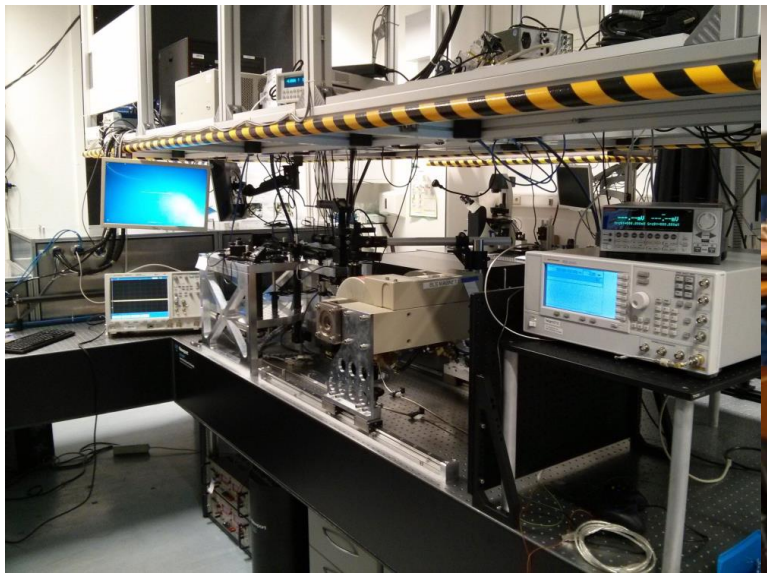
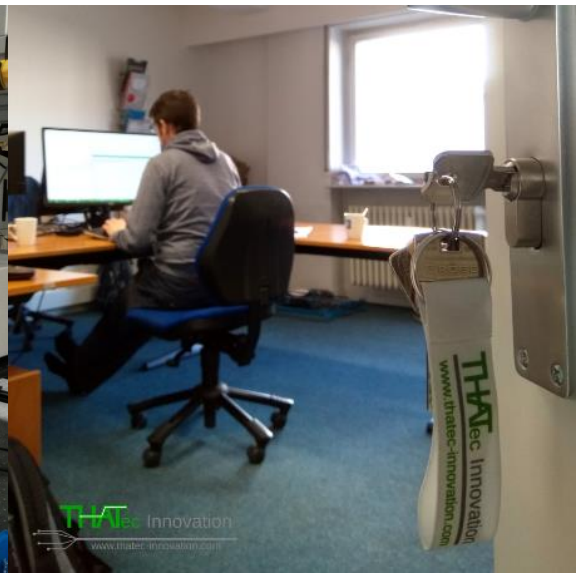
THATec Innovation
www.thatec-innovation.com

From PhD to company founder





THATec Innovation GmbH

a spin-off of the HZDR
funded in the framework of
Helmholtz Enterprise

HELMHOLTZ GEMEINSCHAFT

HZDR

HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

THE EUROPEAN SCHOOL ON MAGNETISM

Short CV

- **2009, Diploma in Physics:** *Magnetooptische Untersuchungen zum Schaltverhalten kleiner magnetischer Strukturen*
  AG Hillebrands, TU Kaiserslautern

- **2010-2013, PhD in Physics:** *Linear and nonlinear spin dynamics in Co2Mn0.6Fe0.4Si Heusler microstructeres*
  AG Hillebrands TU Kaiserslautern

- **2014 & 2015, PostDoc:** *Spin dynamics & Brillouin light scattering microscopy*
  Helmholtz-Zentrum Dresden-Rossendorf, Emmy-Noether group of Dr. Helmut Schultheiß

- **2016, project leader GridLab:** *technology transfer in the framework of Helmholtz Enterprise,* Helmholtz-Zentrum Dresden-Rossendorf

- **since August 2016: CEO of THATec Innovation GmbH**

Short CV

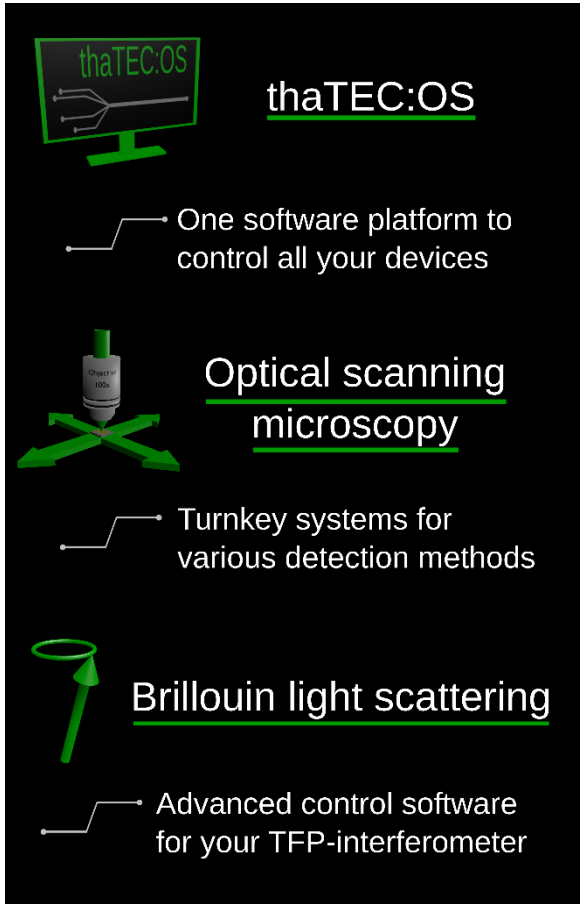
Helmut Schultheiß

Burkard Hillebrands

Attila Kákay

Thomas Meyer

Thomas Sebastian



Outline

1. Scientific/technical background
   - Brillouin light scattering (BLS) microscopy
   - Technical aspects and ideas for a startup

2. THATec Innovation
   - Proposal
   - Foundation
   - Business activities

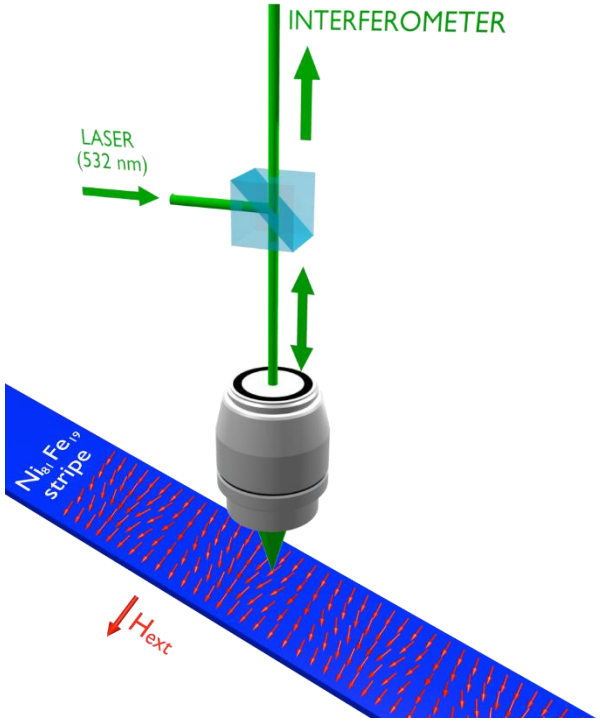
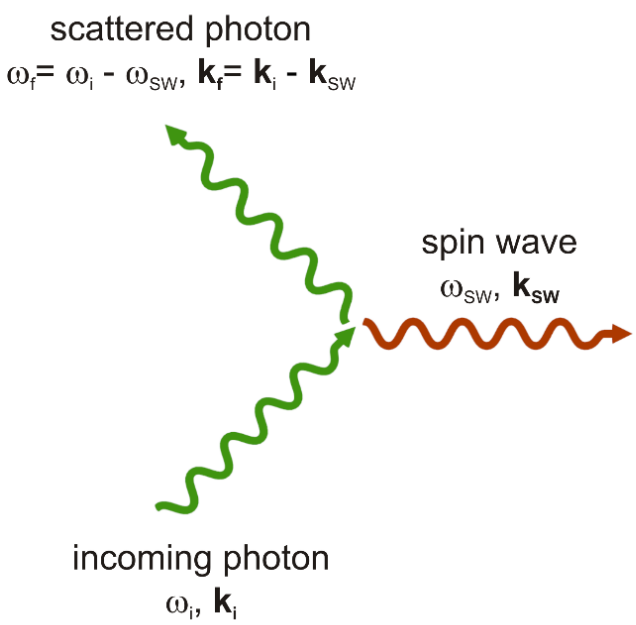


Illustration by Helmut Schultheiss

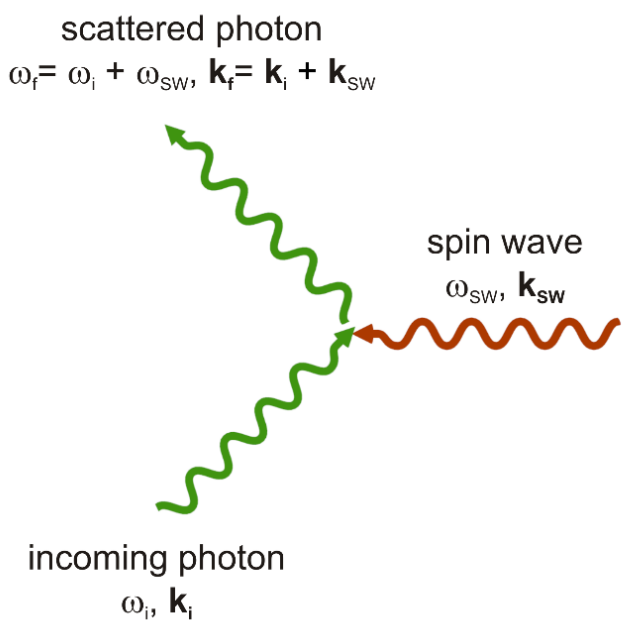
Brillouin Light Scattering

inelastic scattering of photons and magnons

generation of a magnon
(Stokes process)

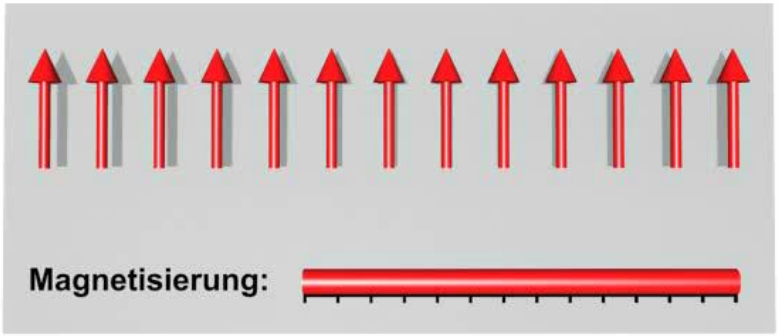


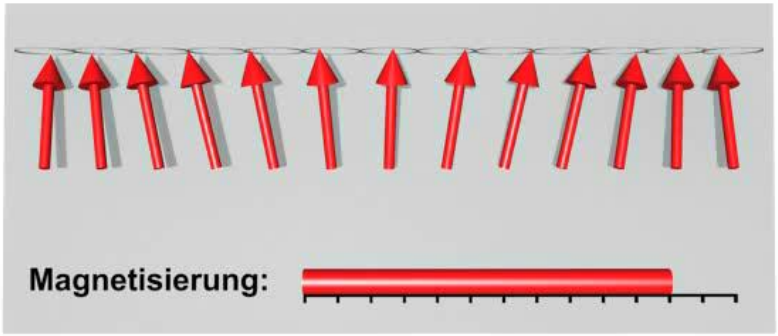
annihiliation of a magnon
(anti-Stokes process)

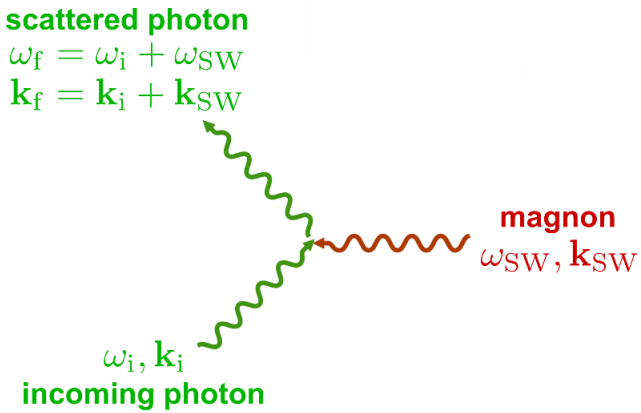


Spin waves?

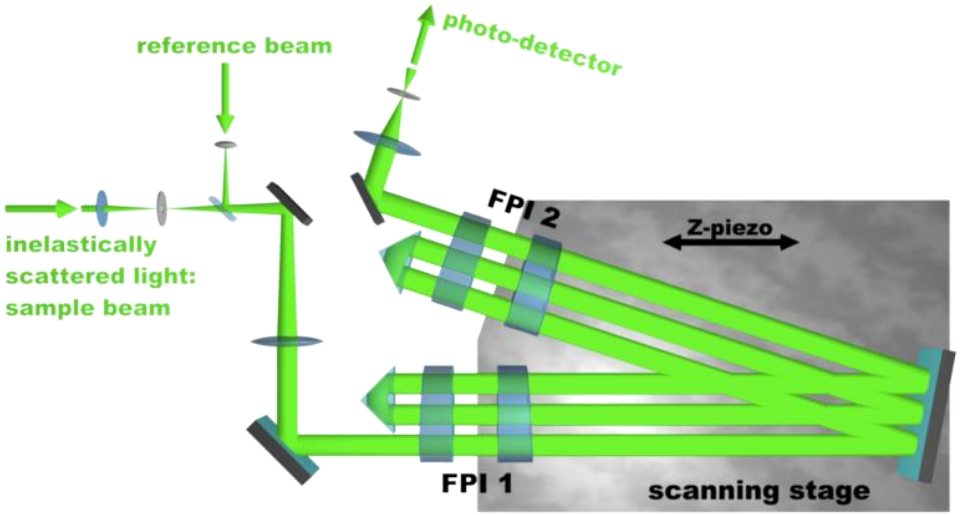
Animation by Helmut Schultheiss



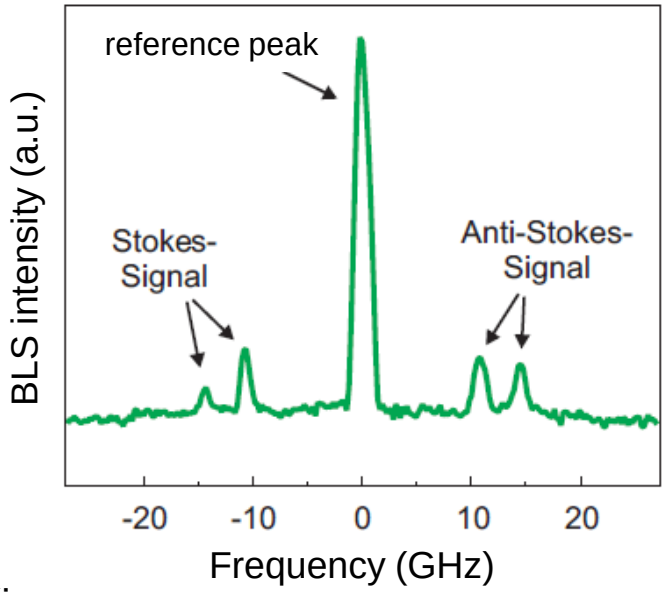




Frequency analysis – the TFPI



Dissertation H. Schultheiss

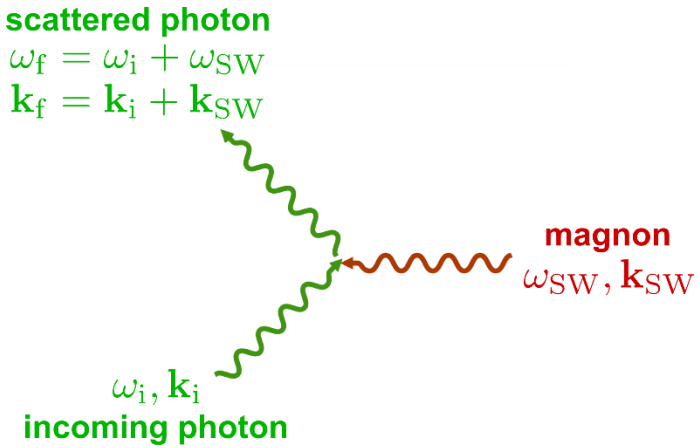


Tandem-(3+3)-Fabry-Pérot interferometer by J.R. Sandercock:

- frequency range: 500 MHz – 1 THz
- spectral resolutions: up to 50 MHz
- ➢ instrument needs to be aligned before measurements
- ➢ Optics need to be stabilized during measurements

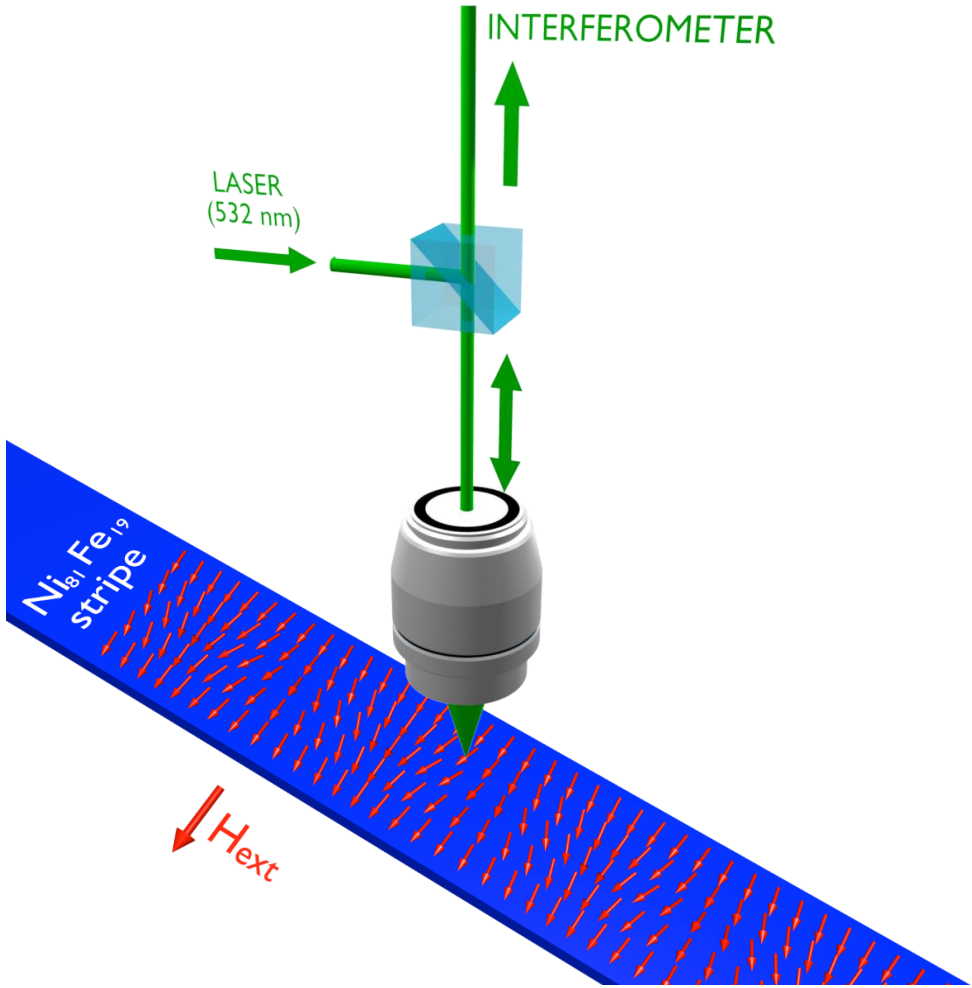
Brillouin Light Microscopy

inelastic scattering of
photons and magnons



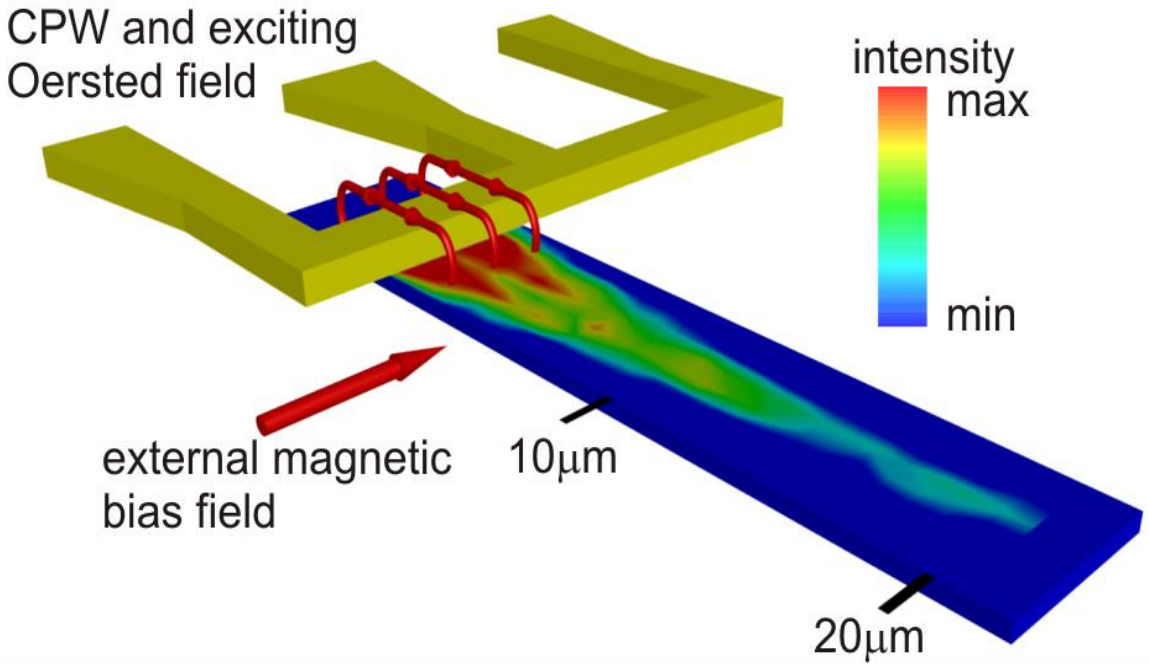
optical technique

- scanning microscopy



BLS microscopy

T. Sebastian et al., Appl. Phys. Lett. 100, 112402 (2012)



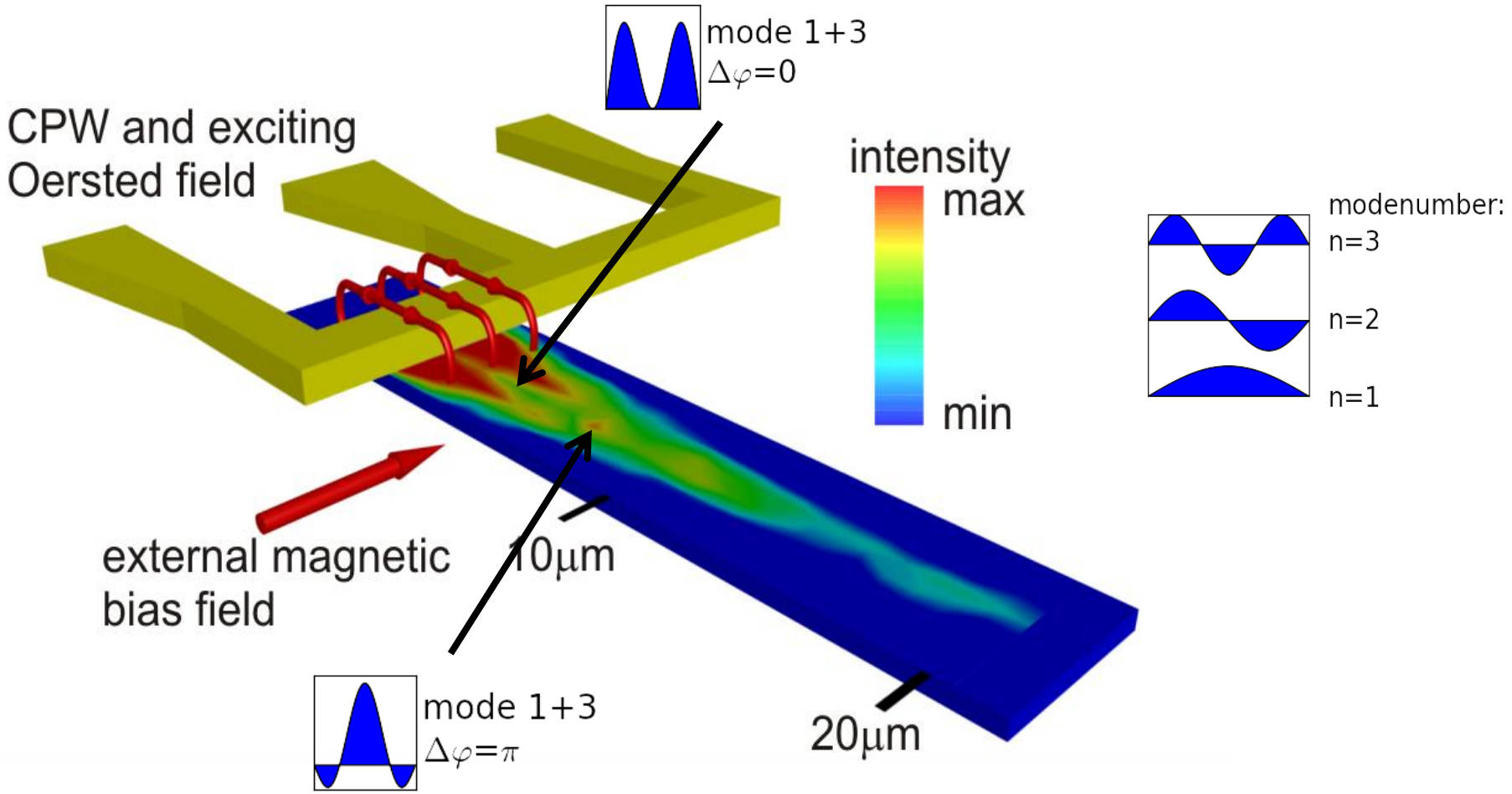
Waveguide geometry
- thickness 30 nm
- width 4 μm

Excitation of spin waves:
- antenna structures
- microwave currents
- torque $\sim \mathbf{M} \times \mathbf{h}$

Experimental parameters
- external field 40 mT
- frequency 6.0 GHz
- microwave power 0.1 mW

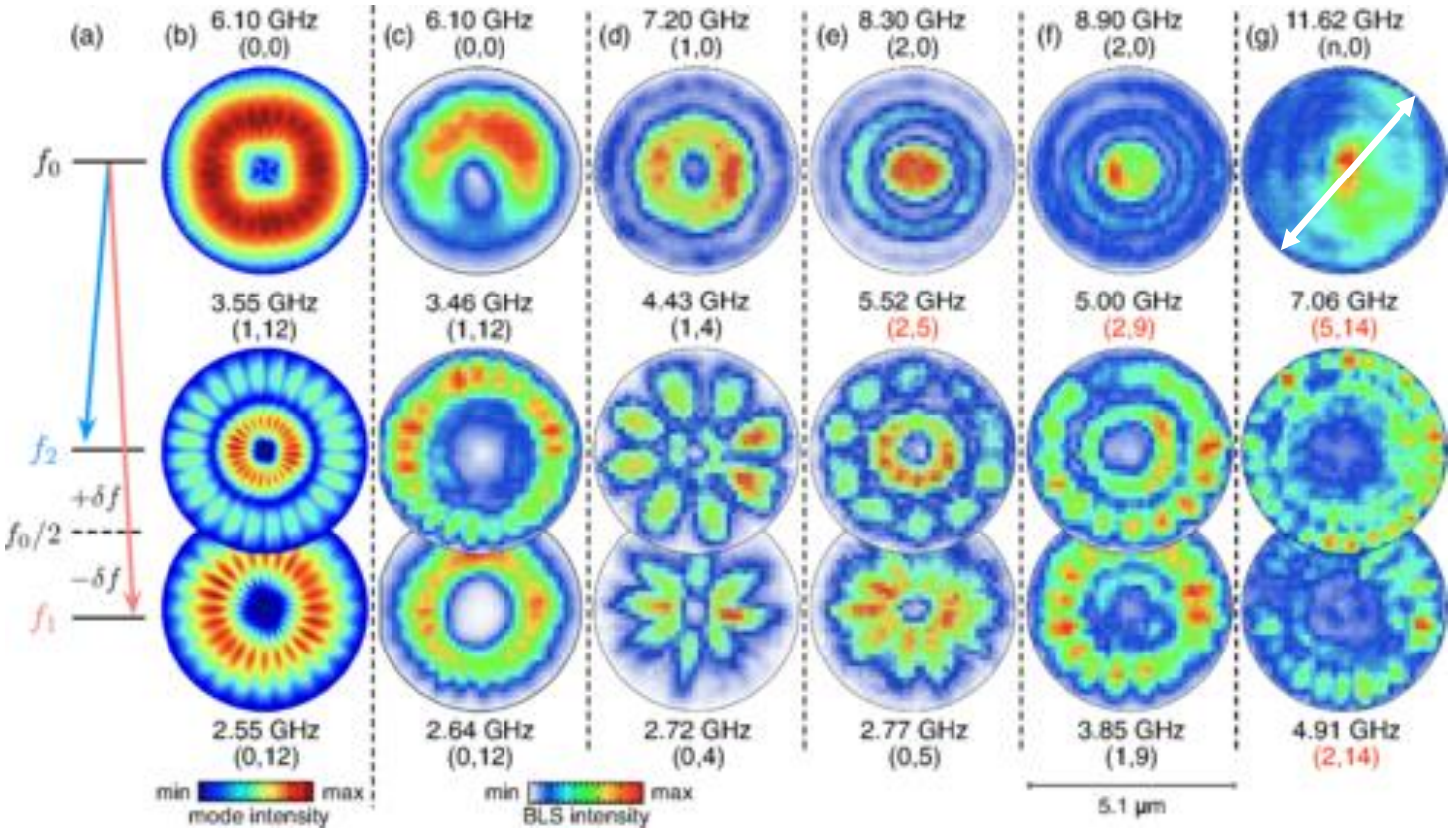
BLS microscopy

T. Sebastian et al., Appl. Phys. Lett. 100, 112402 (2012)



BLS microscopy

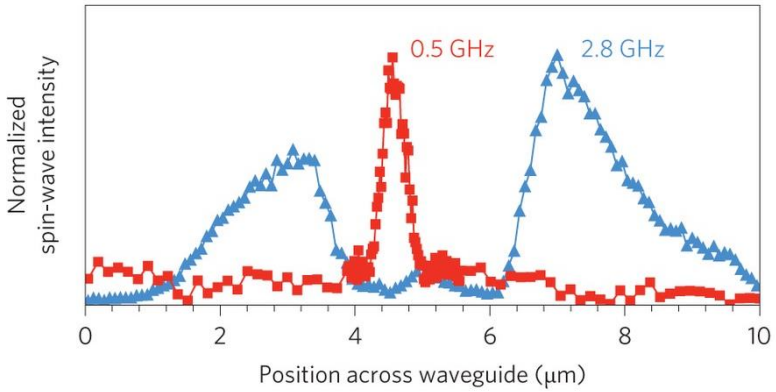
K. Schultheiss, H. Schultheiss, et al. Phys. Rev. Lett. 122, 097202 (2019)

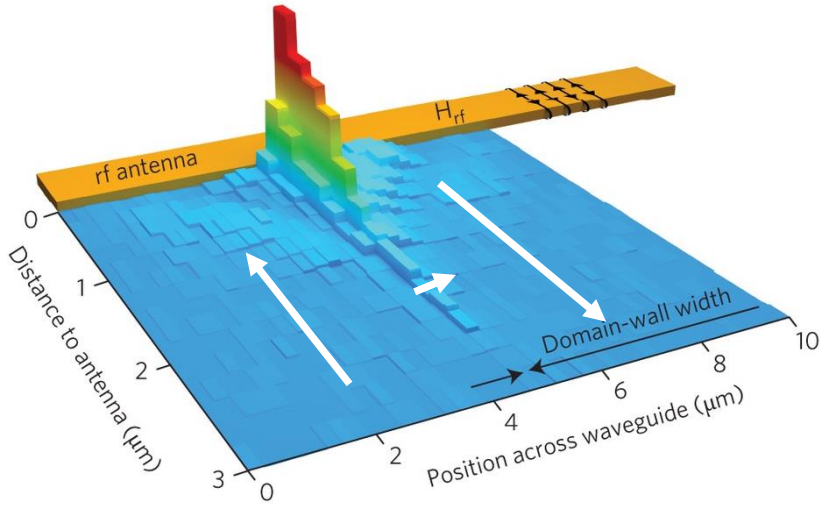


5,1µm

BLS microscopy

Wagner, Kákay, Sebastian, Schultheiß et al.
Nature Nanotechnology **11**, 432–436 (2016)





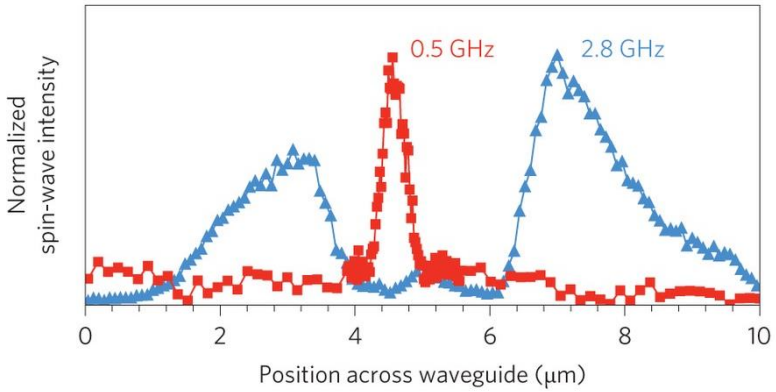
Further reading:

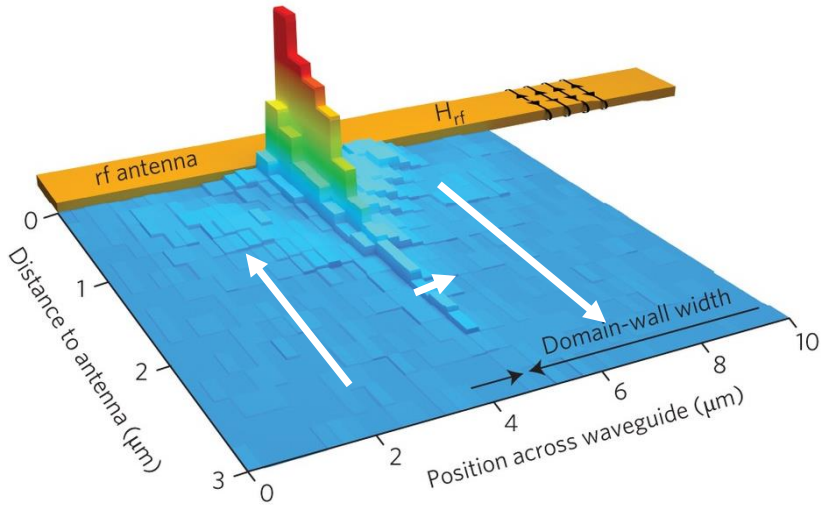
T. Sebastian, et al.:

Micro-focused Brillouin light scattering: imaging spin waves at the nanoscale

Frontiers in Physics, 03 June 2015

Technical aspects



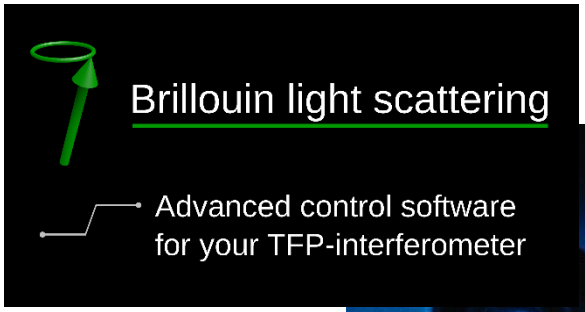


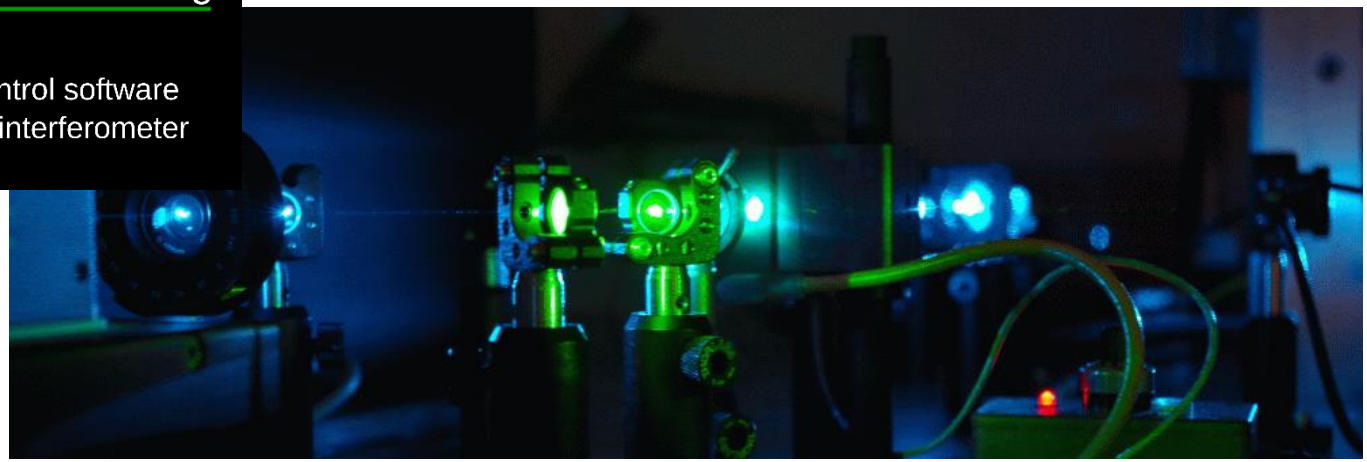
Devices:

- Tandem Fabry-Pérot interferometer
- Microscope
- …

Brillouin light scattering

- Advanced control software for the Tandem-Fabry Pérot interferometer
- Powerful auto alignment routines
- Continuous automated stabilization of the optics
- Time-resolution upgrade available
- Fully extendable with external devices via thaTEC:OS





Brillouin light scattering

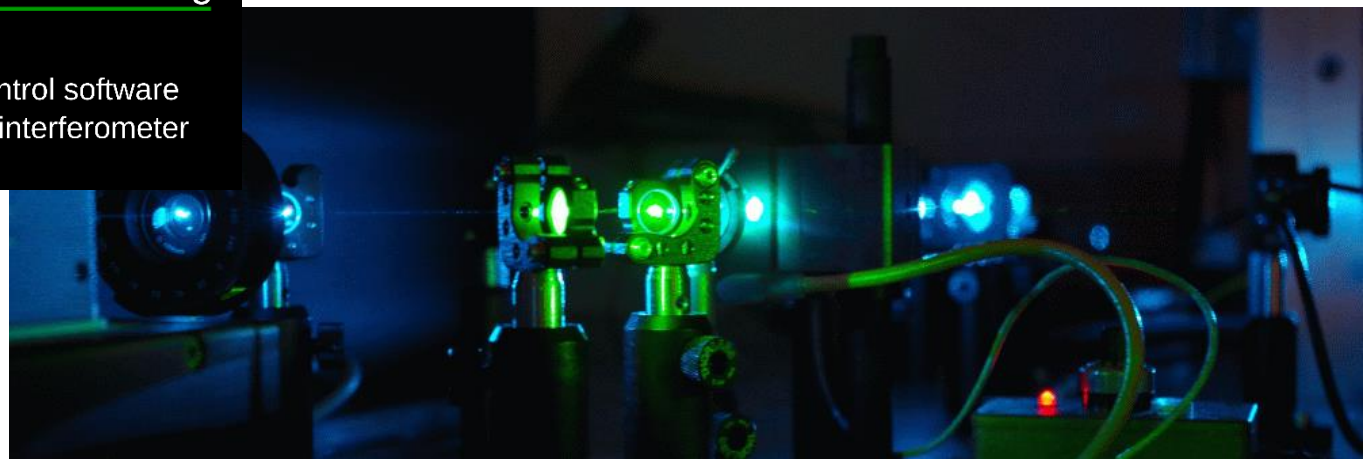
software solution already available

Helmut Schultheiß

Burkard Hillebrands

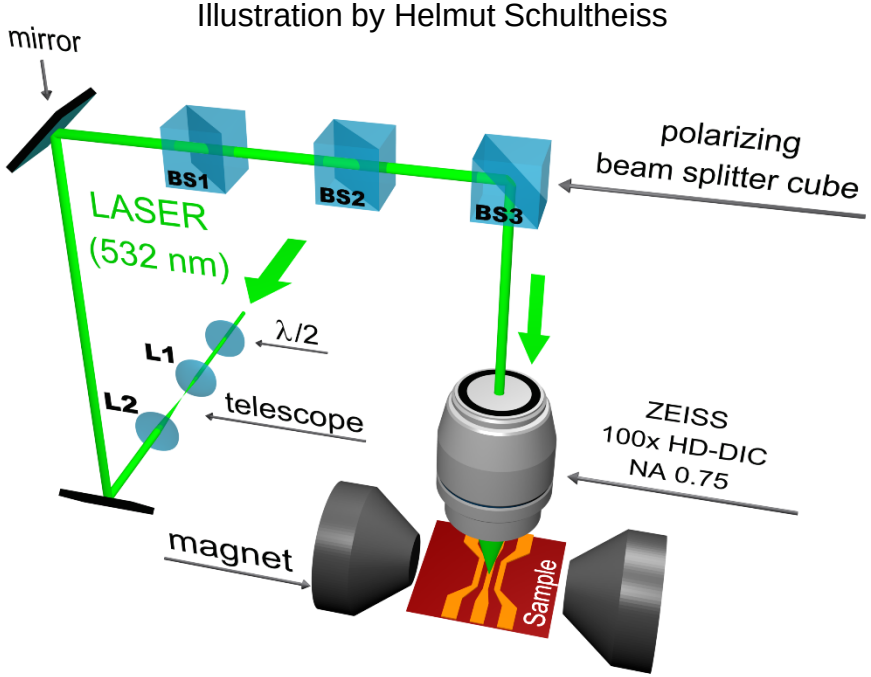
Brillouin light scattering

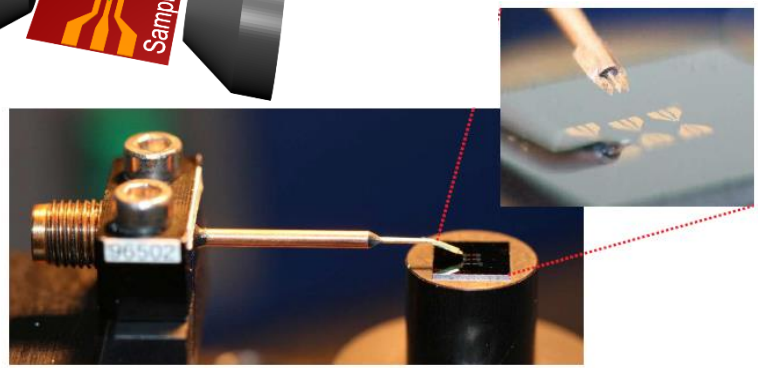
Advanced control software
for your TFP-interferometer



Technical aspects

Illustration by Helmut Schultheiss





Devices:

- Tandem Fabry-Pérot interferometer
- Microscope
- …

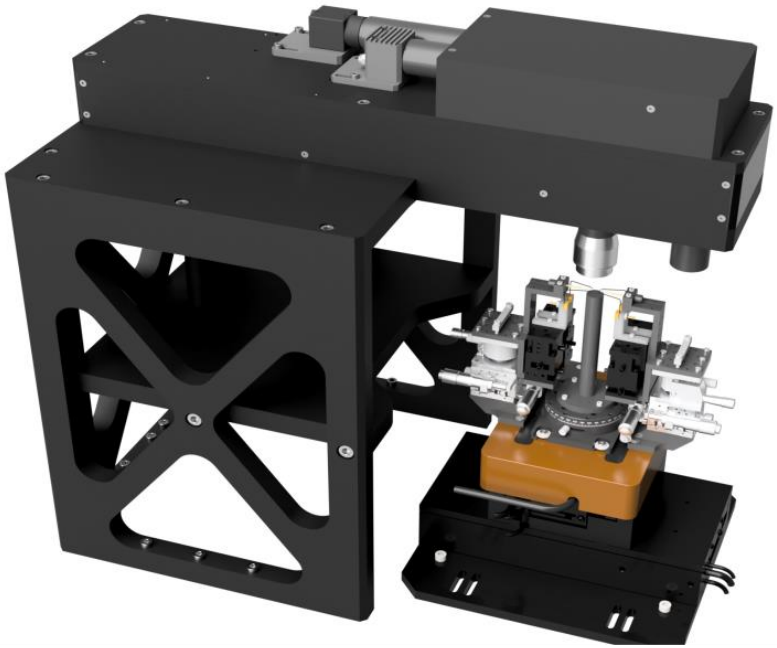
Microscopy requirements

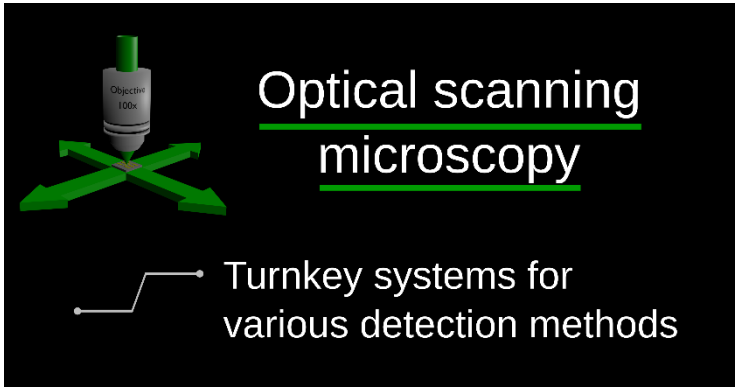
- Enough space for electromagnet
- Sample holder with electrical probes
- In- and output port for laser
- Automated scanning
- Position stabilization

➢ Custom made hard- and software

Optical scanning microscopy

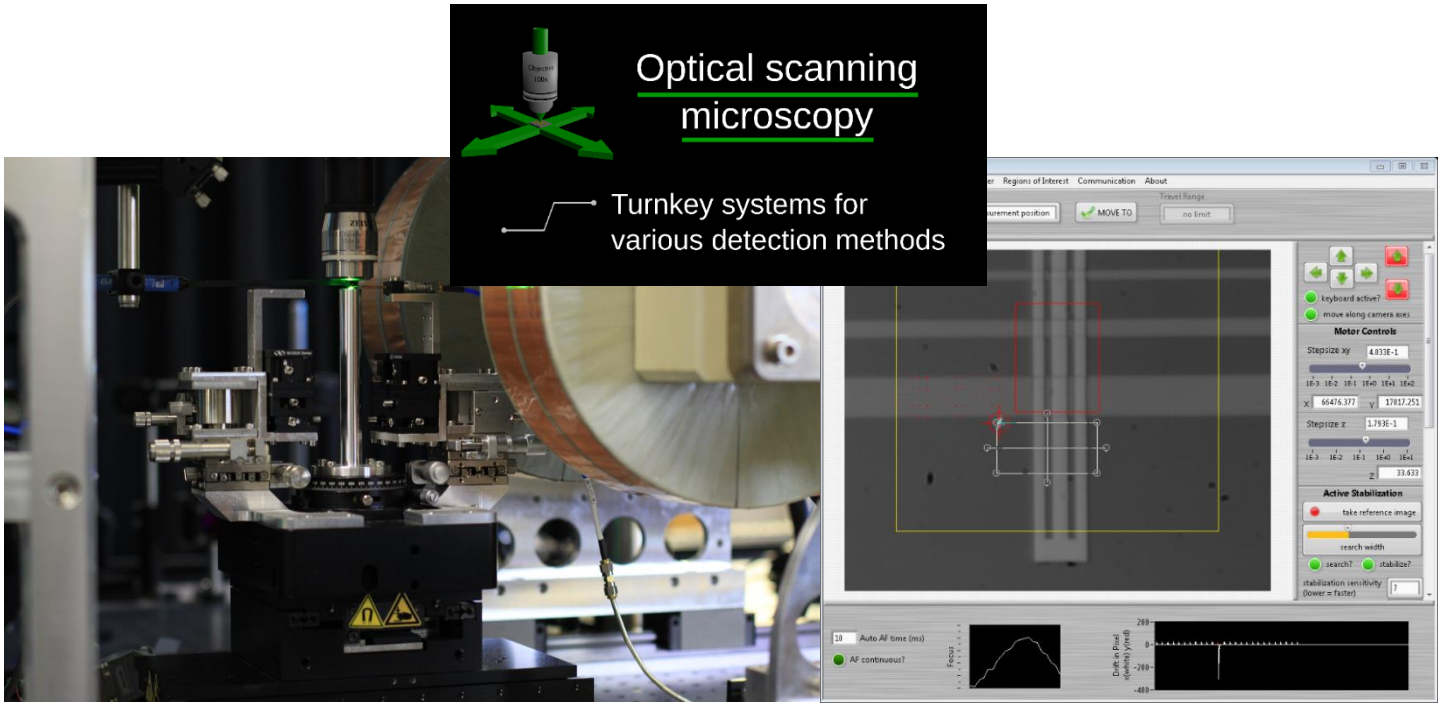
- Customized turnkey systems
- On-site installation and training
- Equipped with probe station



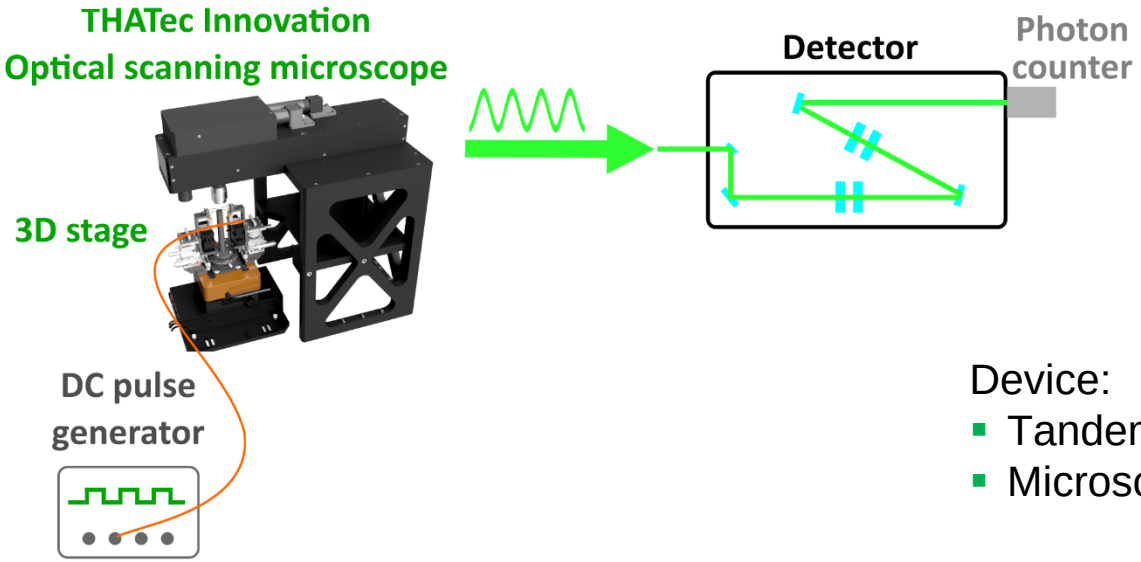


Optical scanning microscopy

- Fully automated sample positioning and scanning
- Easy on-screen scan definition
- Long-term active drift stabilization
- Fully extendable with external devices via thaTEC:OS



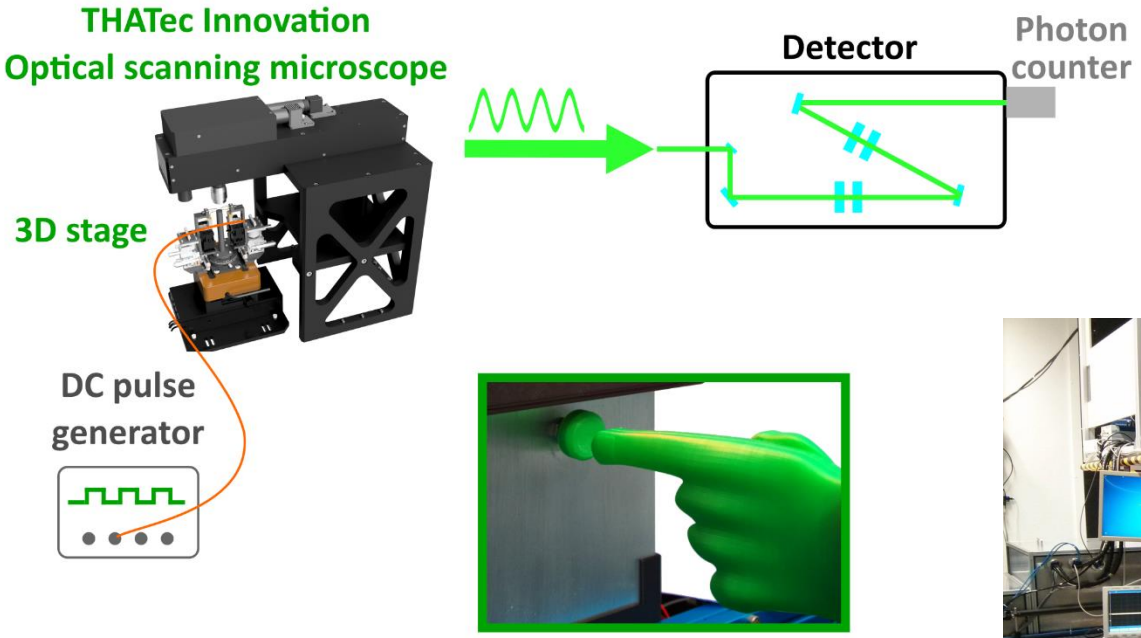
Technical aspects

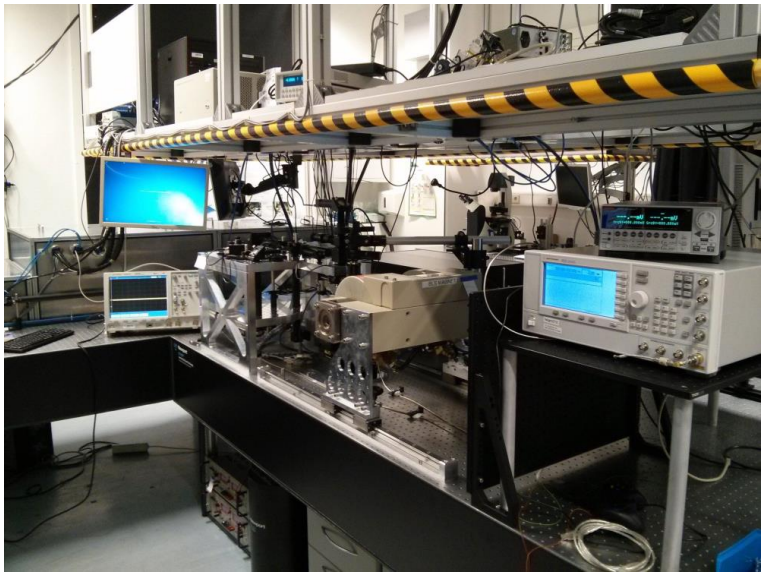


Device:
- Tandem Fabry-Pérot interferometer
- Microscope

Additional peripheral devices:
- Electromagnet
- rf signal generator
- DC sources
- Microwave spectrum analyzers
- …

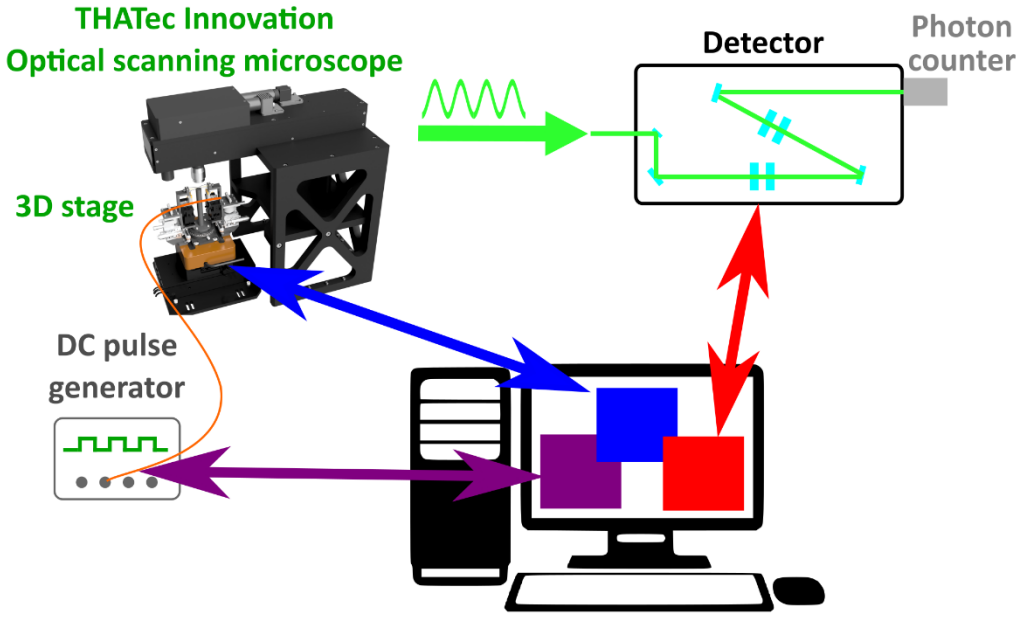
Technical aspects

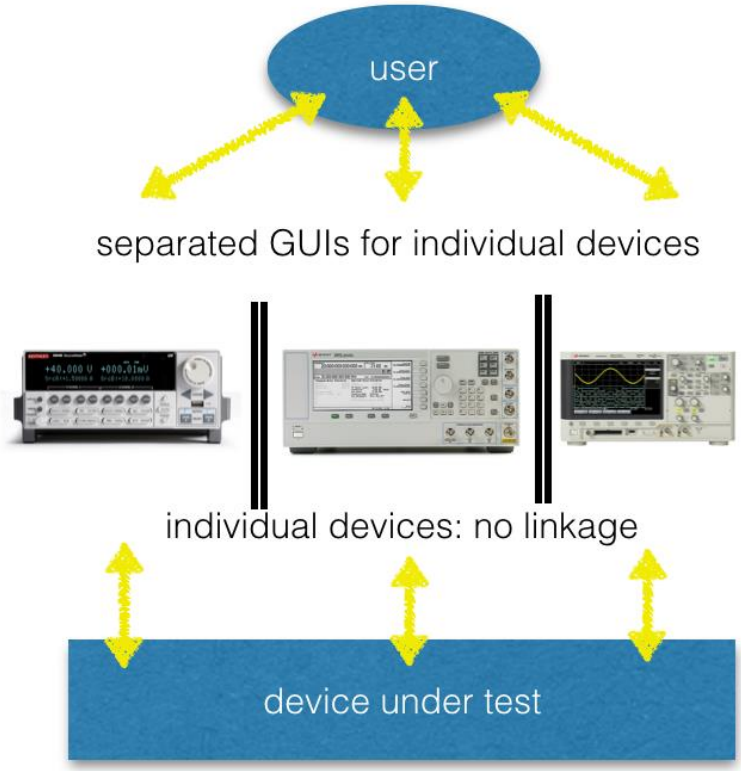




Do you want run around in the lab to push buttons all the time?

Automate your lab!

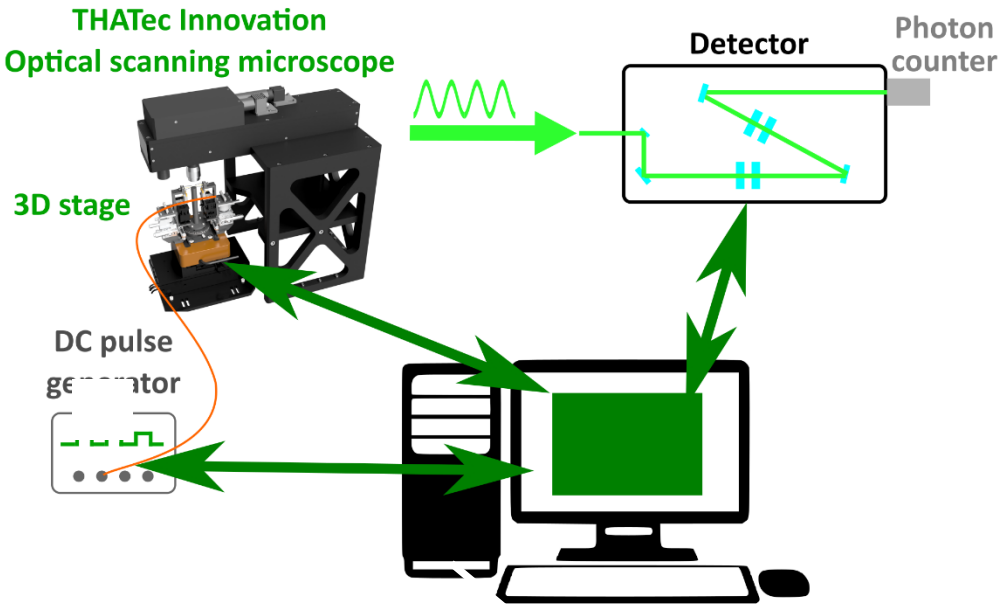


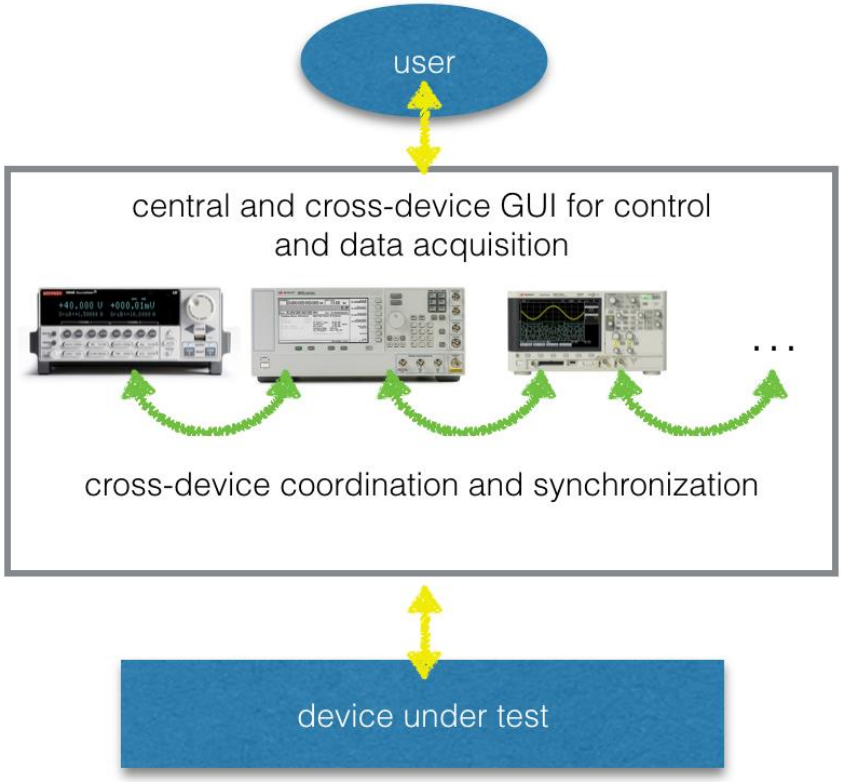


Software modules for all your devices

BUT: how to automatize cross-device measurements?

thaTEC:OS

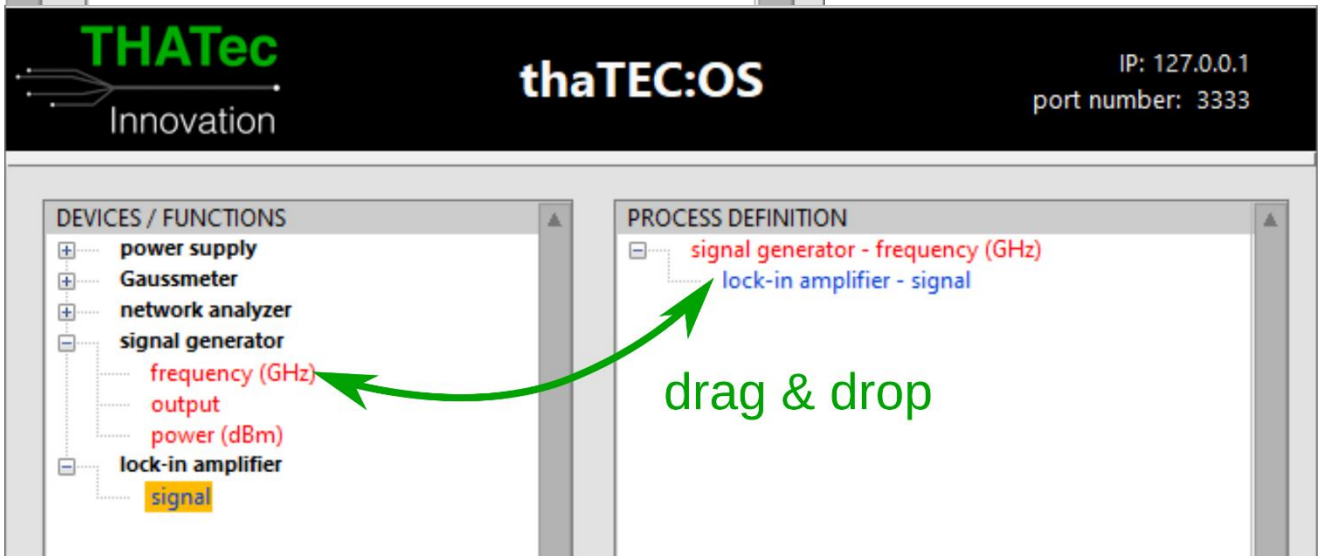




thaTEC:OS
One interface to control and coordinate, and synchronize all your devices in automated measurements

thaTEC:OS


THATec
Innovation
thaTEC:OS
IP: 127.0.0.1
port number: 3333
DEVICES / FUNCTIONS
power supply
Gaussmeter
network analyzer
signal generator
frequency (GHz)
output
power (dBm)
lock-in amplifier
signal
PROCESS DEFINITION


THATec
Innovation
thaTEC:OS
IP: 127.0.0.1
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DEVICES / FUNCTIONS
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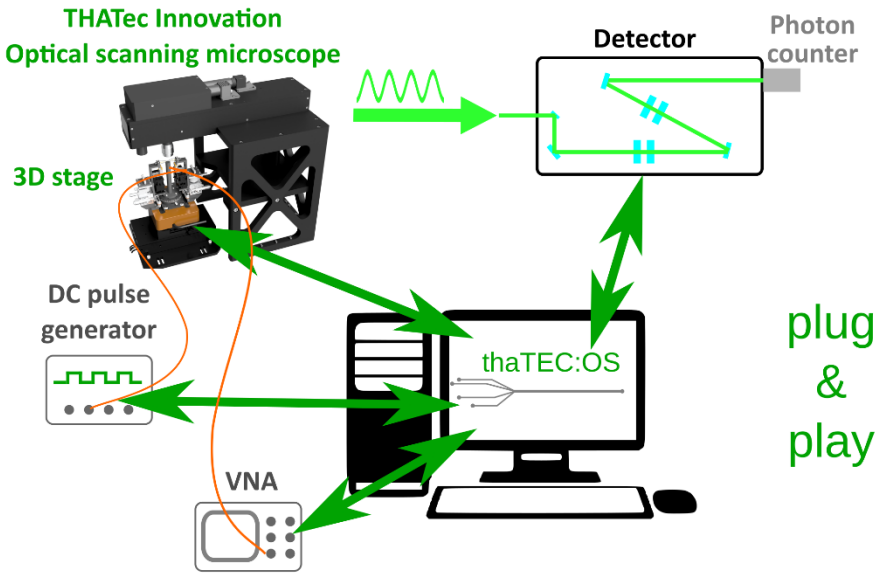
signal generator
frequency (GHz)
output
power (dBm)
lock-in amplifier
signal
PROCESS DEFINITION
signal generator - frequency (GHz)
lock-in amplifier - signal
drag & drop

thaTEC:OS

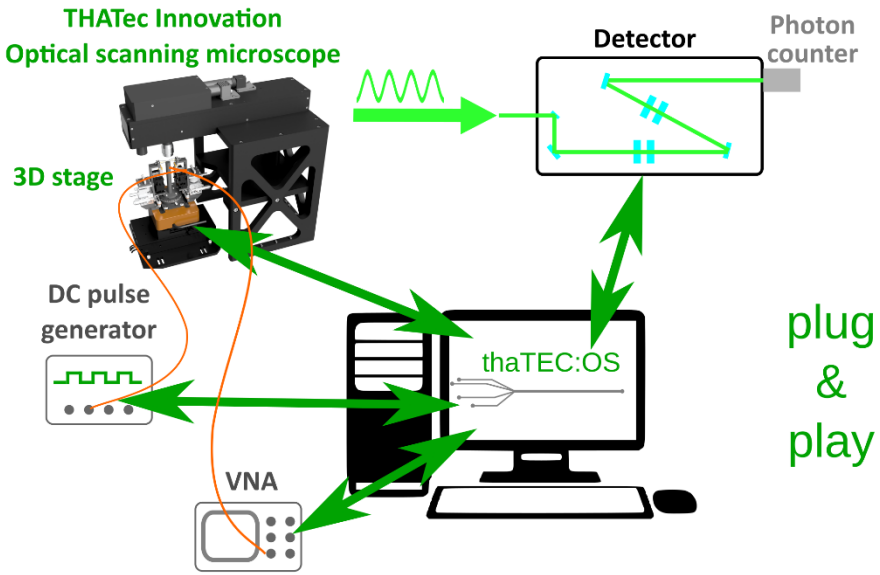
Extend your setup with new devices or substitute devices



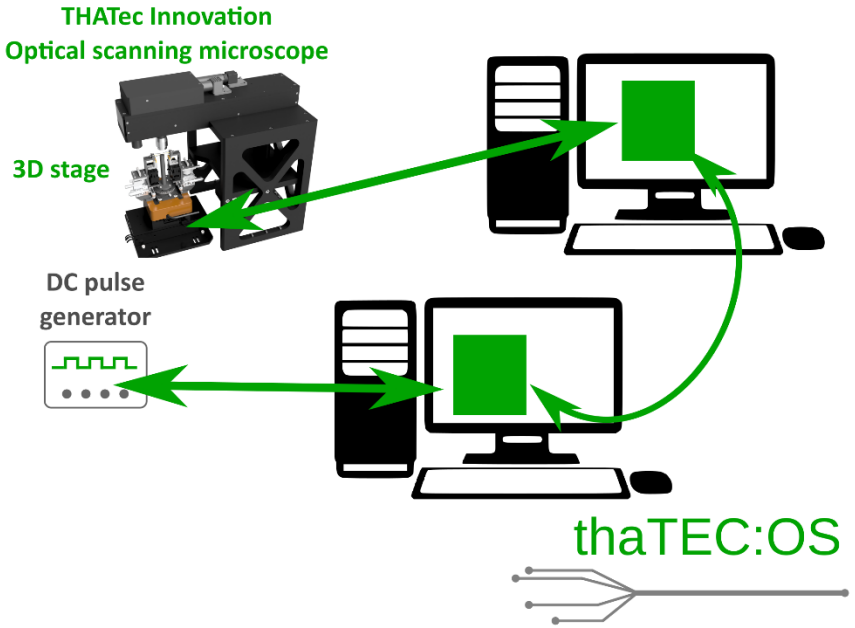
plug & play

thaTEC:OS

Extend your setup with new devices or substitute devices



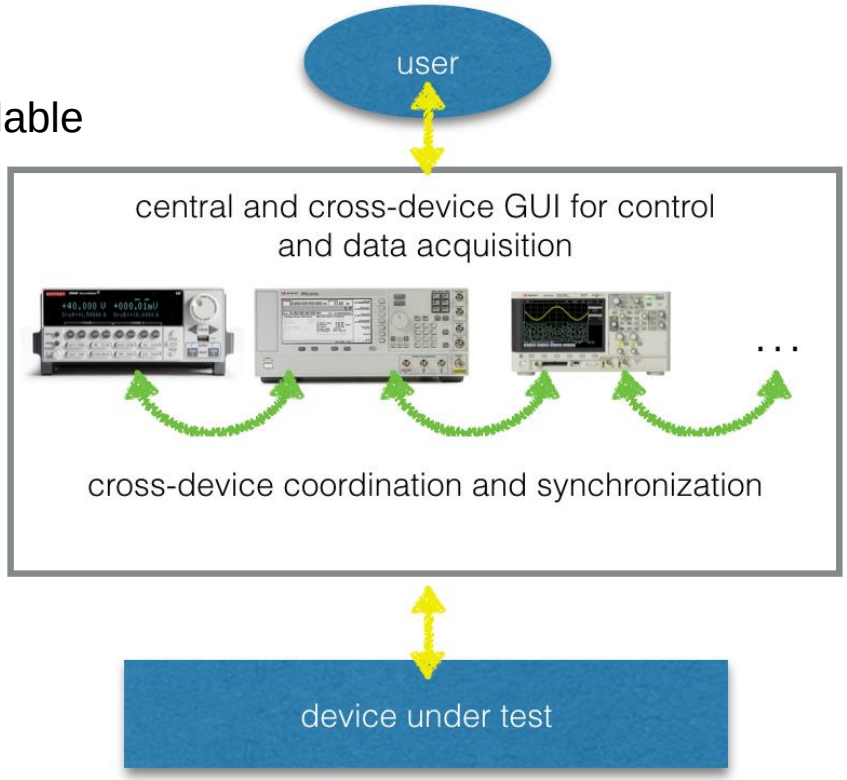
plug & play



Running out of hardware interfaces? Distribute your devices on as many PCs as you like

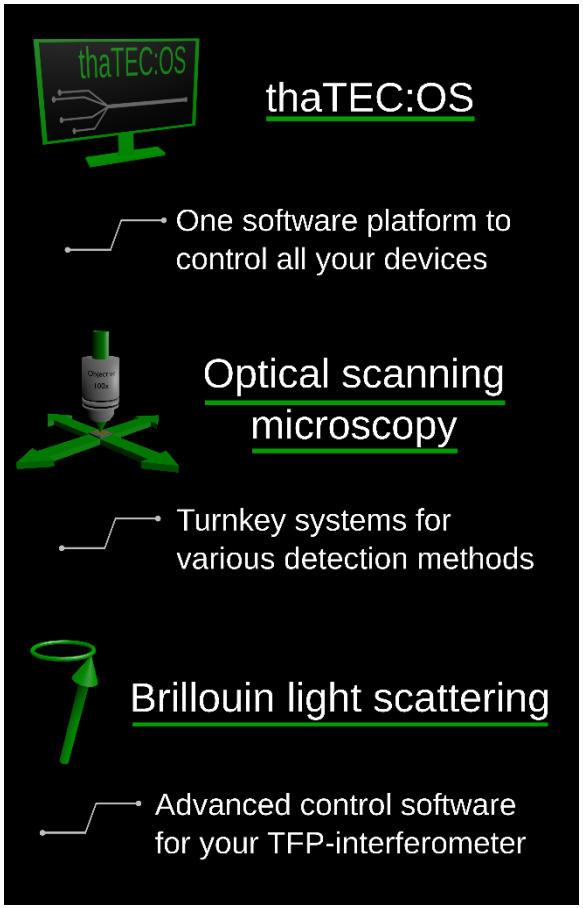
thaTEC:OS

- Central interface to control all your devices
- Easy cross-device automation via drag&drop
- Powerful visualization tools
- Digital lab book in measurement database
- Large device library available
- Extend it yourself: programming templates available
- Minimal training efforts
- Long-term solution



Ideas for a startup

1. Cross-device measurement protocol
   - ac/dc sources, electromagnet, …
2. Scanning microscopy
   - custom hardware
   - position stabilization, scanning
3. Tandem Fabry-Pérot interferometer



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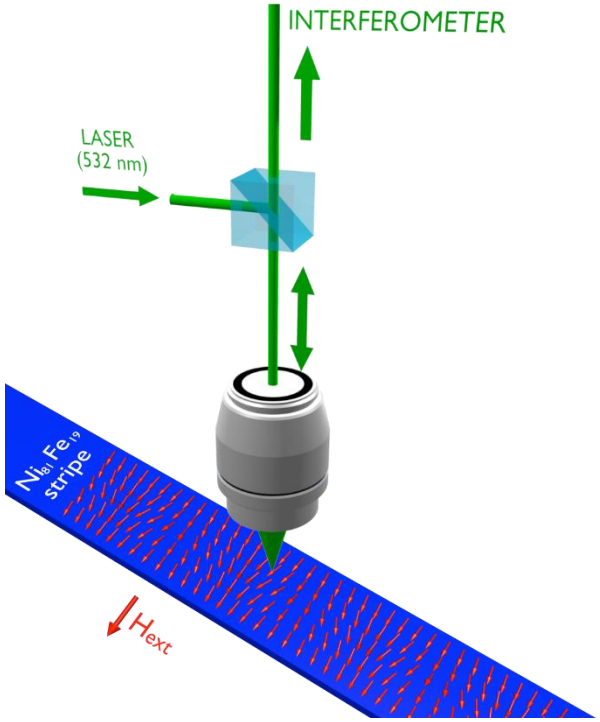


History

Early in 2015: Team

- technical aspects: qualification
- motivation / ready to take risks?
- external team members / job interviews?
- *shared* CEO?

Helmut Schultheiß

My own considerations

- Offer solutions for scientists
- Build something new based on my expertise
- Software development is not too risky
- Define own priorities
- Create my own work environment
- Interest of friends/colleagues to join the company

Thomas Sebastian

History

Early in 2015: Team

- technical aspects: qualification
- motivation / ready to take risks?
- external team members / job interviews?
- *shared* CEO?

Helmut Schultheiß

From April/May 2015: Proposal phase

- meeting with technology transfer department
- discussion about funding options
- discussion about business plan / potential markets
- discussion about shares / licenses
- accelerator programs?
- joint work on proposal

Thomas Sebastian

Fraunhofer VENTURE

HELMHOLTZ GEMEINSCHAFT

eXIST

High-Tech Gründerfonds

THE EUROPEAN SCHOOL ON MAGNETISM

Team and Proposal

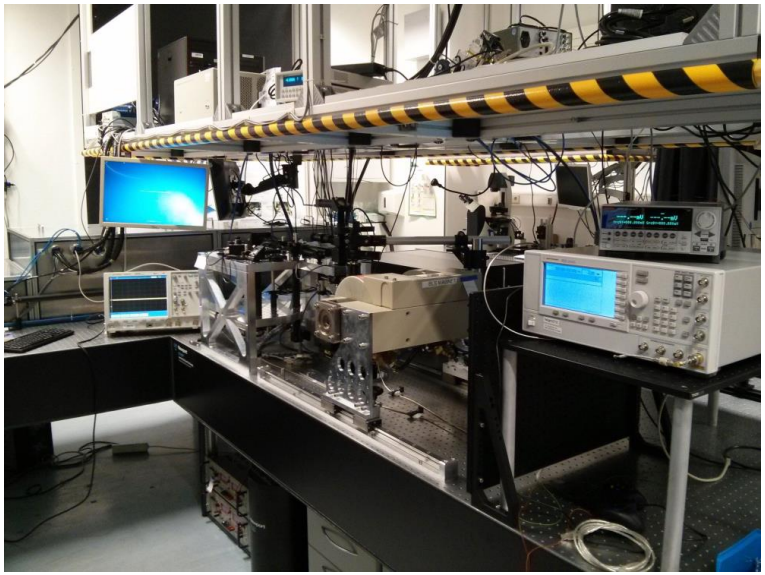
Dr. Attila Kákay

Dr. Helmut Schultheiß

Dr. Thomas Sebastian

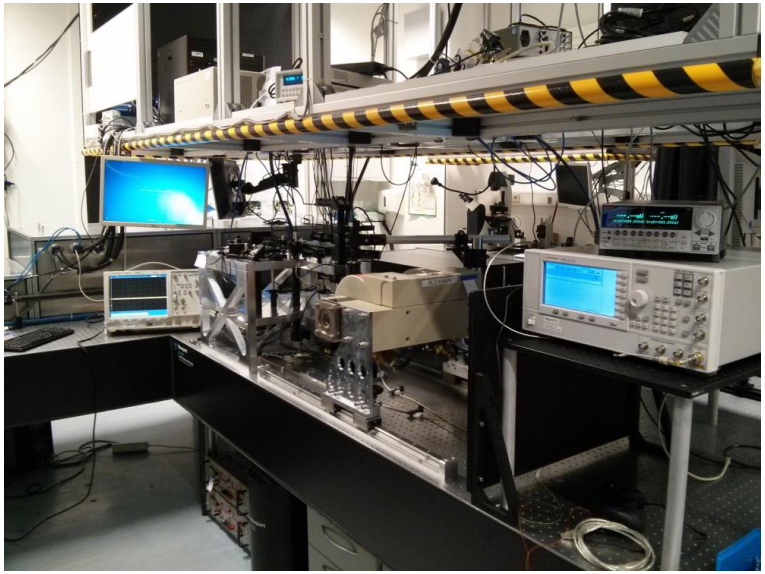
Andreas Henschke

HELMHOLTZ GEMEINSCHAFT



Team and Proposal

How to sell this idea to referees without scientific background?

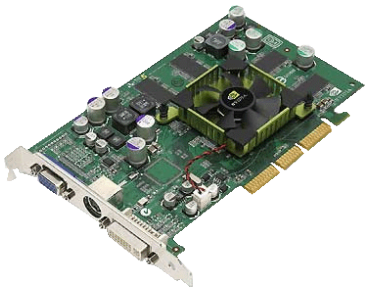


Proposal

- text processing
- spreadsheet
- presentation
- music, videos, …
- ….

Proposal

coordination of
internal components



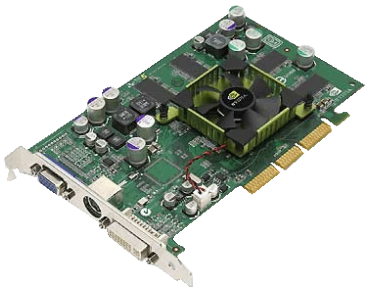
extension via
external components
plug&play

Proposal

operating system

1. coordination & synchronization
2. interfaces & drivers

coordination of
internal components

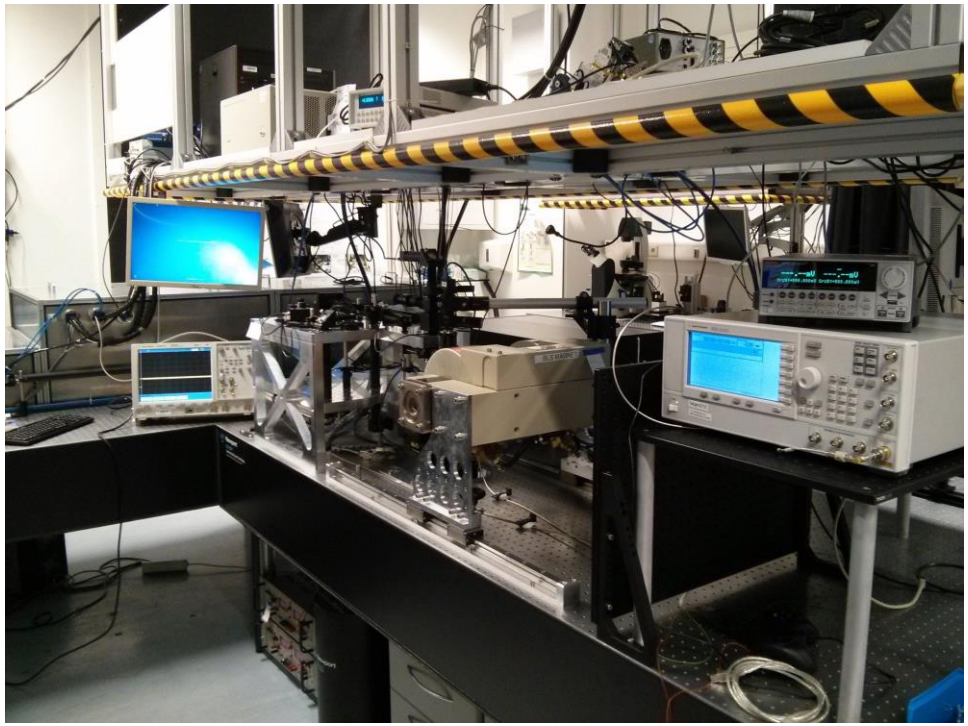


extension via
external components
plug&play

Operating System for Labs

operating system

1. coordination & synchronization
2. interfaces & drivers



- our solution: thaTEC:OS
- collection of more than 20 LOIs
- survey about willingness to pay

History

October 2015: submission of proposal
- Helmholtz Enterprise

December 2015: project presentation
- Helmholtz in Berlin

April 2016: start of funding period
- participation at Fdays (Fraunhofer accelarator program)
- midterm evaluation in August

August 2016: foundation of company
- Gesellschaftsvertrag: shares / finances

since 2017: start of business activities, sales, break even

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History

August 2018: second full-time employee

- stronger focus on microscopy hardware

Early October 2018: visit to Brno

- Setting up a BLS microscope
- Enjoying Czech hospitality
- Discussion about the ESM 2019

Thomas Meyer

History

August 2018: second full-time employee

- stronger focus on microscopy hardware

Thomas Meyer

Early October 2018: visit to Brno

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- Enjoying Czech hospitality
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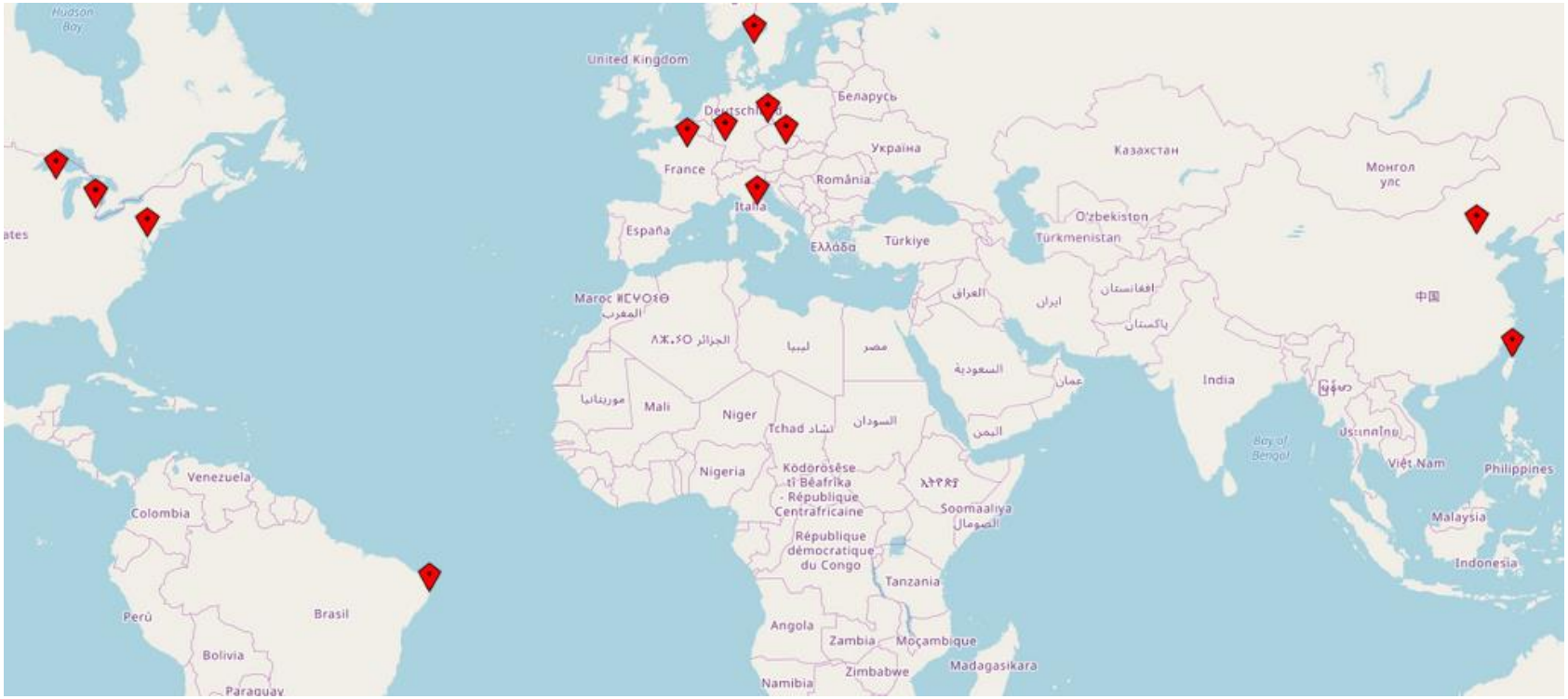
End of October 2018:
***real* vacation for me**

History

Labs running thaTEC:OS



Experimental techniques: Brillouin light scattering, magnetooptical Kerr effect, electrical transport measurements, Raman scattering, optical detection of phase-resolved FMR, fluorescence measurement, …

Lessons learned?

1. Minimum marketable feature
   - Identify what can be used immediately
   - Find test users as early as possible
   - Talk to potential users as early as possible

2. Marketing, marketing, marketing

3. Finances: Everything takes longer than expected

Daily work

the fun part

- freedom to realize your own ideas
- freedom to organize your work as you wish
- technical aspects / developments
- contacts to basic research, visits to labs all over the world

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new playgrounds

- marketing
- exhibition stands
- practical / workshops
- social media

thatecinnovation

@thatecinno

THATecInnovation

YouTube

Daily work

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new playgrounds

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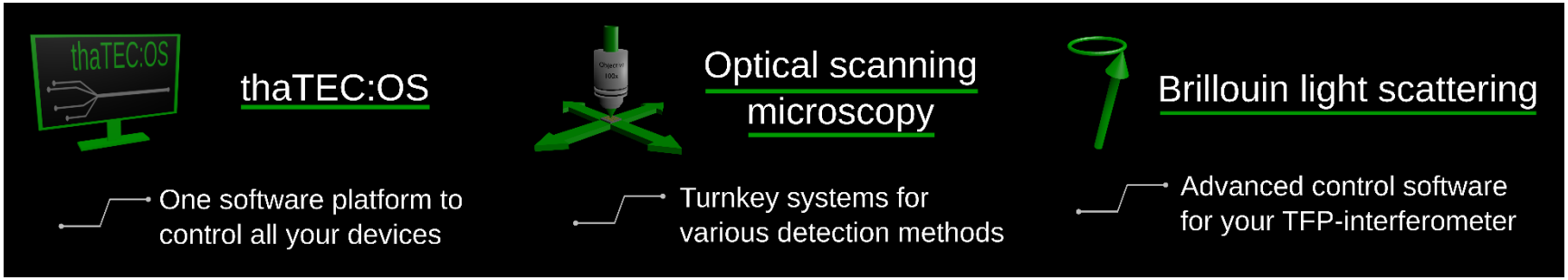
annoying obligations

- finances
- insurances
- taxes, customs, legal dealings
- infrastructure
- …all the responsibility and risk

THATec Innovation

By scientists for scientists – Let's automate your lab!



Thank your for your attention!

https://www.thatec-innovation.com
contact@thatec-innovation.com

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funded in the framework of
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