

02.12.2022

## Agenda

- Introduction vario-optics & technology
- Products based on vario-optics photonics boards
- The realization of miniaturized interferometer
- Conclusions

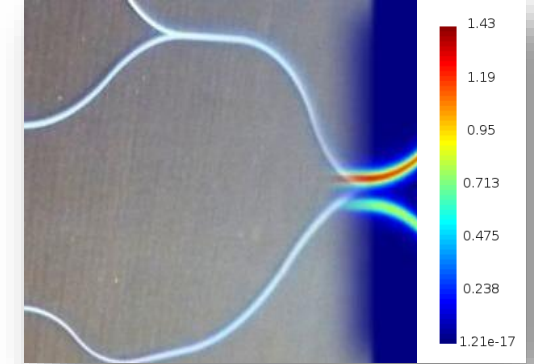
# vario-optics ag

Heiden, Switzerland

- SME based in Switzerland
- Spin-off from Varioprint AG
- Leading manufacturer of EOCBs
- Applications of photonic boards:
  - Photonic Sensing
  - High-speed on-board communication
  - Photonic chip packaging



Cleanroom class ISO 5 (100)



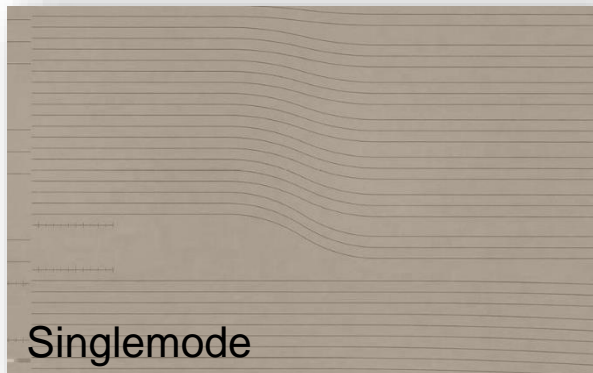
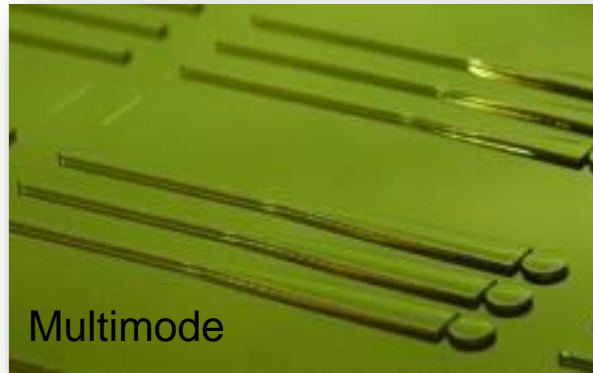
Design & simulation services



## Competences:

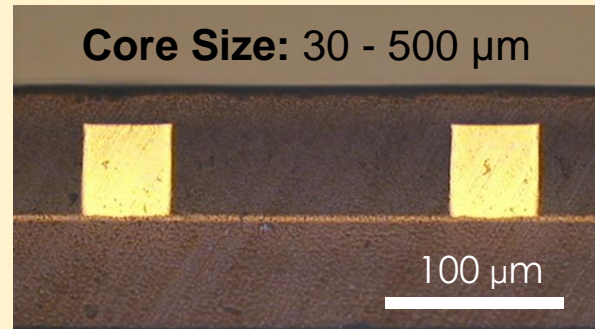
- Design & Simulation of photonic circuits
- Manufacturing & Process IP
- Assembly & Connectorization
- PCB Integration



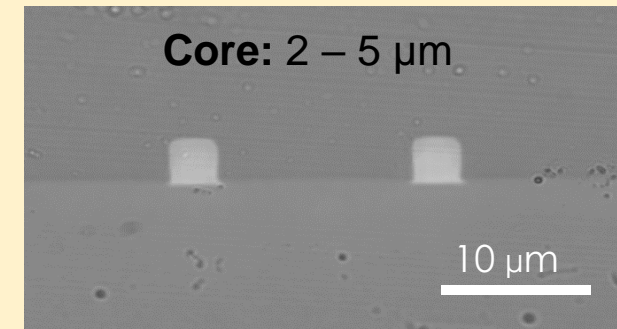


## Polymer Waveguides

### Multimode



### Singlemode

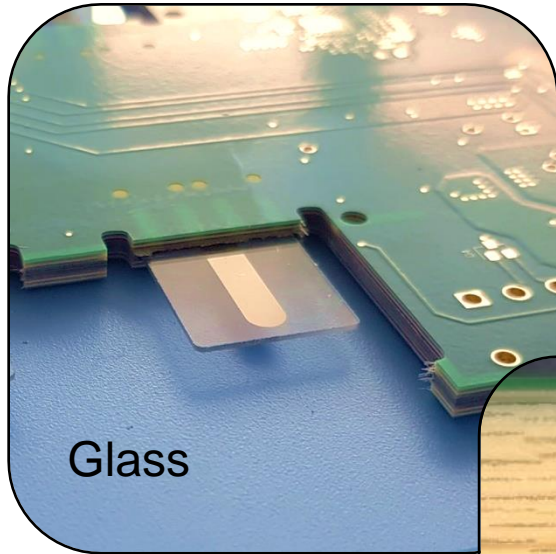


	Multimode	Singlemode
<b>Spectral Range</b>	450 - 1600 nm	850 - 1600 nm
<b>Propagation Loss</b>	0.05 dB/cm (850nm) - 0.5 dB/cm (1550 nm)	

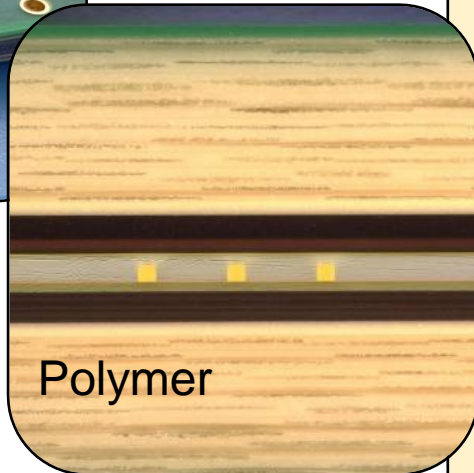
<b>Environmental Stability:</b>	
Operating Temperature	120°C (280°C short time)
Environmental Test	85% rel.h / 85°C for 1000h (Telcordia ongoing)
Temperature Cycling	- 55°C to + 100°C

# Core-Technology: Planar Waveguides

## PCB Integration



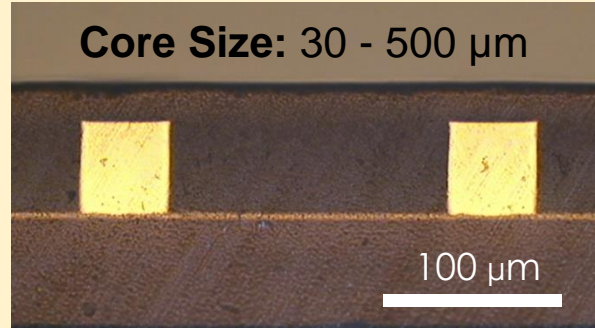
Glass



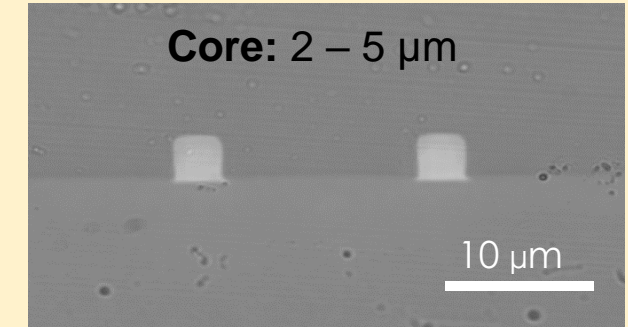
Polymer

Many **optical sensor systems** are optoelectronic systems including PCBs and laser, LEDs, PDs etc

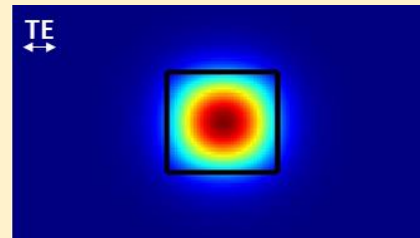
### Multimode



### Singlemode



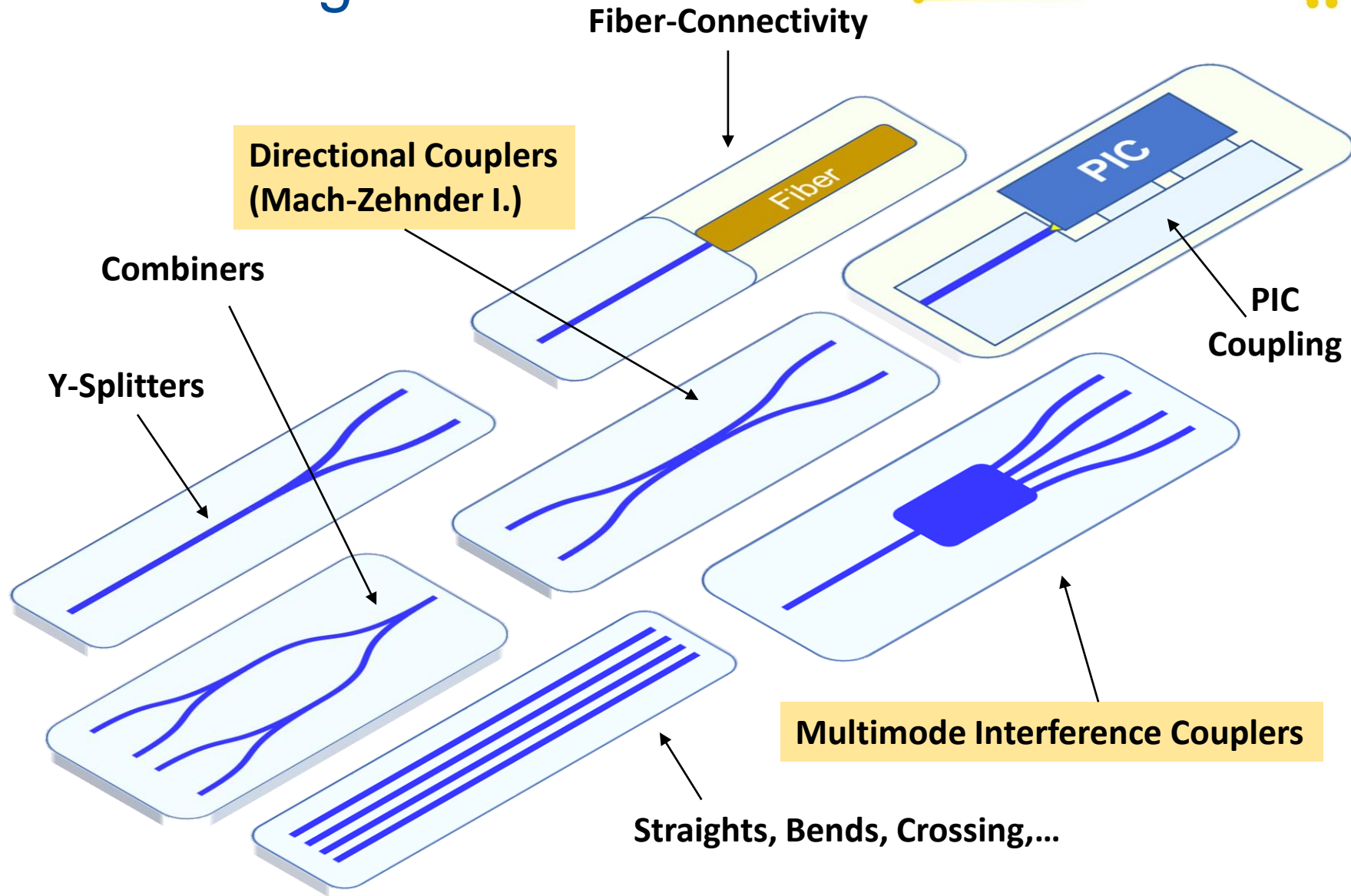
	Multimode	Singlemode
<b>Spectral Range</b>	450 - 1600 nm	850 - 1600 nm
<b>Propagation Loss</b>	0.05 dB/cm (850nm) - 0.5 dB/cm (1550 nm)	
<b>Power Handling</b>	> 1W	> 80 mW



- **Adjustable MFD (4 – 10 μm)**
- **On-chip mode conversion**
- **TE / TM Polarization supported**
- **Polarization maintaining!**

# Portfolio: Waveguide Building Blocks

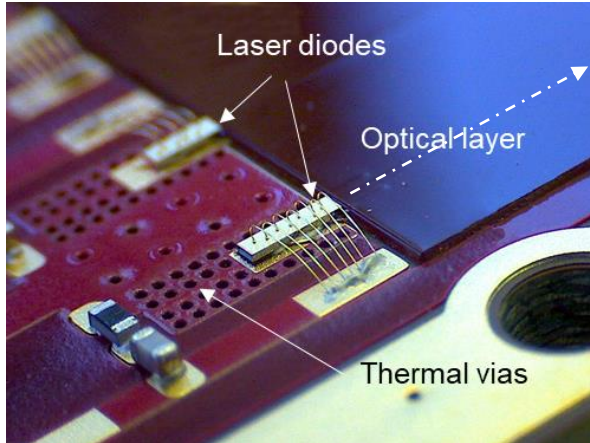
**in-house Simulation & Design**



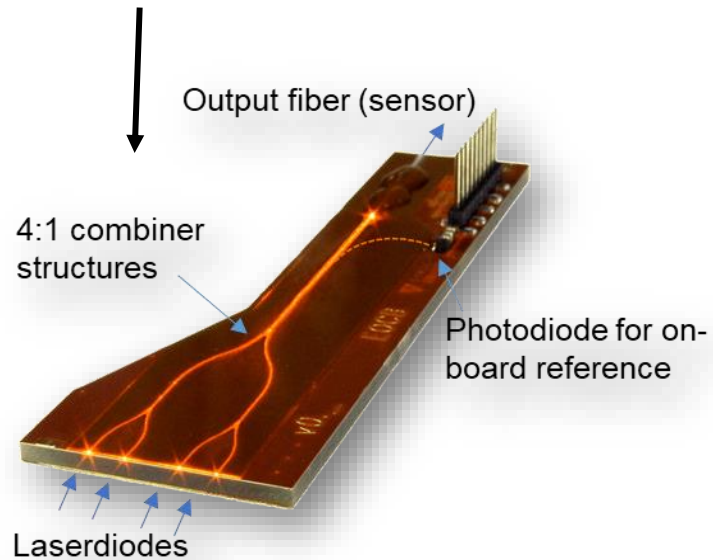


# Sensing Applications

medical & environmental sensors, on-chip Interferometry

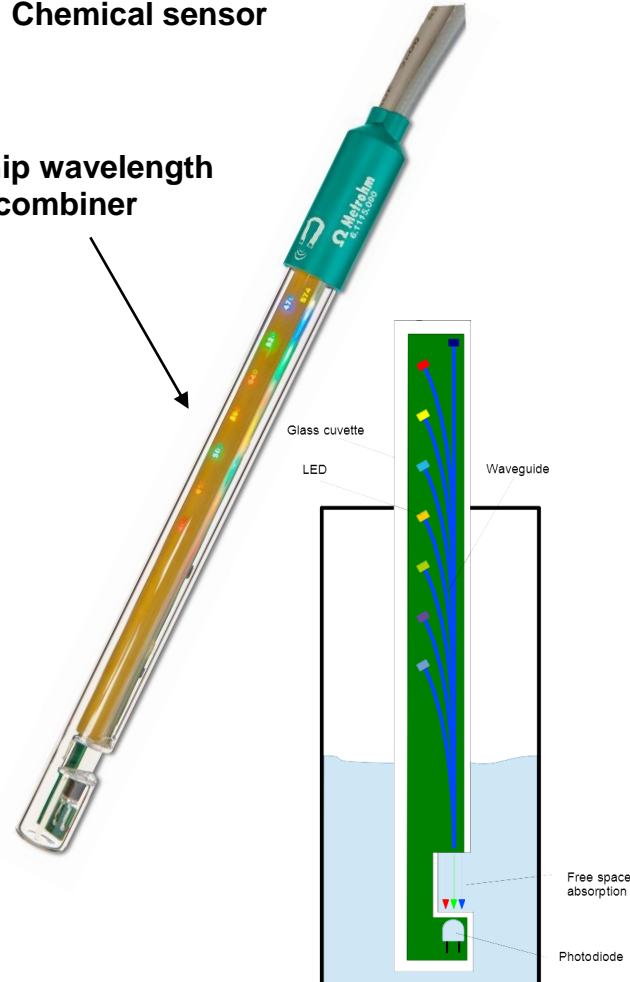


Medical sensor, laser source



Chemical sensor

On-chip wavelength combiner



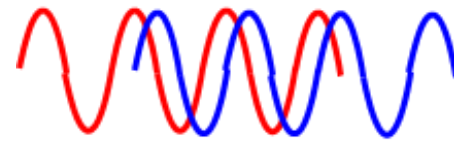
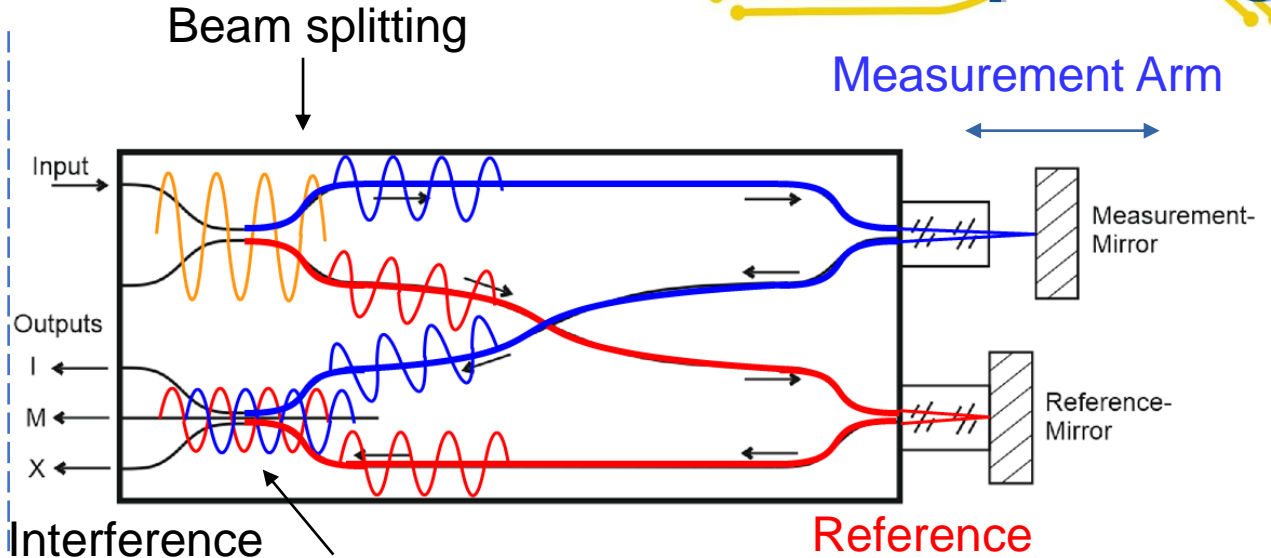
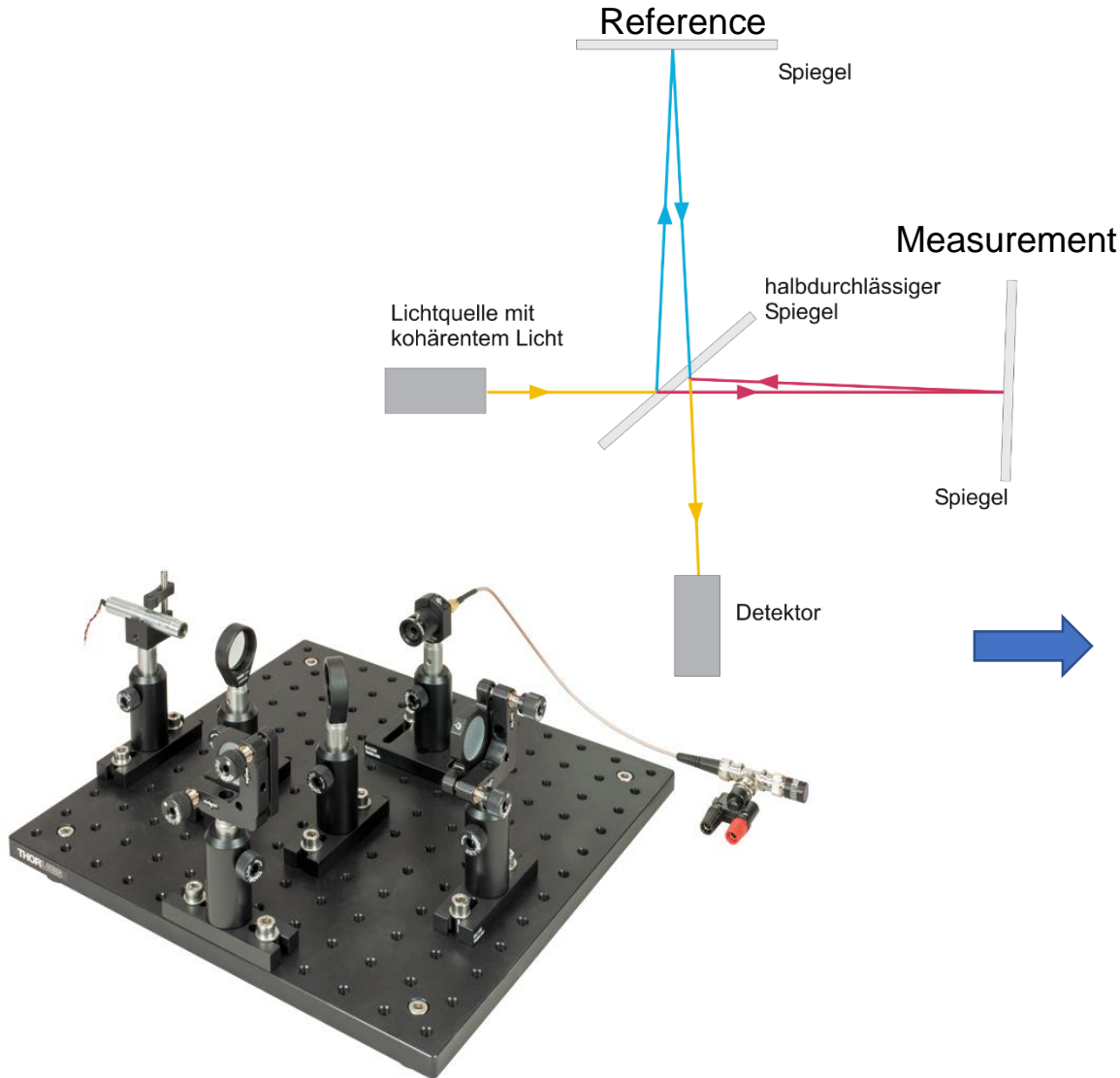
## Applications include:

- Optical oxygen concentration sensing
- Environmental gas sensing
- Particle, vibration sensing
- On-chip interferometric sensing

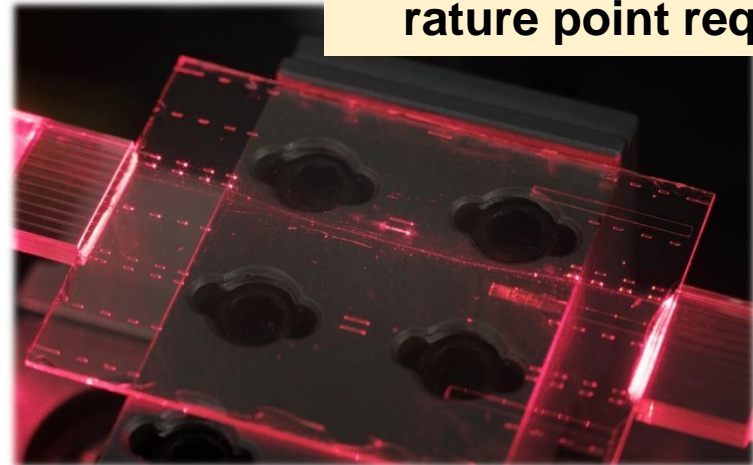
## Features:

- Compact & stable electro-optical sensor units
- Customizable photonic circuits
- Direct mounting of laser diodes, photodiodes, optical layers on PCBs

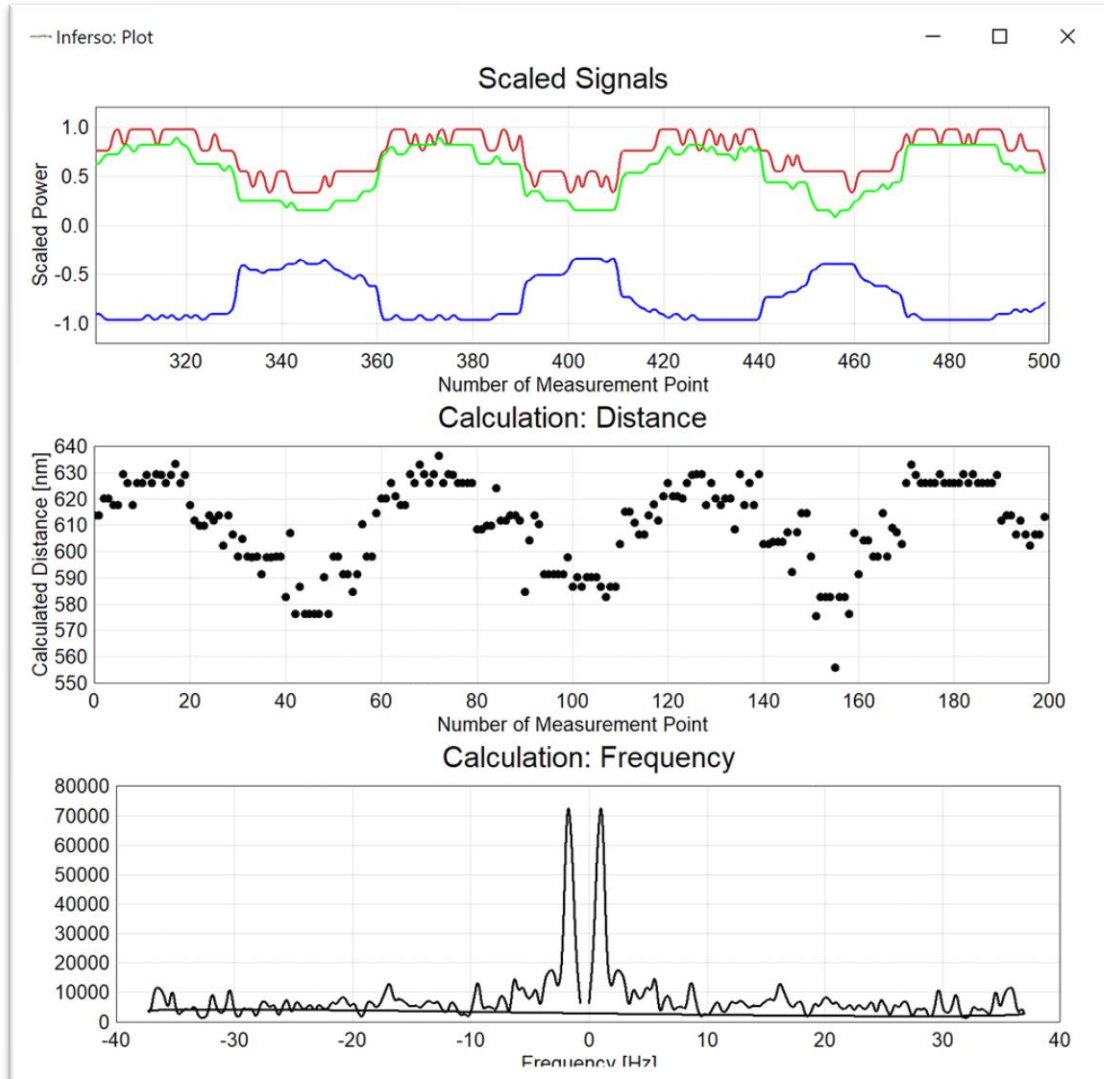
# On-chip Interferometer



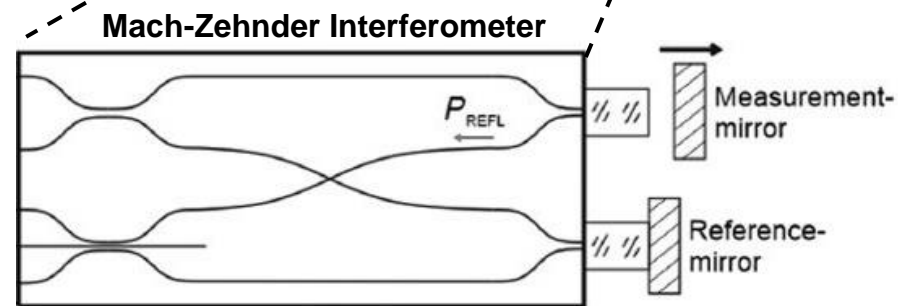
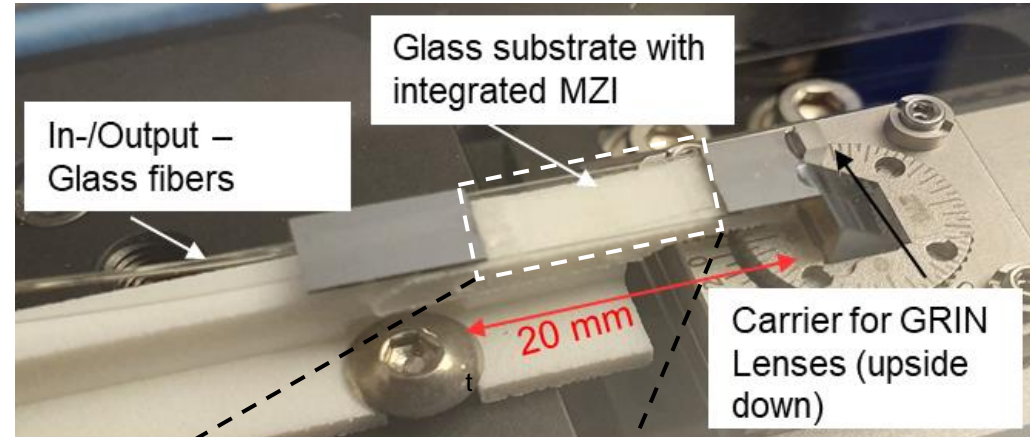
- Sensitive to phase-shift
- nm precision
- no calibration of quadrature point required



# On-chip Interferometer – Distance Sensor



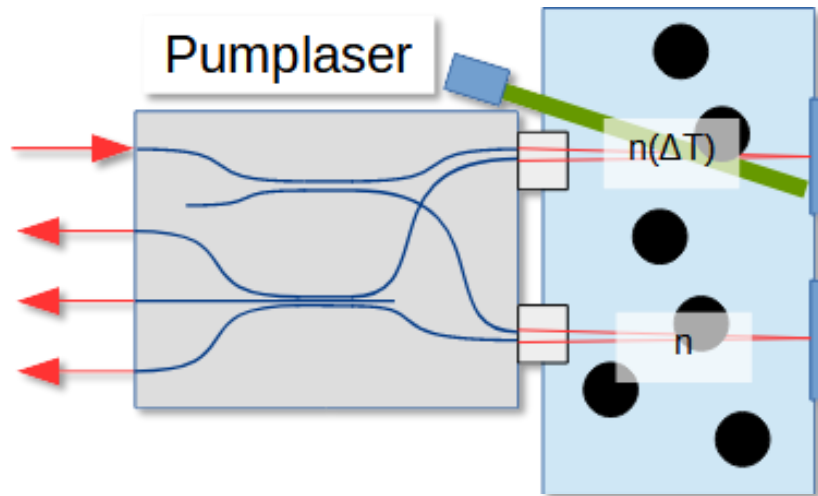
## Miniaturized distance sensor



J. Kremmel, N. Cramer, T. Lamprecht & M. Michler, "Passive aligned assembly of an integrated optical displacement sensor based on a reflective Mach-Zehnder interferometer with a 3x3 directional coupler," *Opt. Eng.* 57(8), 2018

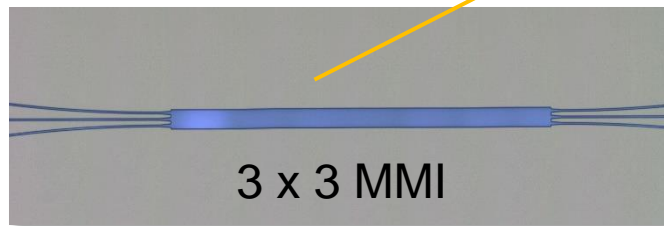
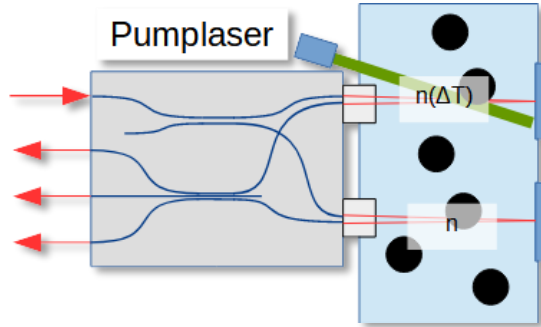
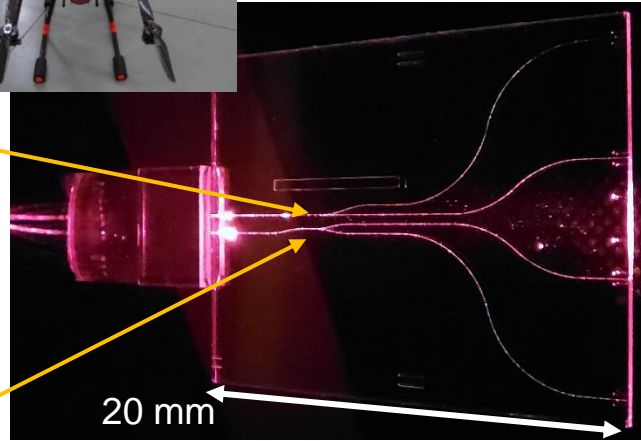
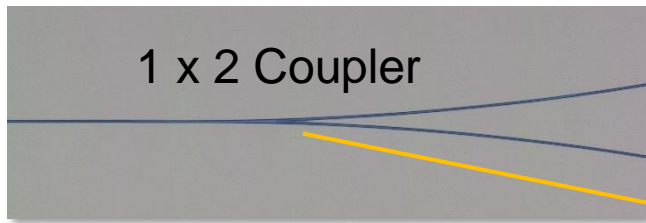


# Black Carbon Particle Sensor for Drone Operation

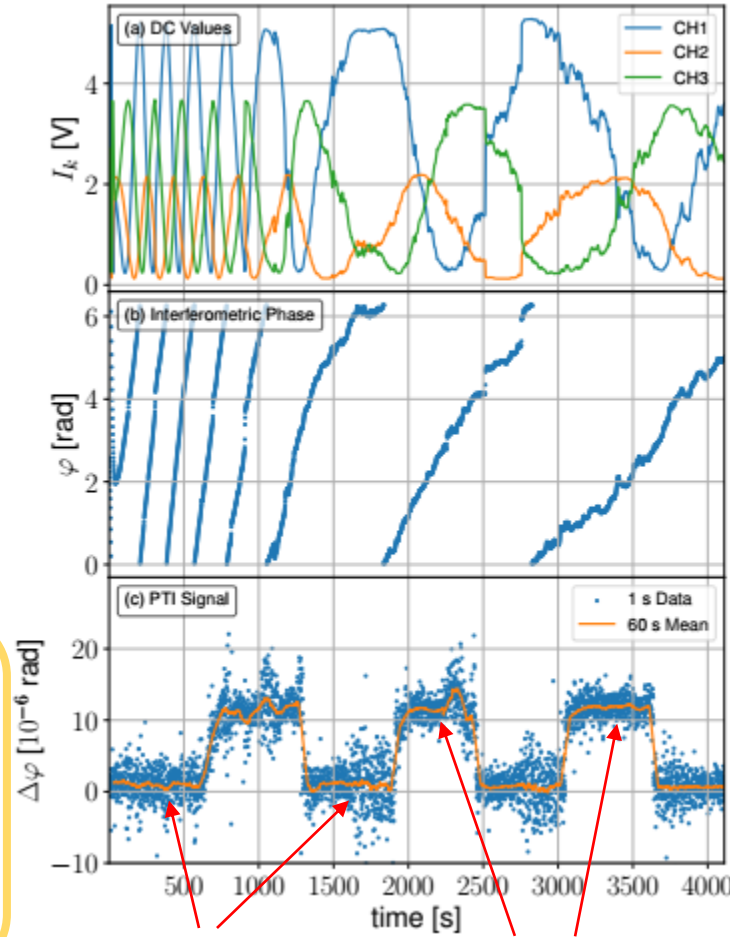


- Starting Point: Laboratory based Photothermal Interferometer
  - Very bulky free-space optics
  - Very sensitive against vibration, temperature- and pressure changes
  - Time consuming calibration in short intervals

# Black Carbon Particle Sensor for Drone Operation



- Intermediate results:
  - Very robust system, due to 3-phase output calibration effort massively reduced
  - Next step: elimination of fibers and full integration of detectors and micro-lenses



Clean air

10 ppm NO<sub>2</sub>



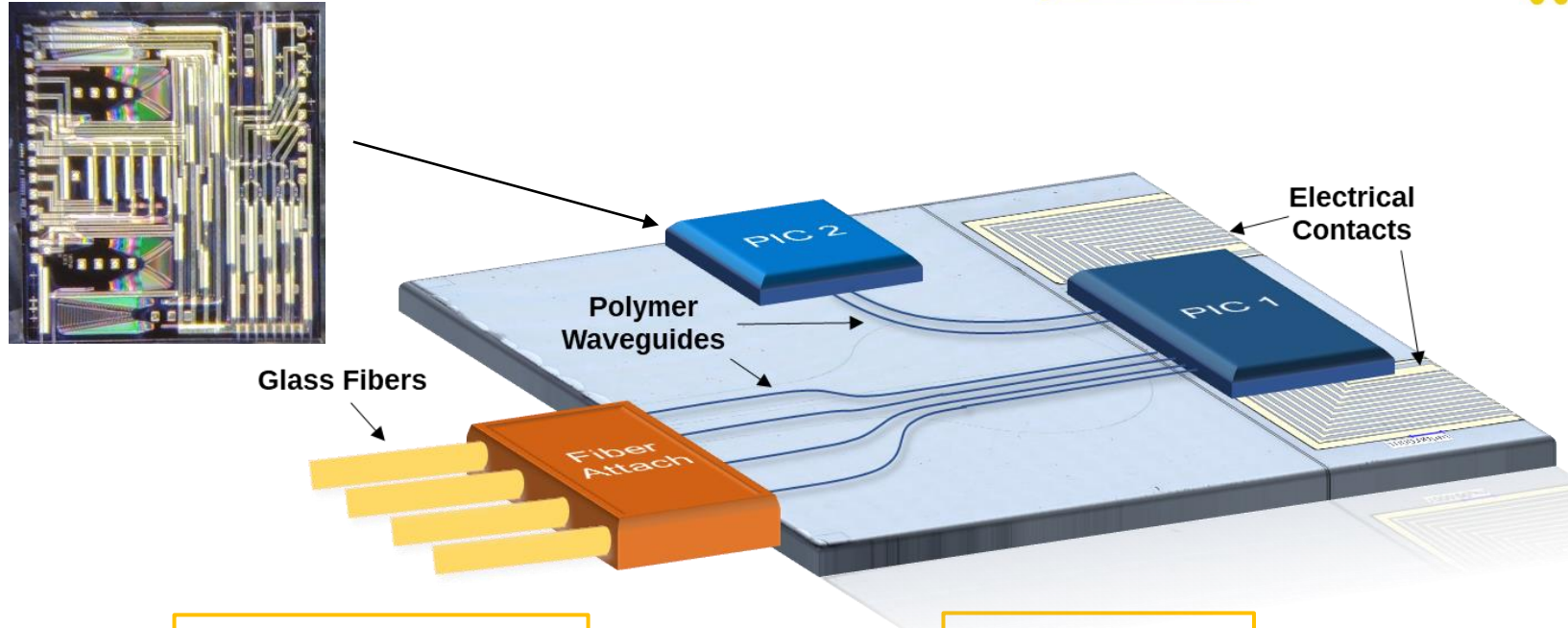
# PIC packaging Platform: all-in-one approach:

Highly integrated photonic chips (PICs) are entering the market.

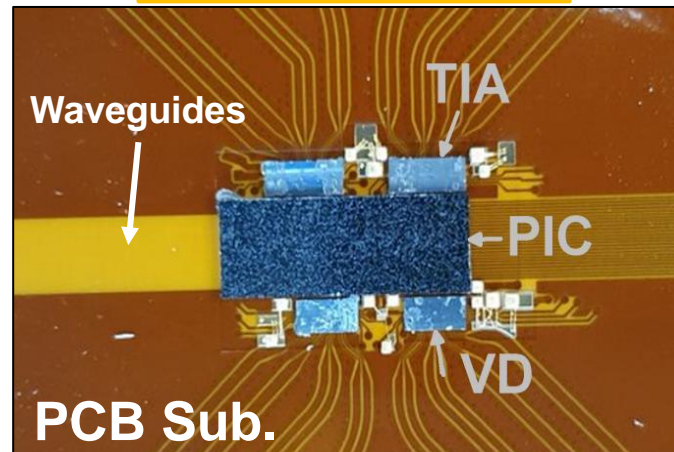
vario-optics offers the necessary **packaging technology** to access and efficiently interface these chips.

## Features of our chip-packaging platform:

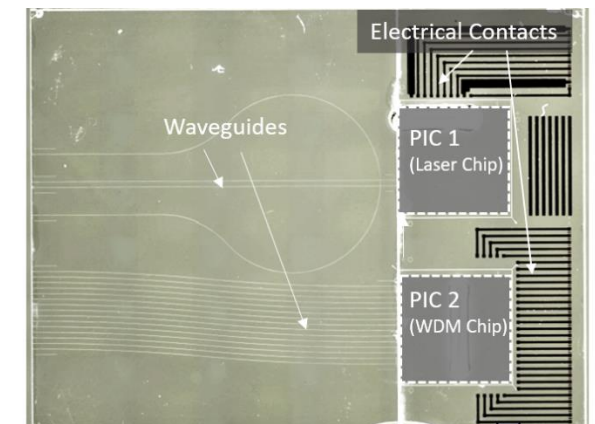
- **multiple** parallel (optical) channels (4,8,16,...)
- adjustment of pitch & MFD
- Simultaneous mechanical, **electrical & optical interface!**
- **Polarization maintaining** (TE&TM)
- **High-power** operation (> 80 mW per channel)



### Adiabatic-Coupling



### Butt-Coupling



# Conclusions

- WE OFFER a mature photonic board technology for
  - Miniaturized robust optical systems for highly integrated sensing applications
  - Carriers for photonic integrated chips with high electric- and optic pin counts enabling cost-effective photonic packages
- WHAT WE ARE LOOKING FOR
  - System partners with corresponding needs for creative solutions for future miniaturized optical systems





The Future is  
Bright !

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