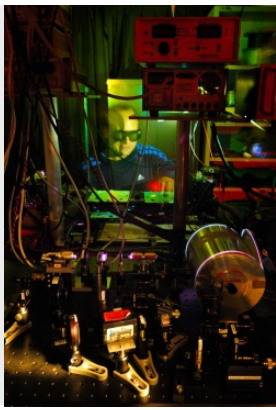
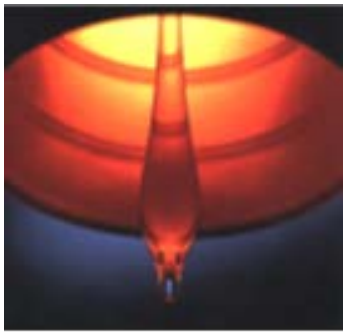
SWISSPHOTONICS National Fiber Laboratory (SNFL)



Valerio Romano

March 28, 2013



In cooperation with the CTI

KTT-Support
National thematic networks

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Commission for Technology and Innovation CTI

Goal of SNFL

- Gather the expertise in Switzerland in the field of fibers, fiber lasers and applications
- Offer:
  - design of active / passive / microstructured fibers
  - drawing of fiber prototypes (Fiber Rapid Prototyping)
  - fiber characterisation
  - development of applications
    - beam delivery, shaping
    - light sources
    - fiber lasers
  - interfacing («all in fiber», fiber<>integrated systems)
  - ...more to come out from group discussion

SNFL partners

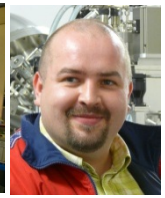
- Fiber Center of Competence, Bern
  - Institute of Applied Physics (University of Bern)
  - Institute of Applied Laser Photonics and Surface Technologies, ALPS, (Berne University of Applied Sciences)

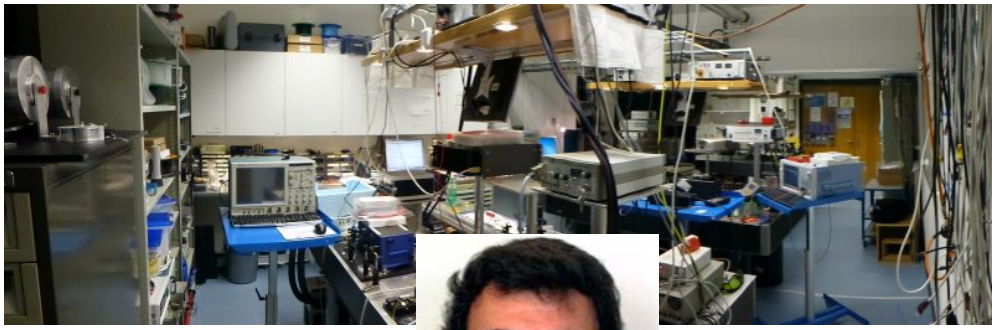
- Joining soon
  - Institut für Mikro- und Nanotechnologie, MNT, (Interstaatliche Hochschule für Technik Buchs)
  - EPFL

People and labs of FCCB

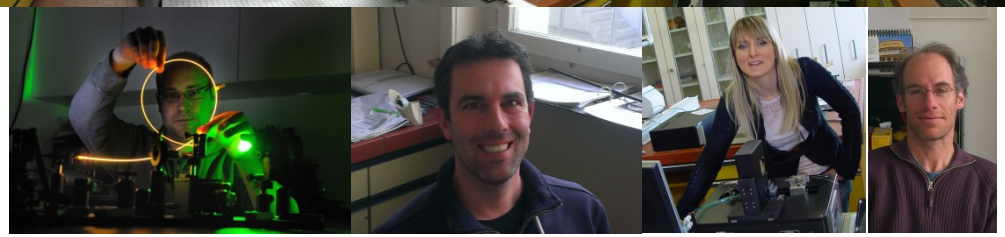












Collaboration between:
Inst. of Appl. Physics, IAP Uni Bern
and Inst. for Applied Lasers,
Photonics and Surface Technology
ALPS of BUAS:

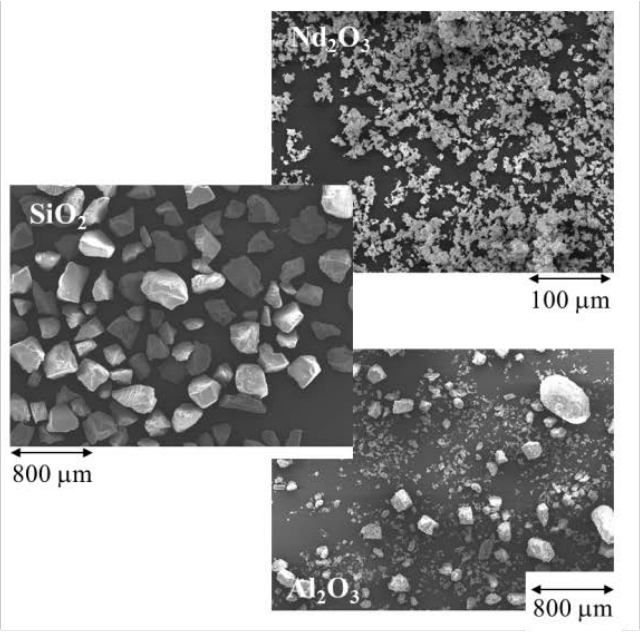
applications of modern fibers

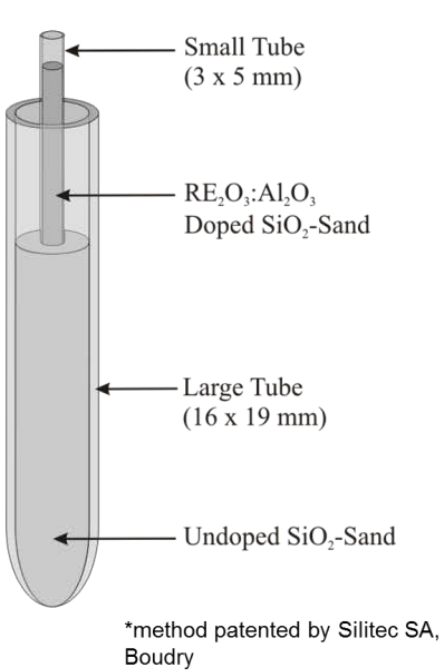
- fiber lasers and amplifiers
- materials processing,
- sensing, metrology,
- light sources
- fiber beam delivery
- beam shaping

Two labs: one in Bern,
one in Burgdorf

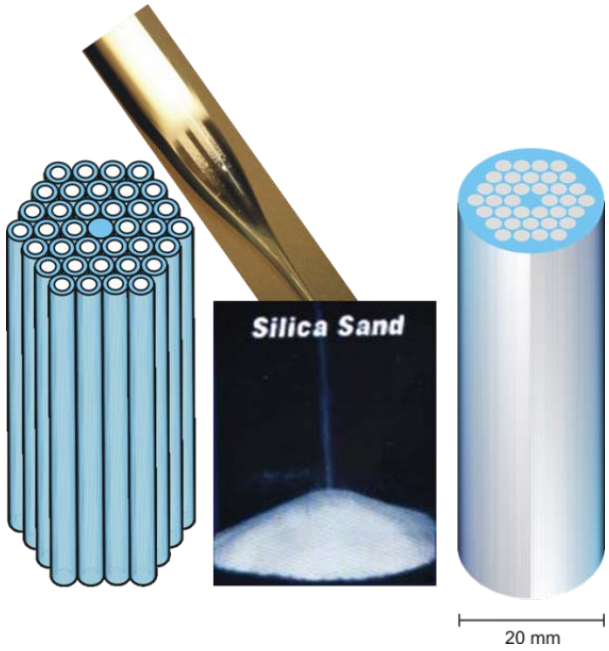
At present: 11 people

Key tecnology: Fiber Rapid Prototyping (FRP)



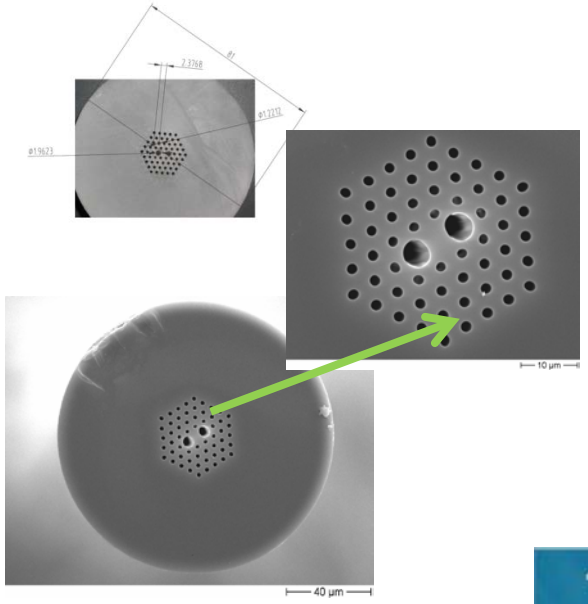


*method patented by Silitec SA, Boudry



Granulated silica is used to produce preforms with any microstructure

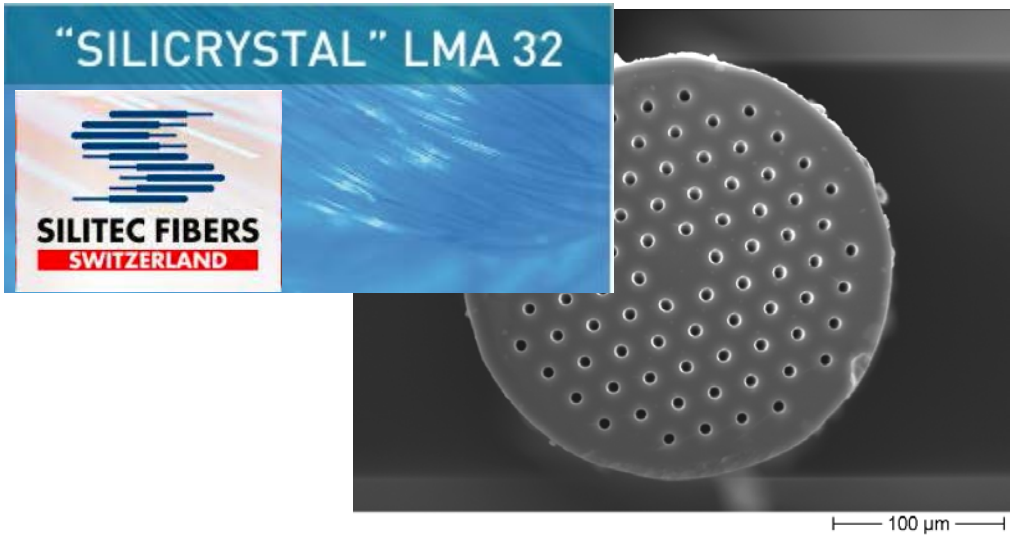
Example: microstructured fibers



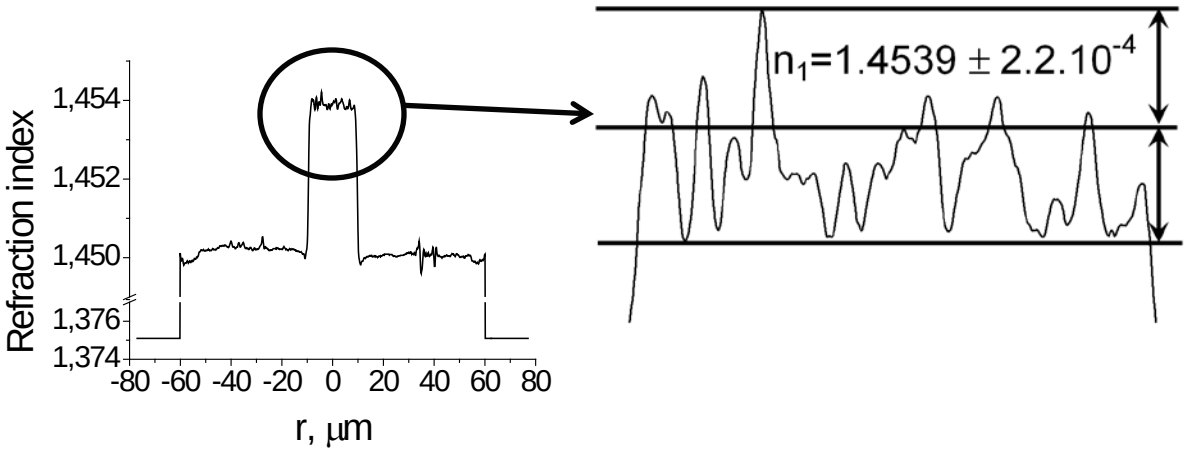
Fiber diameter: 170µm

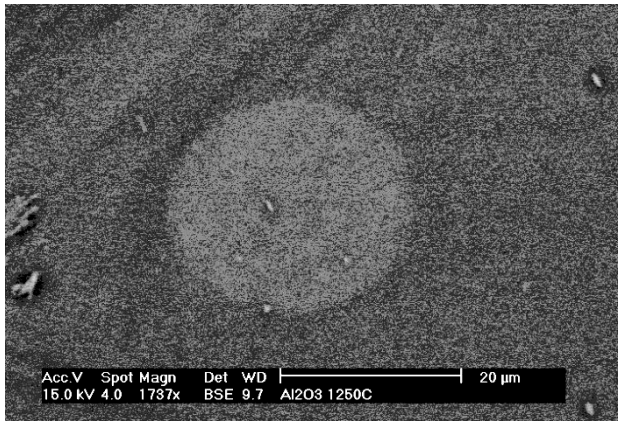
Core diameter (d): 21 µm

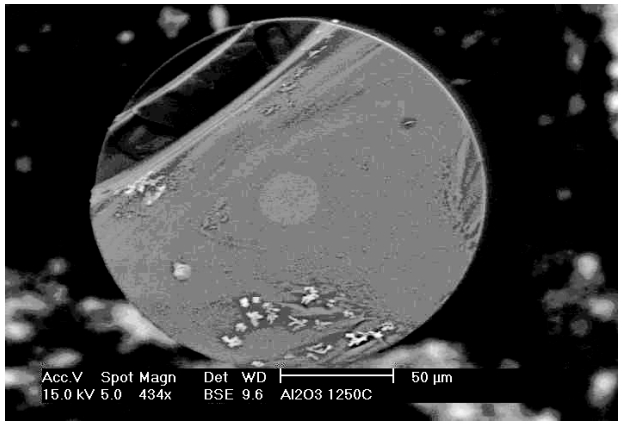
Hole diameter: 7 µm



Yb-doped Laser Fiber







Core diameter : 20 μm Δn : 4.10^{-3}
Inner cladding NA : 0.46

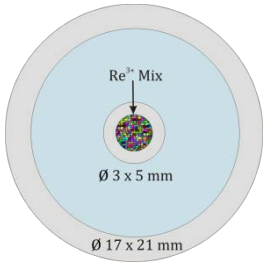
High homogeneity of the core index :
ripples < 2.5.10^{-4} with a mesured resolution of 1.10^{-4}

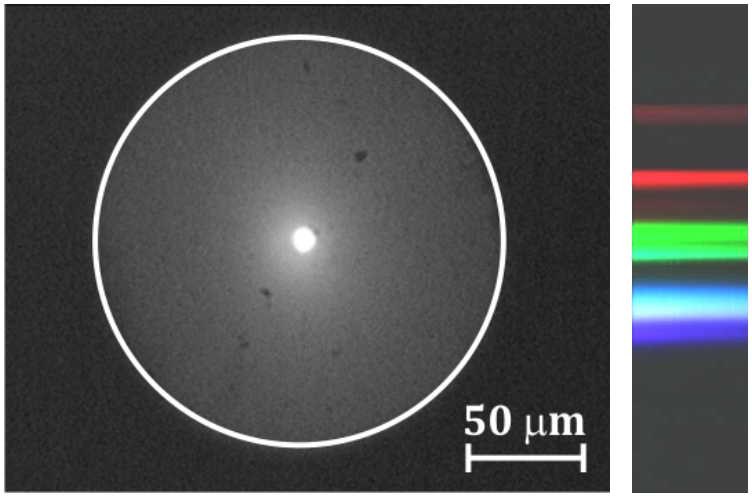
Energy-dispersive X-ray spectroscopy analysis :
3600wt-ppm ytterbium concentration

Background losses : 0.8 dB/m -> 0.1 db/m
Ytterbium absorption at 975 nm : 0.180 dB/m

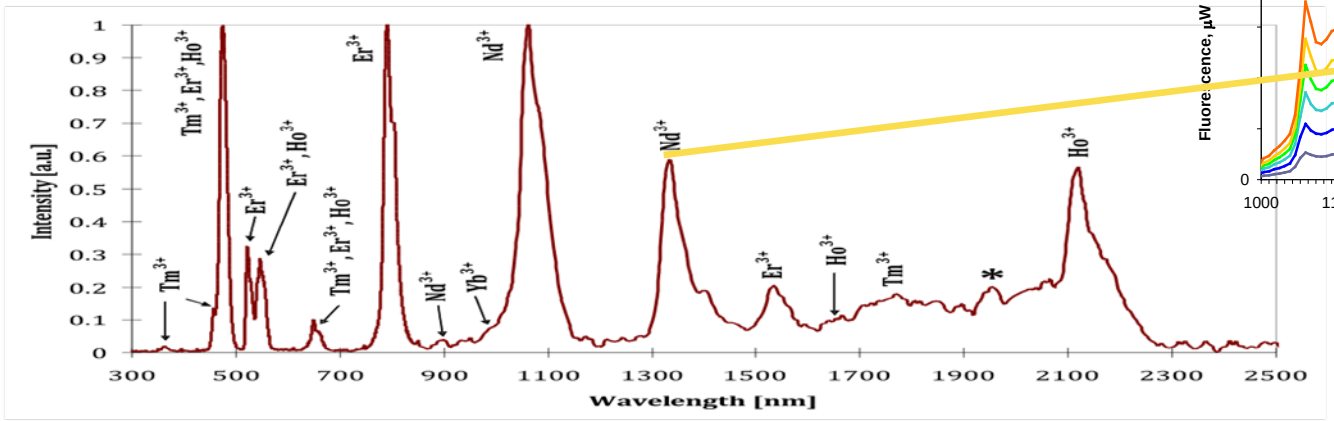
Special fiber: broadband light source

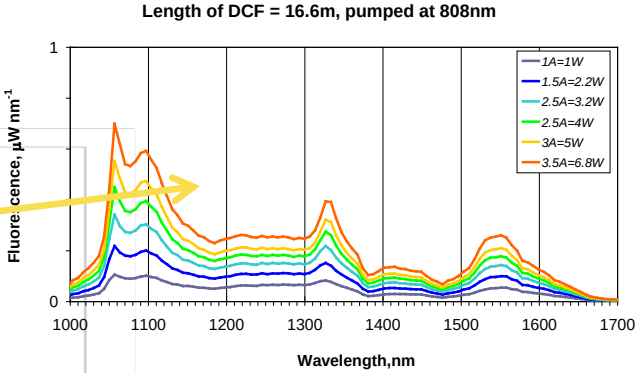
0.1 at. % Nd^{3+}
0.3 at. % Ho^{3+}
0.1 at. % Er^{3+}
0.3 at. % Tm^{3+}
0.2 at. % Yb^{3+}
7.0 at. % Al^{3+}



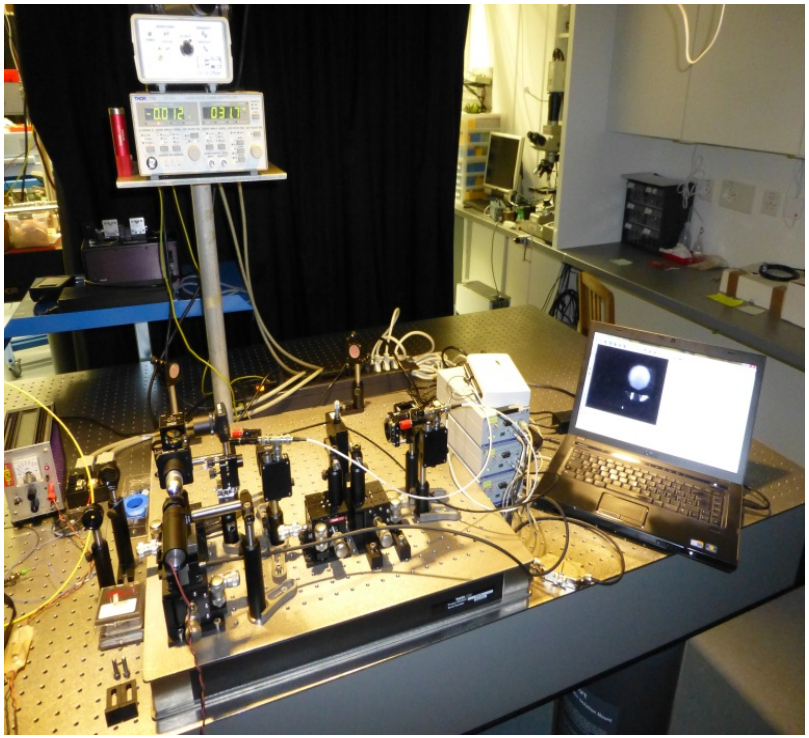


$Ø_{Cladd}$ = 180 µm / $Ø_{Core}$ = 6.5 µm NA = 0.1





Fiber Characterisation, processing, handling



R.I.P.: 1D- Refractive index profiler
(Master Thesis Jonas Scheuner, IAP Bern)

2D-version: Bachelor thesis at BUAS

Characterisation:

- Losses
- Spectroscopy
- Index profile

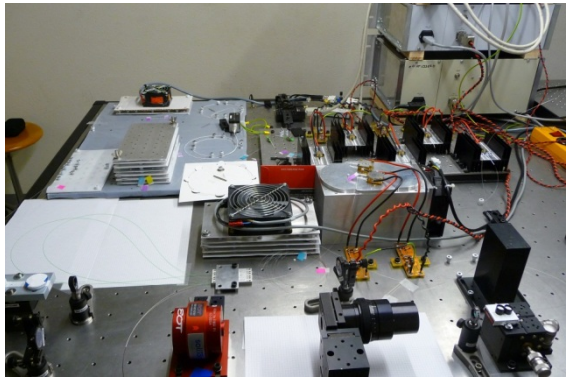
Processing:

- Cleaving
- Splicing
- Tapering

Fiber lasers, amplifiers and applications

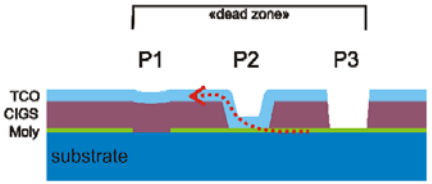
...are cost effective, robust («all in fiber»), display high average power at very high repetition rates or extremely high CW output power with excellent beam quality.

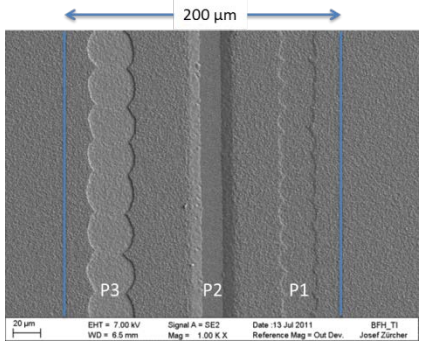
They have large potential to be integrated in materials processing machines.



Example for pulsed application (50ps, <10µJ / pulse) where high repetition rates are requested:

scribing of thin film PV elements (CIGS) for efficient harvesting of solar energy.





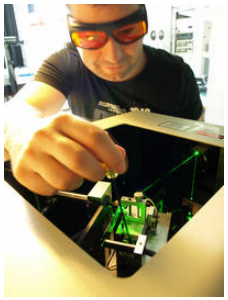
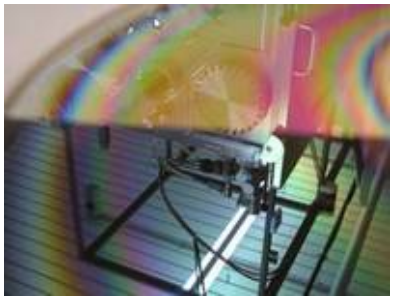
SNFL – Photonics^{MNT} activities @ NTB Buchs

Photonics^{MNT} → We link microsystem technology and **optics**.

- Part of the Institute for **M**icro- and **N**ano**T**echnology (MNT) at NTB
- specialized on:
  - Fiber optics
  - Integrated optics
  - MOEMS (optical microsystems)
  - Optical Simulation (waveguides / thin films)
- Industrial projects / services / teaching
- 5 running CTI-projects in photonics



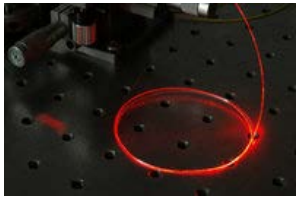
http://www.ntb.ch/mnt/kompetenzen/photonics.html

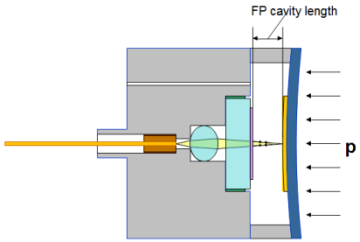



SNFL – Photonics^{MNT} activities @ NTB Buchs

Fiber optics

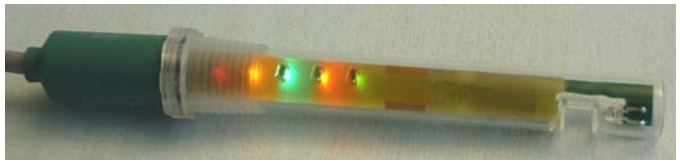
- Fiber Assembly (splices / connectors)
- Fiber Packaging (bundles / GRIN packages)
- Fiber Sensors
  - Optical Pressure Sensor
  - Hybrid pH/dO Sensor

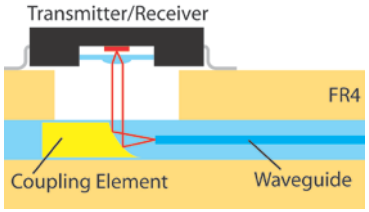




Waveguide optics

- Waveguide simulation (RSoft for singlemode / ZEMAX for multimode)
- Waveguide characterization (refractive index, loss, power, side wall roughness, …)
- Polymer waveguide assemblies





Future plans of SNFL

- improve equipment and knowledge
- work towards «all in fiber systems»
  (high power connectors, interfaces, (real) very large core fibers)
- develop fibers with bigger cores for
  higher pulsed energy delivery (limit: 4.77MW)
- explore and develop fiber lasers in the
  eyesafe 2μm wavelength range (Thullium-Holmium)
- strengthen national and international collaborations

- ...more in the workgroup discussion