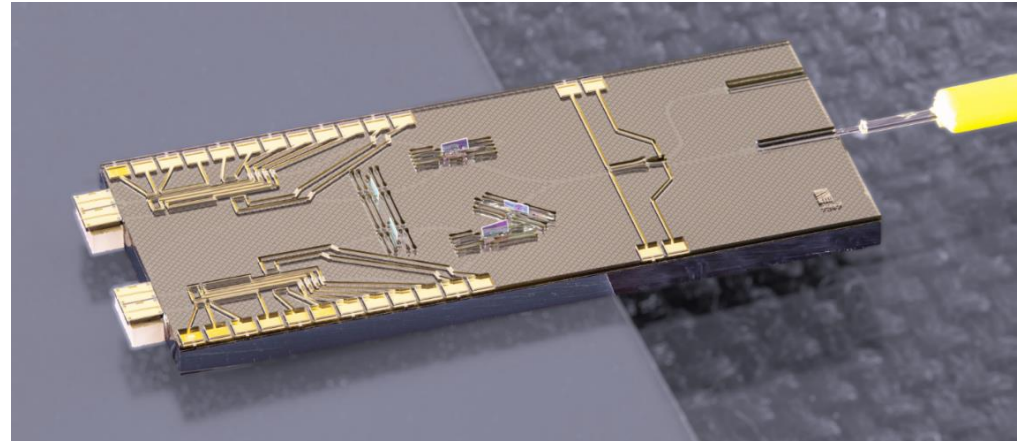


# Hybrid Photonic Integration at Fraunhofer HHI

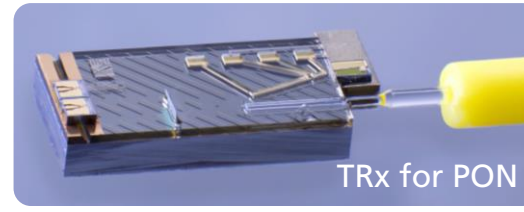
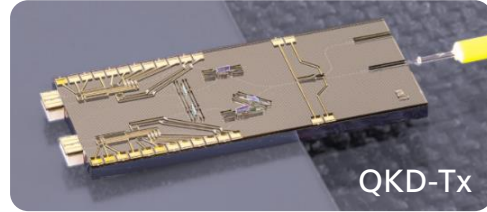
From optical benches to integrated circuits

**Moritz Kleinert**

Fraunhofer Heinrich Hertz Institute  
Photonic Components Department



# Hybrid Photonic Integration at HHI



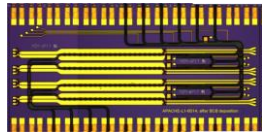
## Hybrid PICs – PolyBoard



Laser



Receivers & Detectors

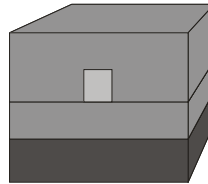


Modulators

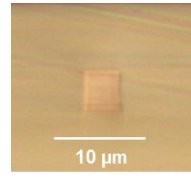


SPADs

### Optoelectronic components InP, GaAs, SOI, LNOI, ...

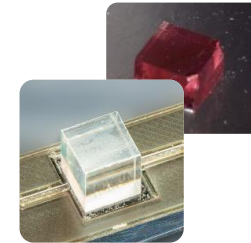


Channel waveguide

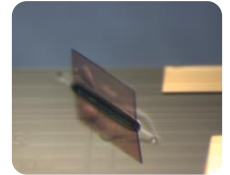


Diced facet

### Single-mode waveguides Polymers, Si<sub>3</sub>N<sub>4</sub>



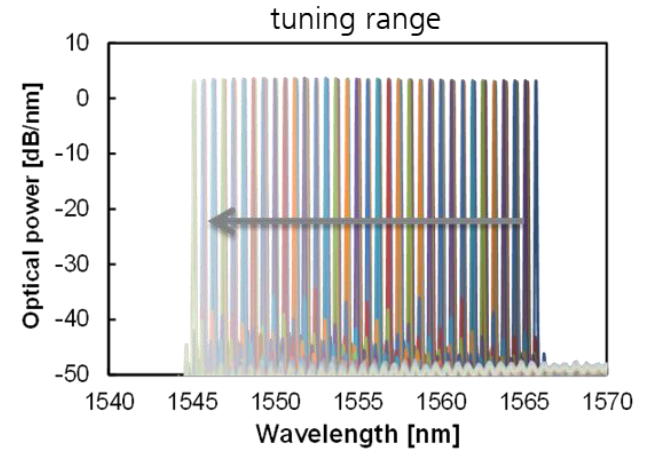
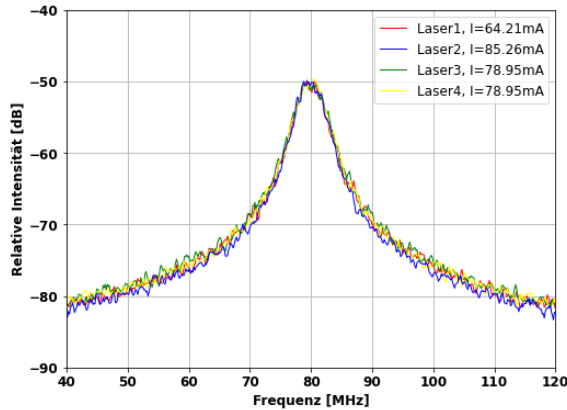
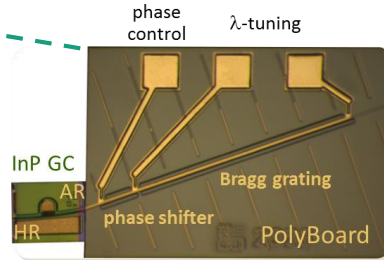
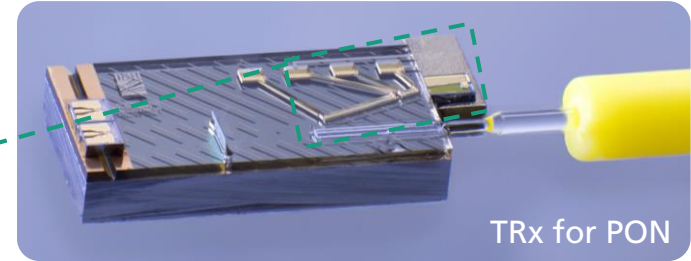
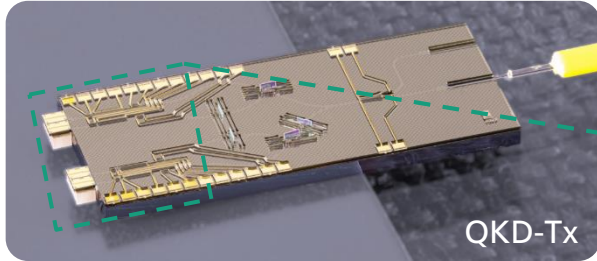
Crystals



Filters

### Micro-optical elements TFFs, ppLN, ppKTP, ...

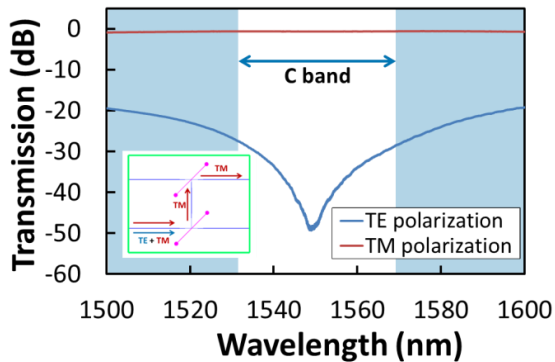
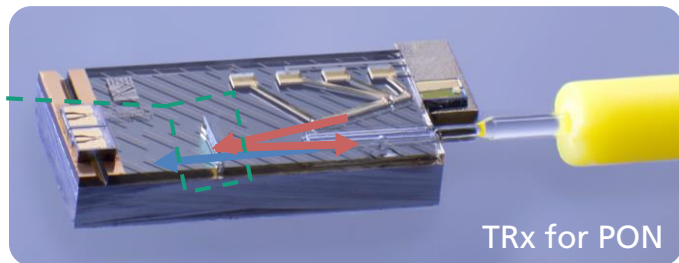
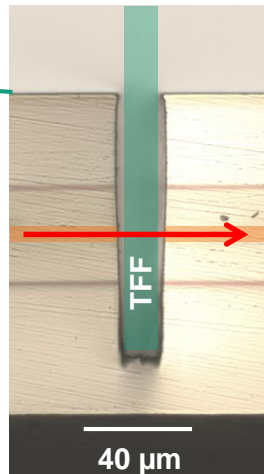
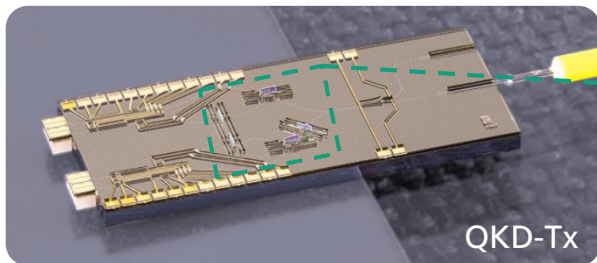
# Tunable Lasers



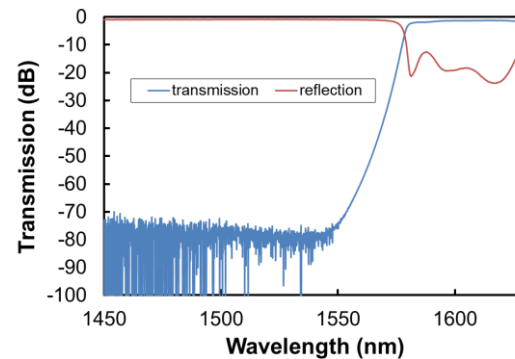
Reproducibility for indistinguishability

20 nm tuning for colorless operation

# Slots & Thin Film Elements

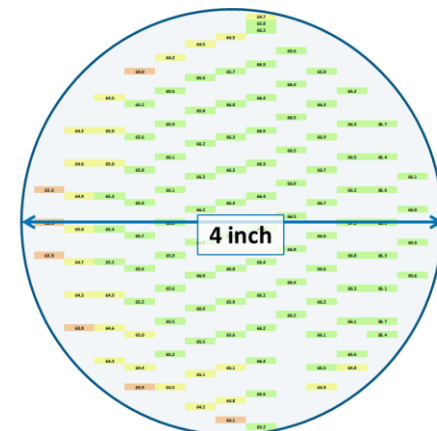
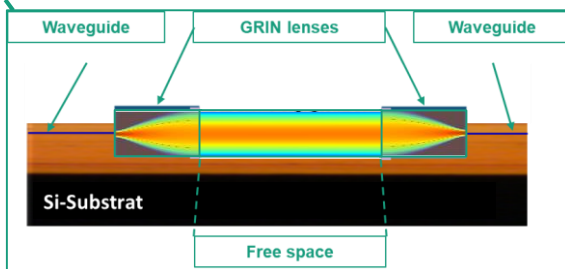
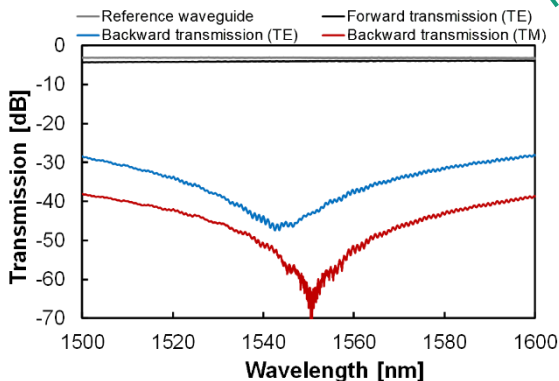
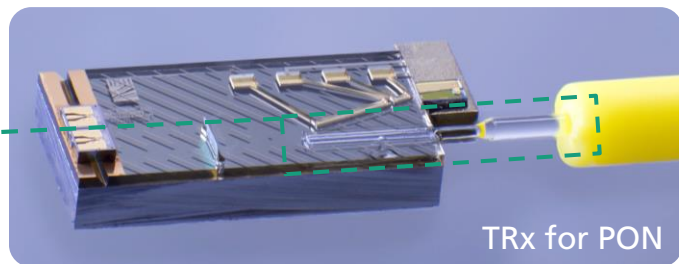
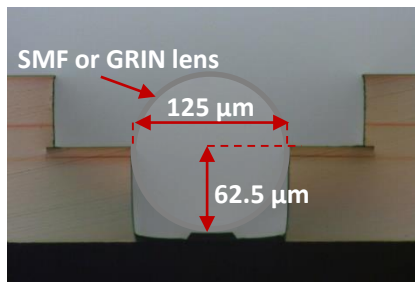
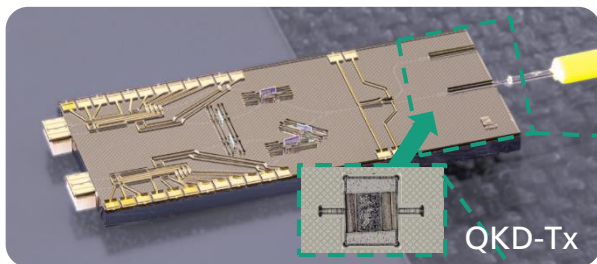


Polarizing beam splitter and half-wave plates



C/L band dichroic mirror

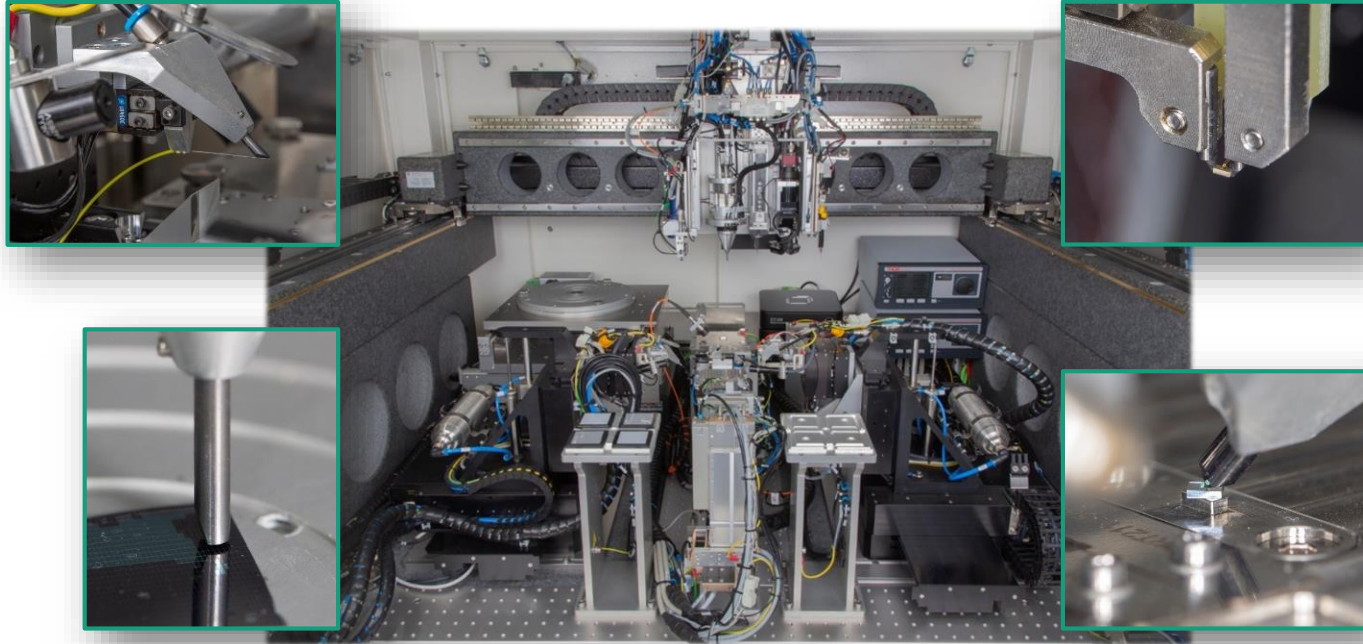
# U Grooves and Micro-Optical Bench



< 1 dB on-chip loss & > 40 dB isolation

$\pm 1 \mu\text{m}$  etching precision for passive alignment

# Hybrid Assembly Automation



ficonTEC CL1500

# Fraunhofer Heinrich-Hertz-Institut, HHI

**WE PUT SCIENCE  
INTO ACTION.**

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