## Main Research Interests:

- Stretchable bioelectronic devices
- Biosensors
- Interfacing biology with FluidFM nanopipette
- Building controlled neuron networks





# Prof. Vanessa Wood

D-ITET, Laboratory for Nanoelectronics

[www.lne.ethz.ch](http://www.lne.ethz.ch)

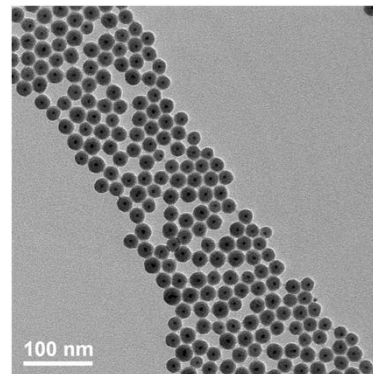


## Main Research Interests:

- Optical and electronic measurement techniques on nano- and micro-size materials & structures
- Nano- and micron-size materials with new electronic or ionic properties
- Applications: LEDs, solar cells, batteries

Optoelectronic  
& Electrochemical

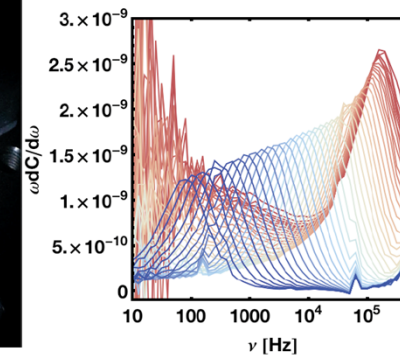
Materials



Devices



Analytcs



# Prof. Klaus Ensslin

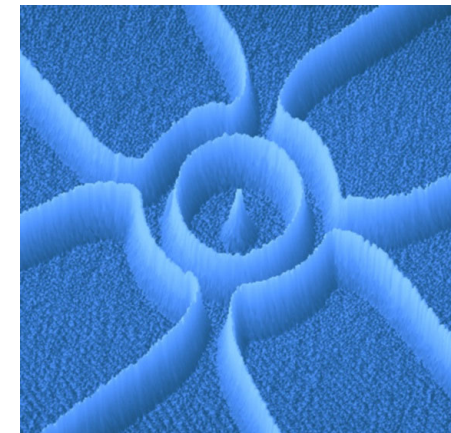
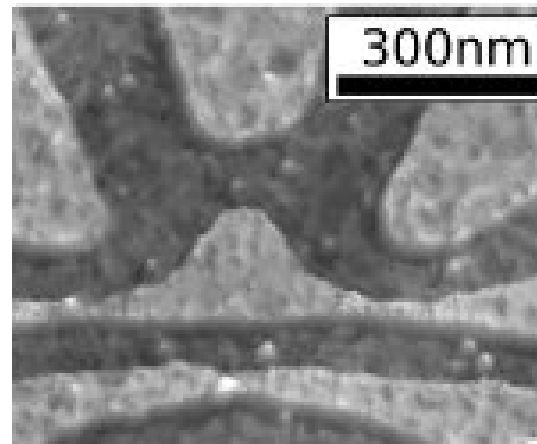
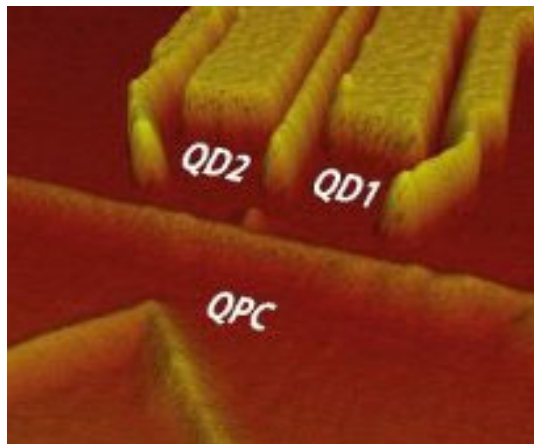
D-PHYS, Nanophysics

[www.nanophys.ethz.ch](http://www.nanophys.ethz.ch)



## Main Research Interests:

- Nanostructures of GaAs family and Graphene
- Superconductor/Semiconductor hybrids
- Transport in mesoscopic structures



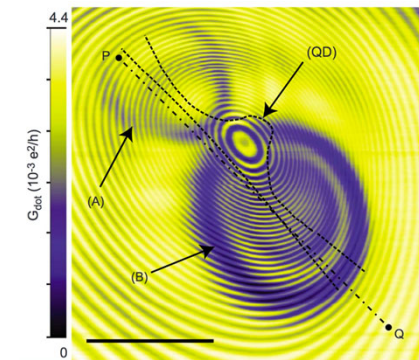
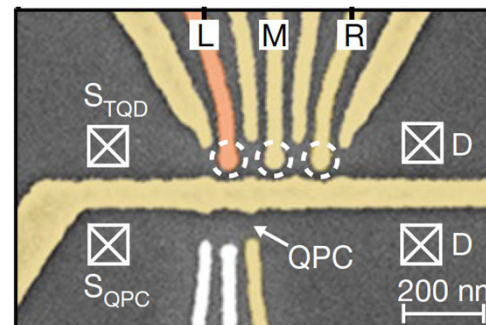
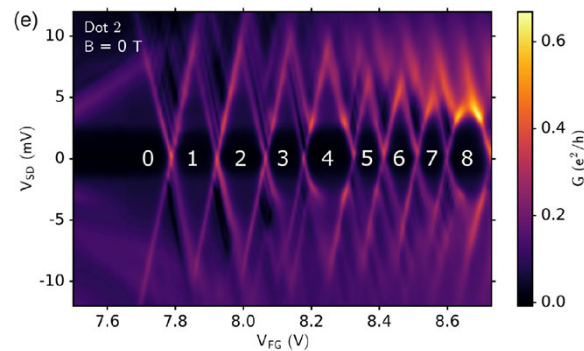
# Prof. Thomas Ihn

D-PHYS, Nanophysics



## Main Research Interests:

- Low-temperature transport experiments
- Graphene and vdW-heterostructures
- III-V semiconductor nanostructures
- Quantum dot qubits coupled to single photons
- Scanning probe techniques applied to semiconductor nanostructures



Prof. Andreas Hierlemann  
D-BSSE, Bio Engineering Laboratory

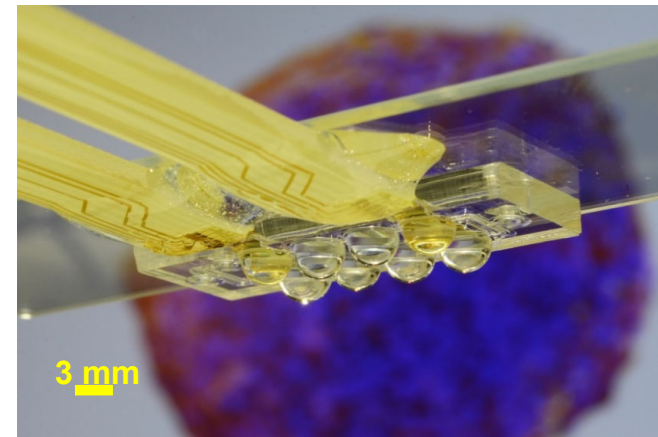
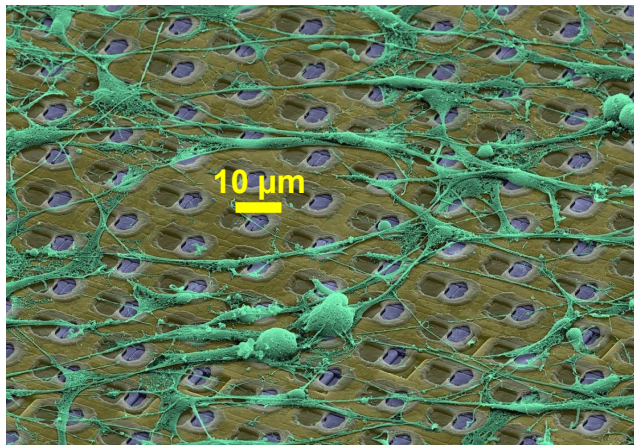


[www.bsse.ethz.ch/bel](http://www.bsse.ethz.ch/bel)



## Main Research Interests:

- Neuroelectronic interfacing
- Microfluidics and microtissues





# D-MAVT Student Administration



Silvia Häfliger



Danijela Lukic



Lorena Luzi



Maddalena Velonà

ETH Zentrum  
LEE K 208  
Leonhardstrasse 21  
8092 Zürich  
[info@mavt.ethz.ch](mailto:info@mavt.ethz.ch)

## Opening hours during the semester:

|               |               |
|---------------|---------------|
| Mon, Thu      | 13:00 - 16:00 |
| Tue, Wed, Fri | 09:00 - 12:00 |