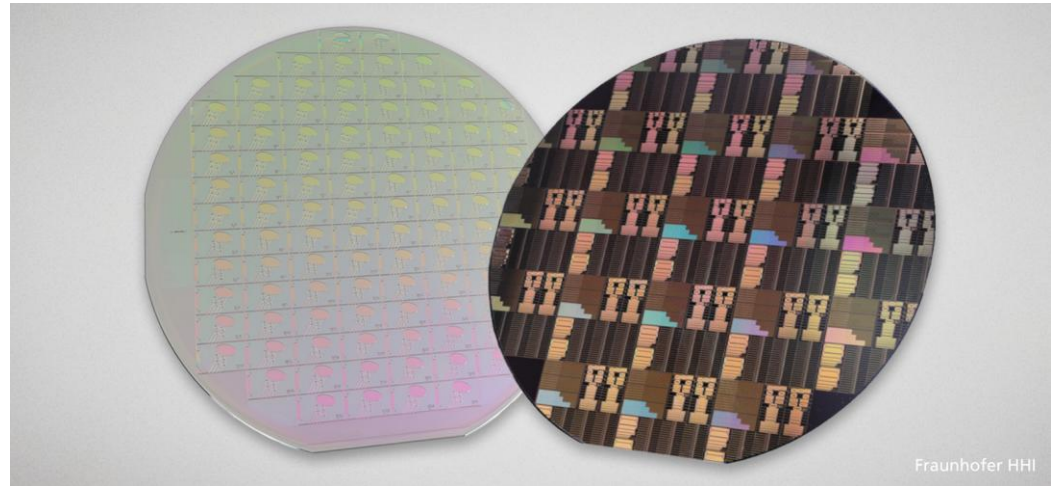


SiN and Polymer PICs for Sensing

Prof. Dr. Martin Schell

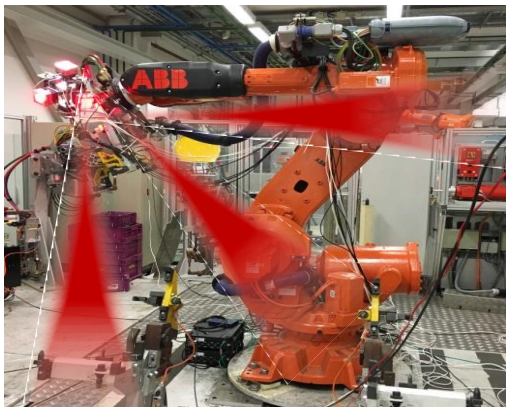
Fraunhofer Heinrich Hertz Institute



Fraunhofer HHI: Photonics for Communication and Sensing

50 Mio € Budget, 400+ people, 80% self-financed

Photonic & Quantum Networks

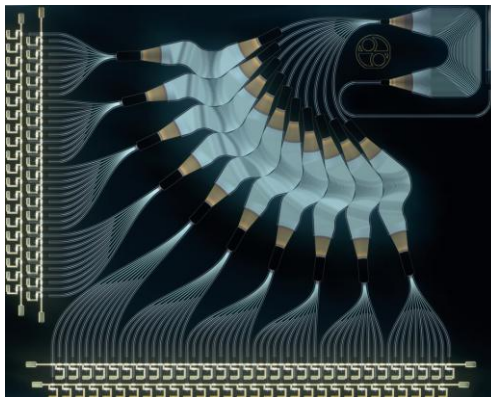


LiFi for high speed data in EMI environments

Quantum Key Distribution

100 GSample/sec data processing

InP, TFLN and RF PICs

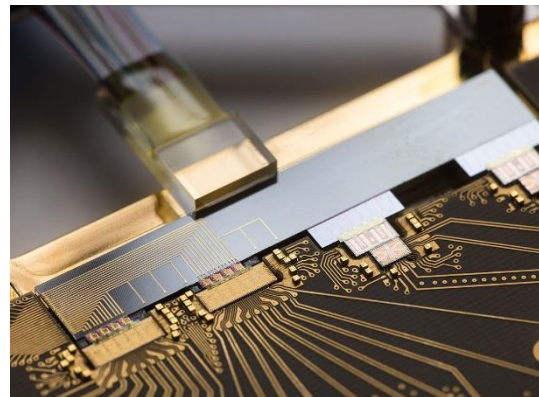


One of ww. two InP MPW foundries

Thin film Lithium Niobate for
450 ... 4000 nm

Up to 145 GHz

Hybrid PICs and Terahertz



Polymer low cost / high
functionality waveguide platform

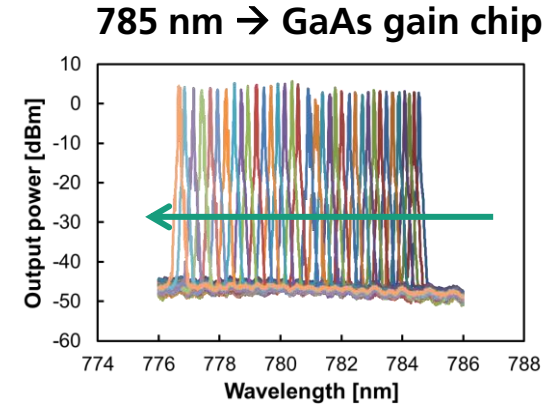
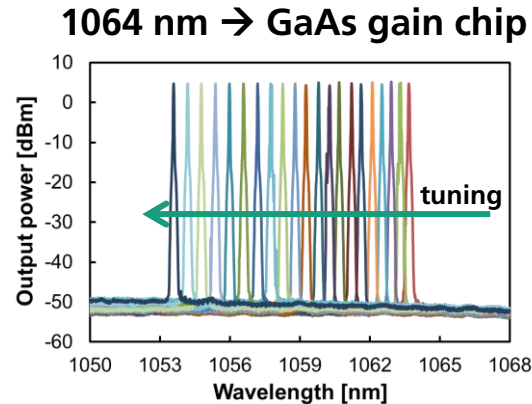
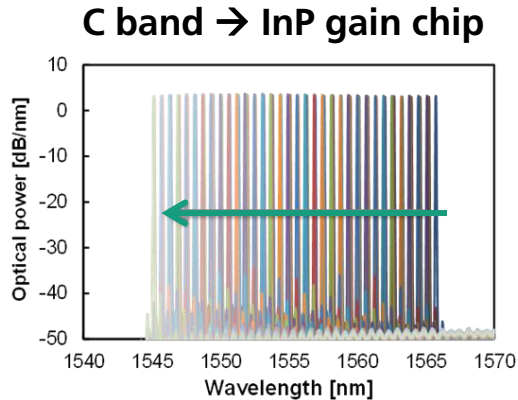
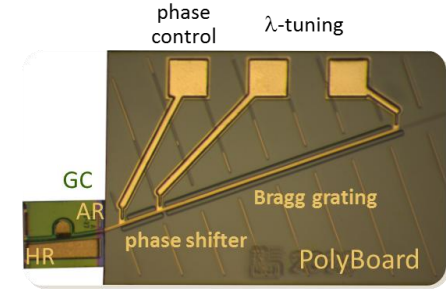
Hybrid InP/GaAs SiN PICs

Terahertz Sensing

Polymer Hybrid Photonic Integrated Circuits

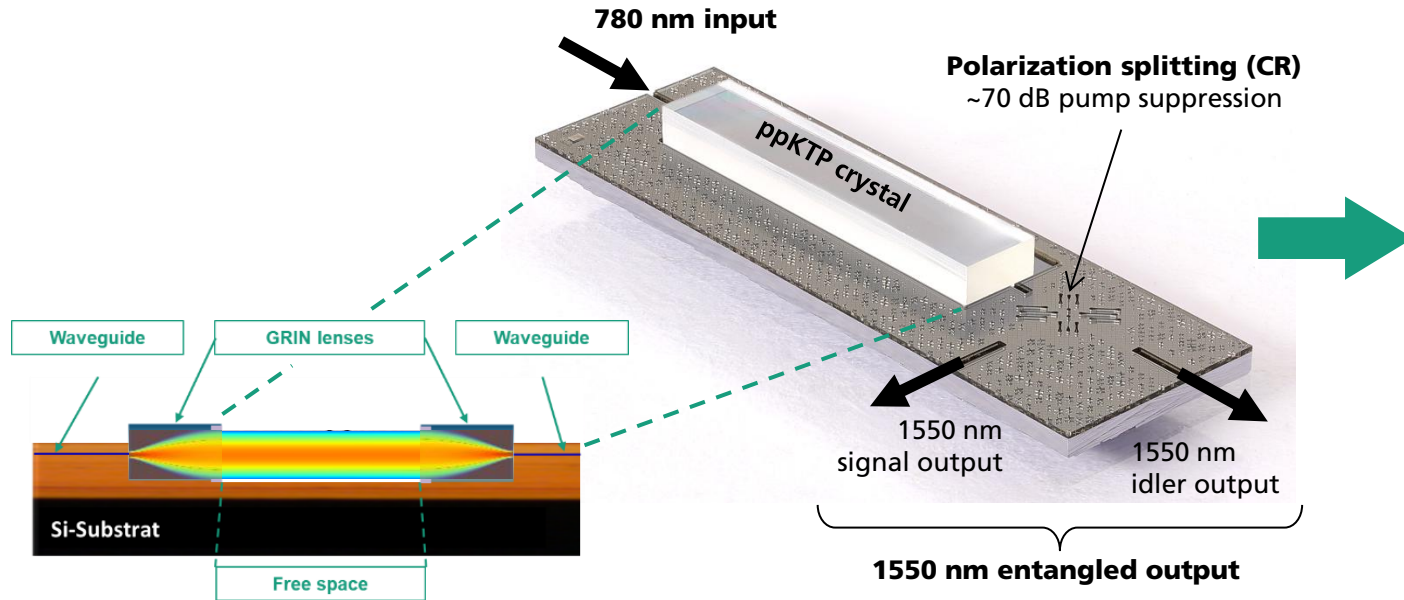
Tunable lasers from communications to sensing

- Single photons via weak coherent pulses
- Integrated pump for non-linear optics
- Laser concept can be transferred into VIS \rightarrow gain chip material

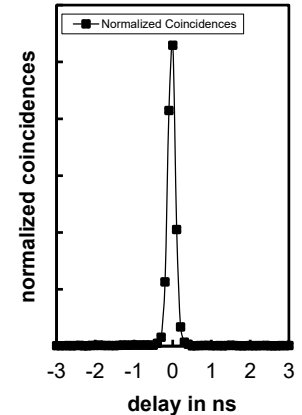


Integrated 1550 nm Photon Pair Source

Enabled by micro-optical bench and hybrid integration

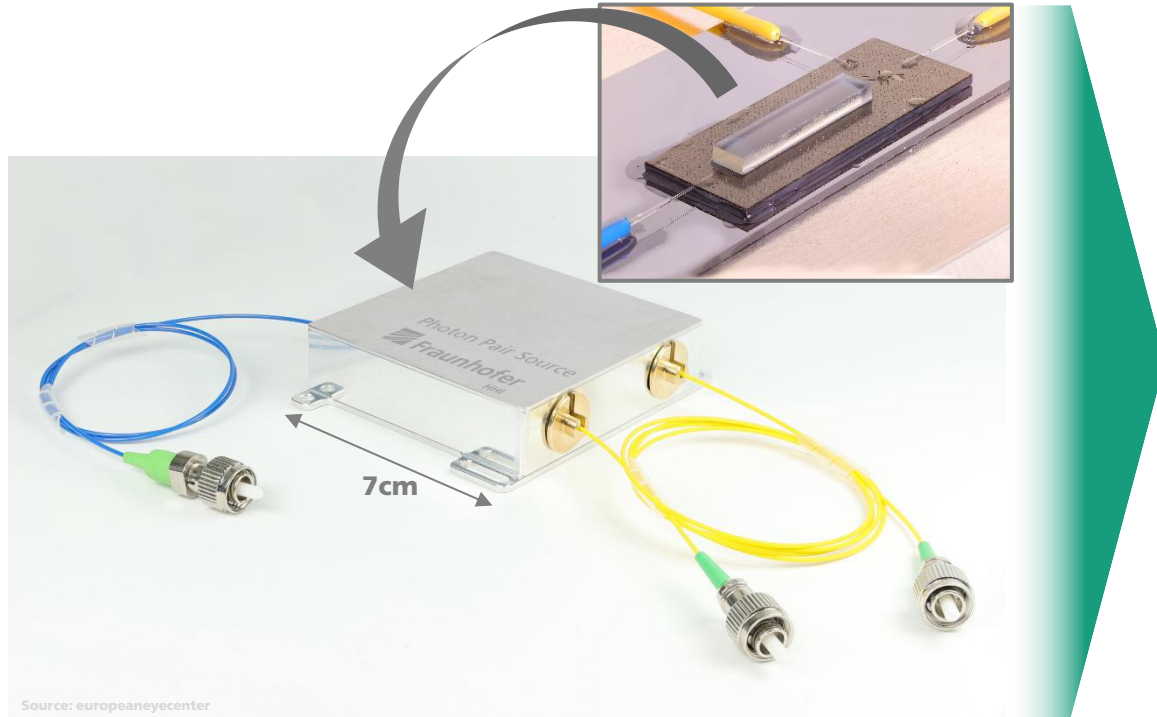


**Photon pairs
→ bunching**



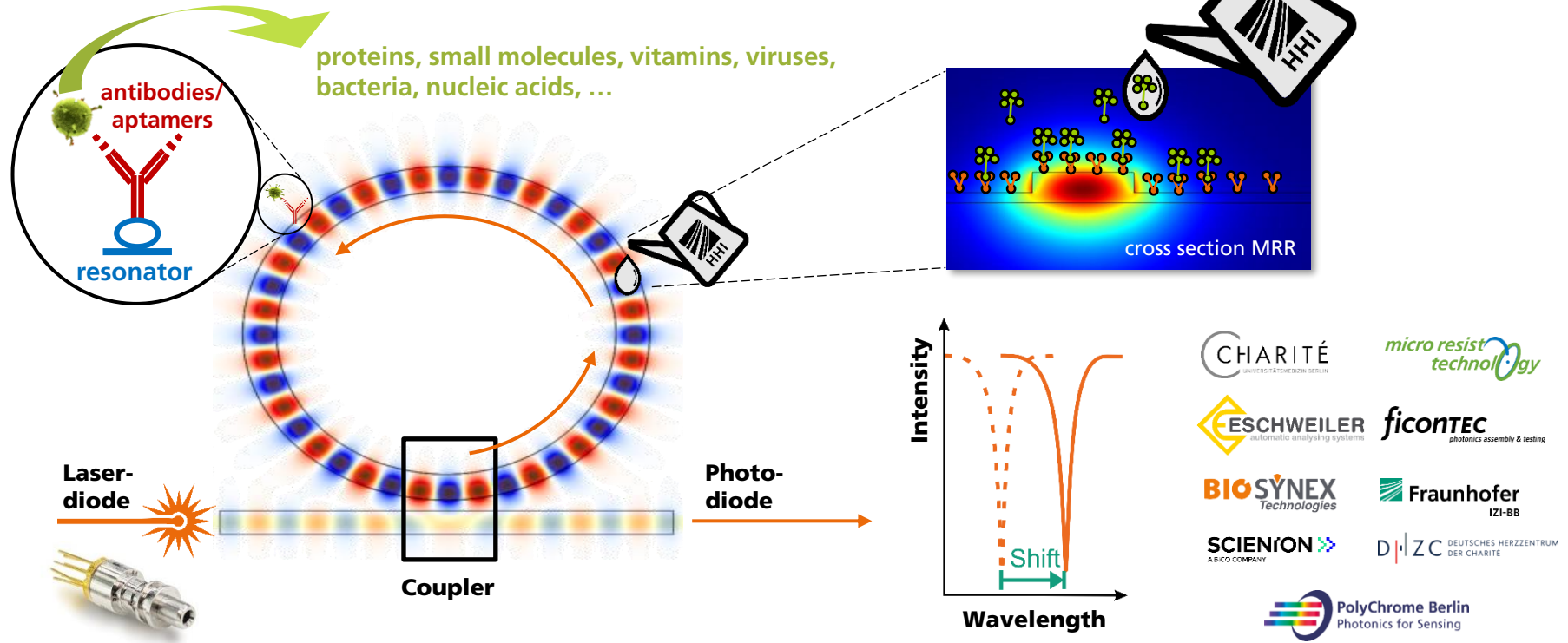
Miniaturized Quantum Modules for High-Precision Imaging

Sources for quantum OCT and microscopy with entangled photons



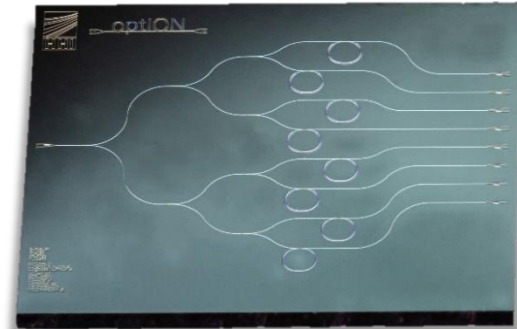
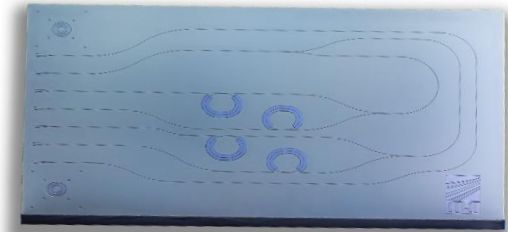
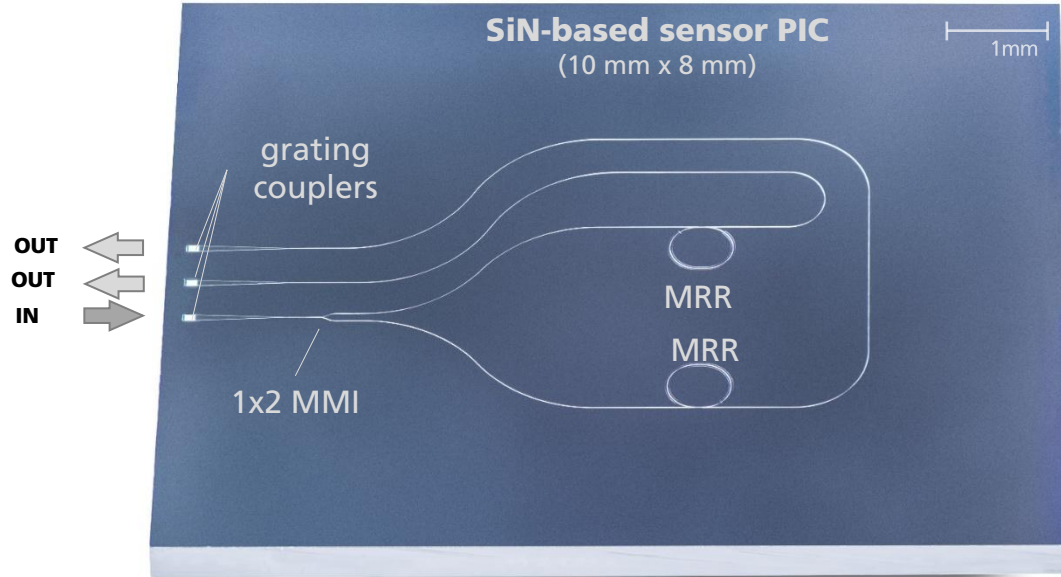
SiN Microrings for Sensing

Biosensors for Point-of-Care diagnostics and analytics



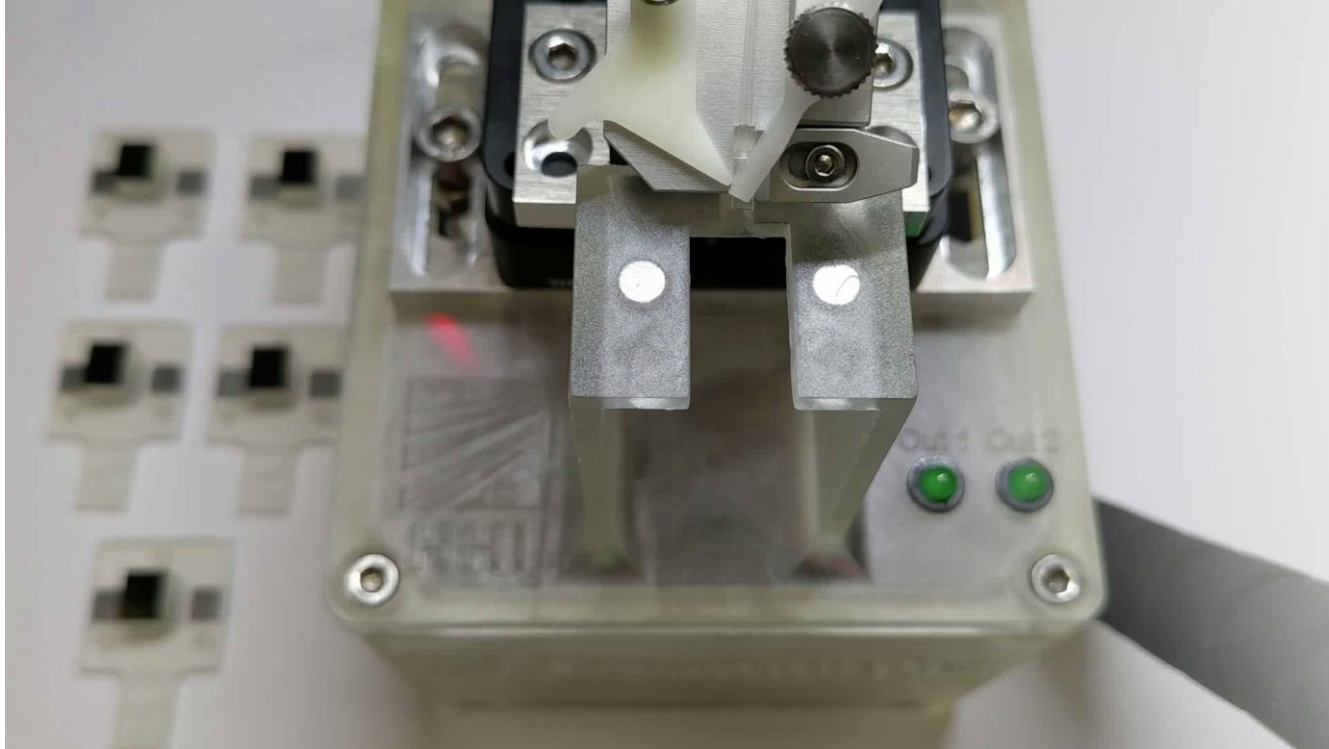
Multiparameter Diagnostics

Scalability by Photonic Integration



Demonstration of Passive Single-Mode Coupling

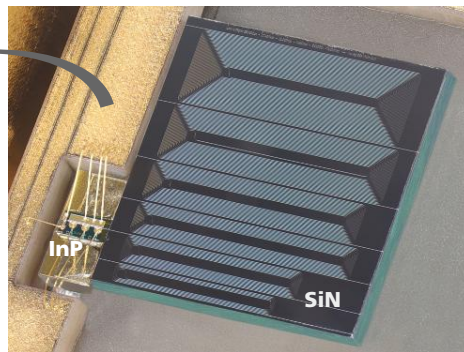
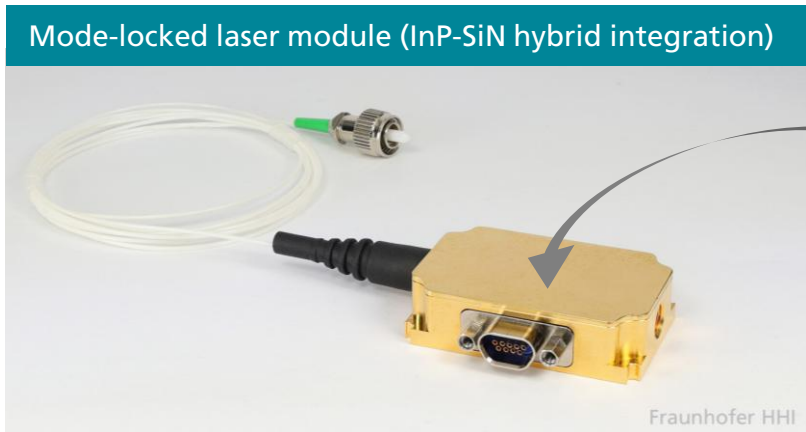
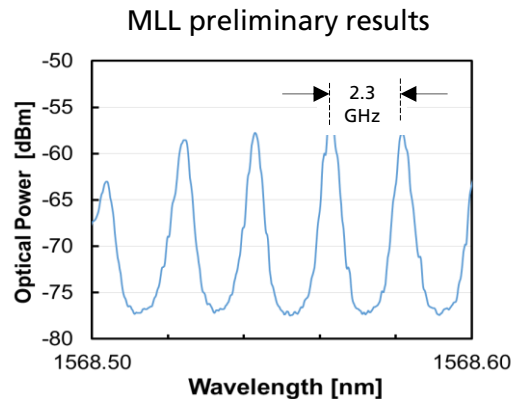
Watch it live at booth A2:117 !



SiN Integration Platform: Coupling to Actives

Mode-locked lasers for sensing

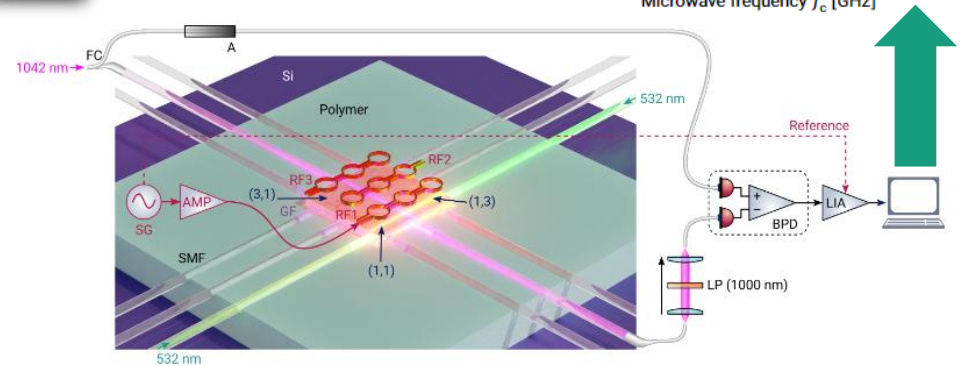
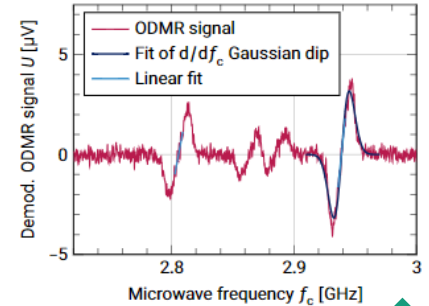
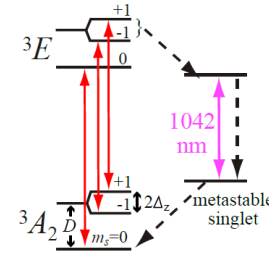
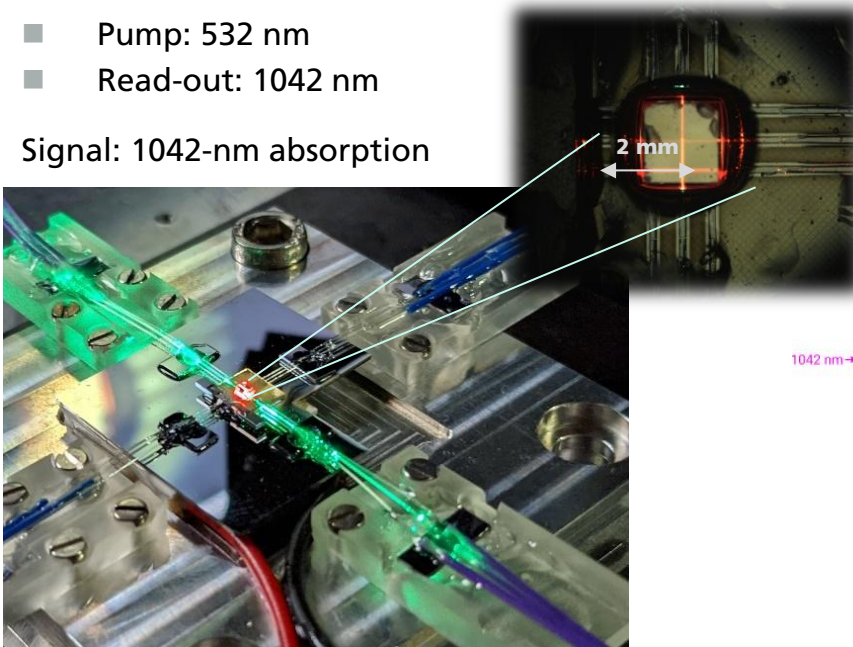
- InP-based MLLs w/ tailorable repetition rates demonstrated
- Narrow-linewidth tunable lasers (< 1 kHz) in development
- Concept can be transferred towards VIS \rightarrow other actives ...



From Complex Setups to Integrated Quantum Sensors

Magnetometry with NV centers in hybrid PICs

- 3x3 Pixel Array
 - Pump: 532 nm
 - Read-out: 1042 nm
- Signal: 1042-nm absorption

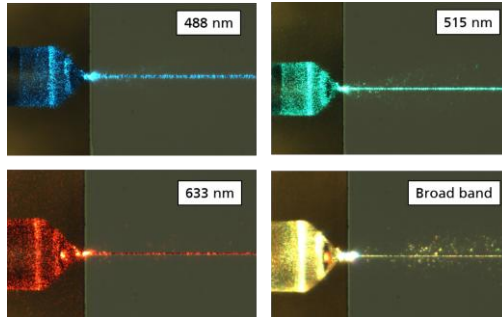


Julian M. Bopp et al.: Diamond-on-chip magnetic field camera for mobile imaging, Phys. Rev. Applied 23, 034024 (2025)

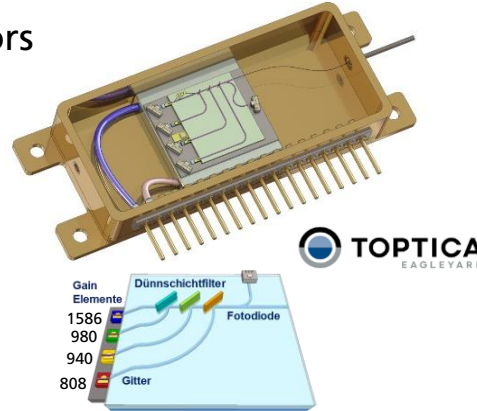
PICs for Sensing

Upcoming developments

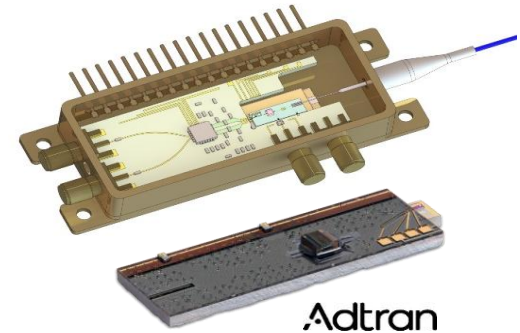
- Si_3N_4 -MPW runs with PDKs (0.2 dB/cm) for C band
- Prototyping in PolyBoard for 780 nm to 1600 nm
- Si_3N_4 and PolyBoard waveguides for VIS laser integration
- Wafer-level microfluidics for biosensors



Si_3N_4 for VIS



Multi- λ source for 808 nm .. 1586 nm



Adtran
Correlation RPS for fiber sensing



Si_3N_4 -MPWs for 1550 nm

405 nm

532 nm

785 nm

1064 nm

1550 nm

PICs for Sensing

Offers and opportunities for cooperation

What we offer

- Photonic integrated circuits (PICs) for sensing based on mature telecom technologies
- Miniaturized photon pair and entangled photon sources for quantum imaging
- Multiparameter diagnostics with robust SiN disposables
- Multi-pixel magnetometers enabled by on-chip micro-optical bench

What we are looking for

- Partners interested to have their actives (GaAs, GaN, ...) integrated with PICs
- Partners interested in leveraging our SiN and PolyBoard technologies to solve their challenges
- Application partners in medical device engineering