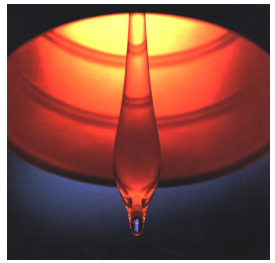
Berner Fachhochschule
Technik und Informatik

UNIVERSITÄT BERN



New Fiber Laser Center of Competence

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Bern University of Applied Sciences, Burgdorf
Institute of Applied Physics, University of Bern

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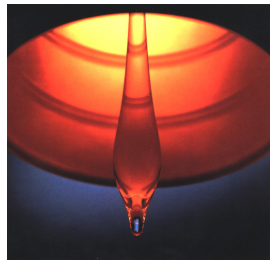
1) General idea
2) Examples
3) Conclusions

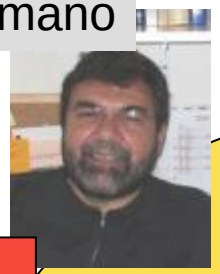
1.0 General idea



- Collaboration of the Institute of Applied Physics of the University of Bern with the Bern University of Aplied Sciences
- Field of collaboration: applications of modern fibers and fiber lasers (Pulsed and continuous fiber lasers and fiber amplifiers for materials processing, sensing, metrology, light sources)
- Two labs: one in Bern, one in Burgdorf
- Coordinator: 50% IAP Bern, 50% BFH-TI

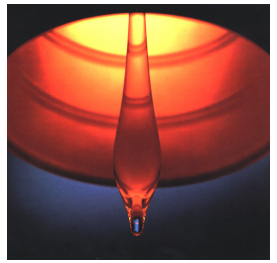
1. The fiber team

V. Romano

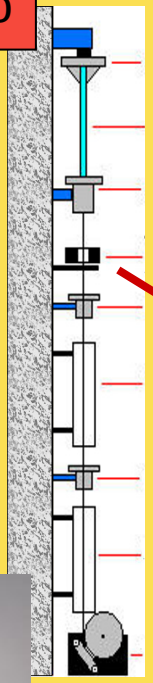


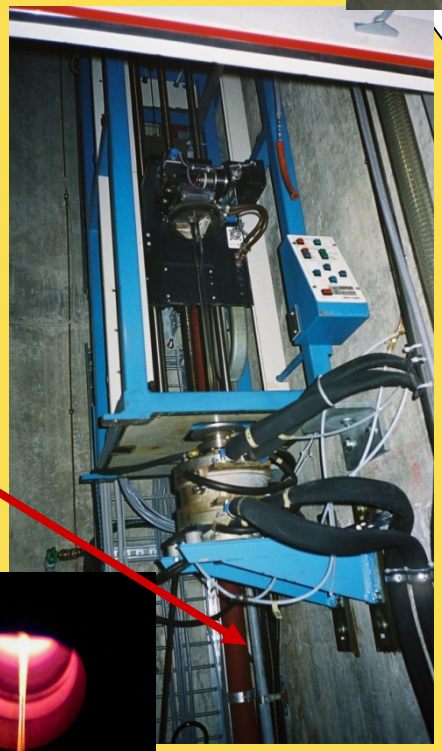
Th. Feurer

W. Lüthy



T. Negro



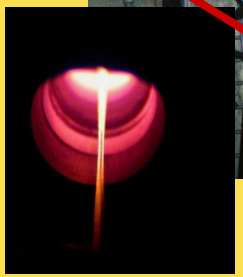


M. Neff

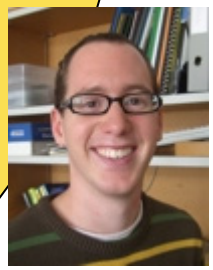
C. Pedrido

J. Boas

S. Pilz



P. Marty

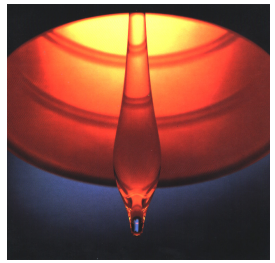


L. Petraviciute

F. Müller

M. Renker

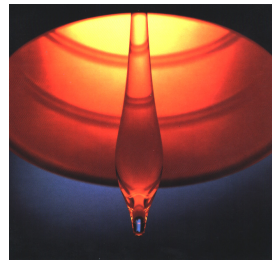
1.1 Laboratories



- 1 fully equipped optical lab at the IAP in Bern
- 1 experimental drawing tower
  - 3 staff members
  - 2 PhD students
  - 2 diploma students

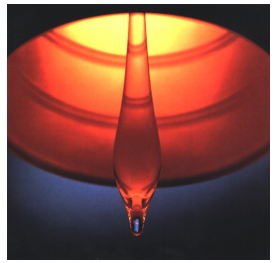
- 1 fully equipped opt. lab at the BFH TI in Burgdorf
  - 2 staff members
  - 1 scientific collaborator
  - 1 technician

1.2 Motivation



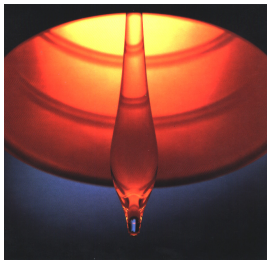
- Exploiting complementarity of 2 instituttions
  - IAP: strong academic background and international contacts
  - BFH: good contacts with industry and strong laser application background
- Being able to offer all necessary elements necessary for innovation: from idea, experimental setup, laboratory prototype to application testing.
- Strengthening a new and extremely interesting technology

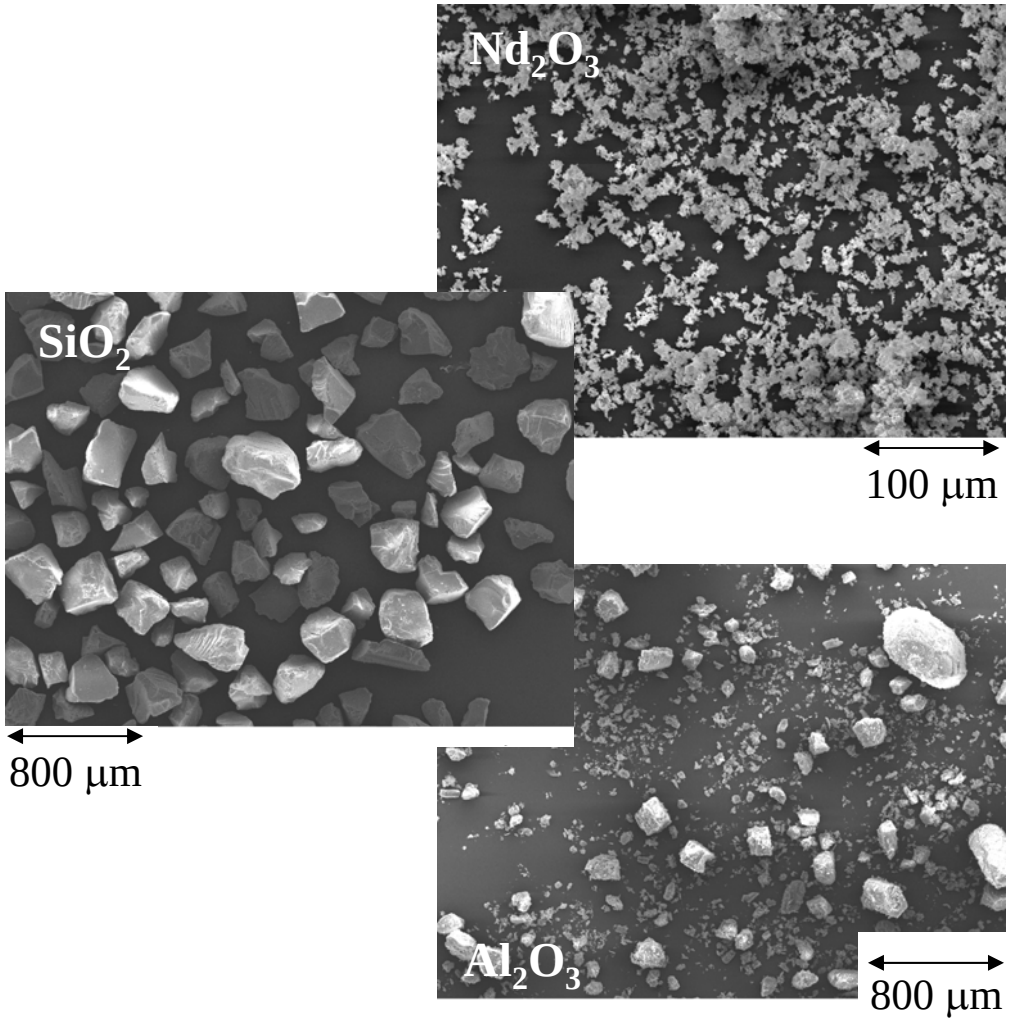
1.3 Activities

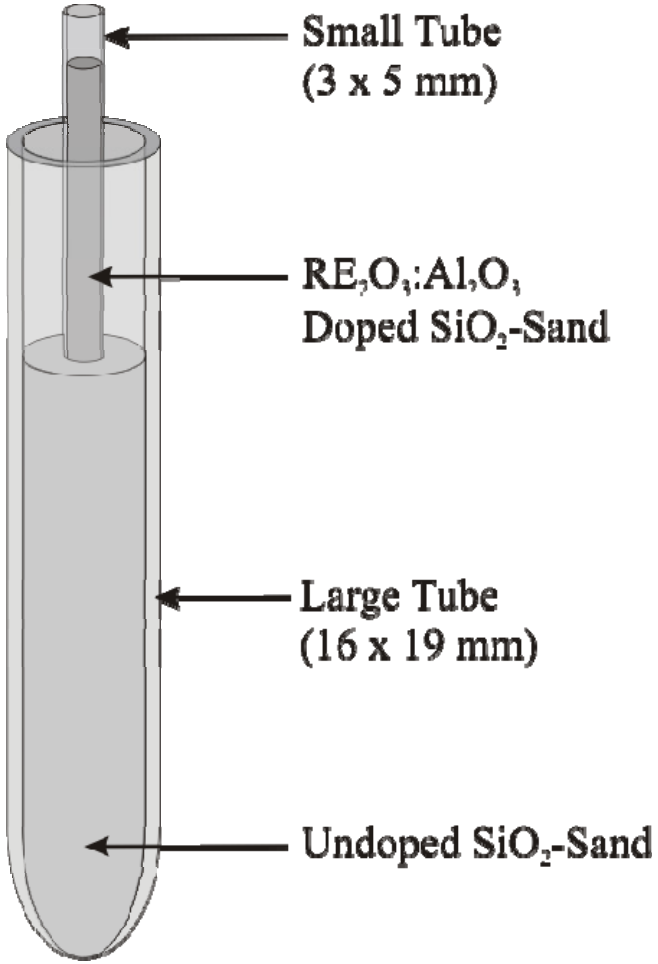


- In various projects:
  - Fibers by the granulated silica method
    - Doped fibers
    - Microstructured fibers for high power applications
  - Systems
    - Pulsed fiber lasers and amplifiers
  - Applications of hollow core fibers (Metrology, nanoparticle filling)

2.0 a) Fibers by Granulated Silica*

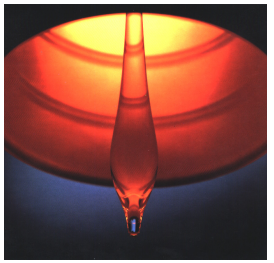


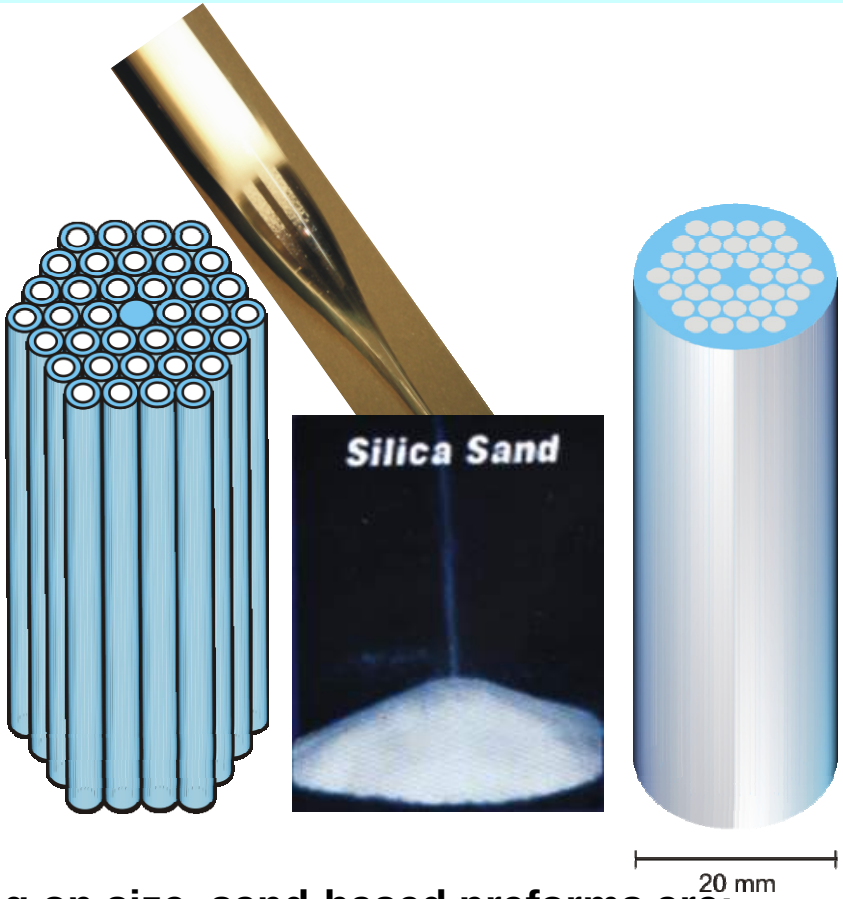




*method patented by Silitec SA, Boudry

2.0 b) PCF by Granulated Silica

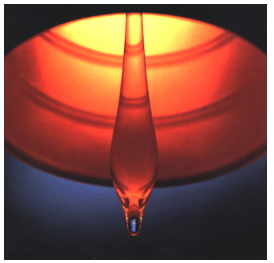


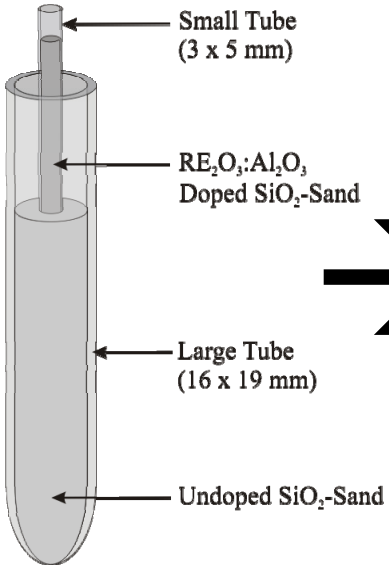


Depending on size, sand-based preforms are:

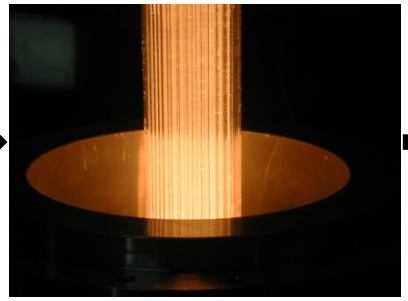
- **Vitrified and drawn directly in one step**
- **Vitrified and drawn in two steps**
- **First vitrified plus stretched and then drawn (two steps)**

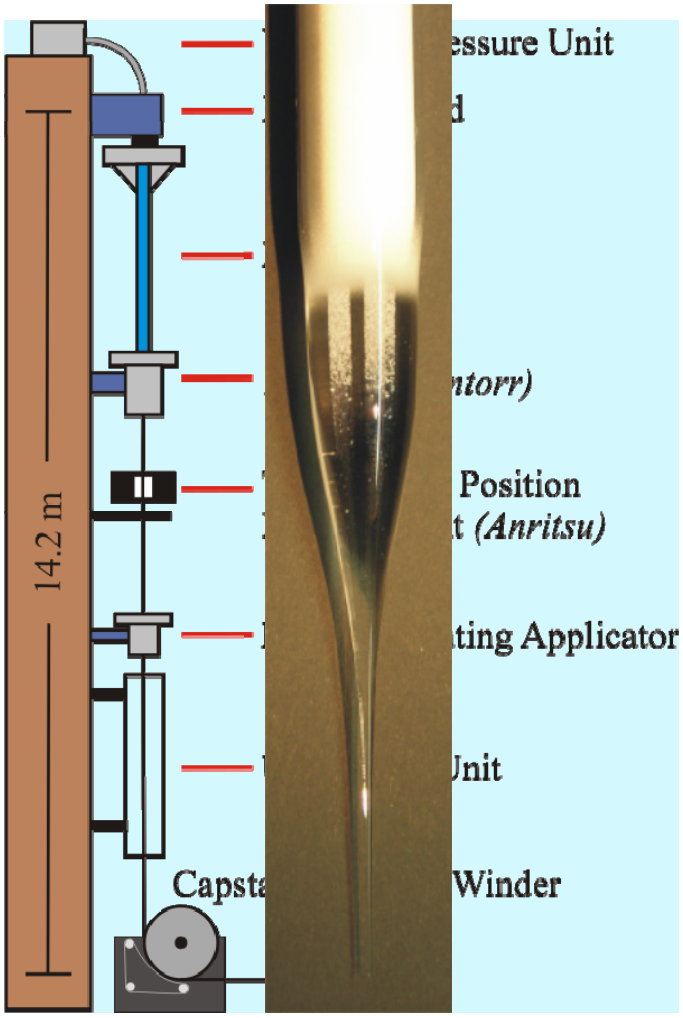
Fibre Drawing





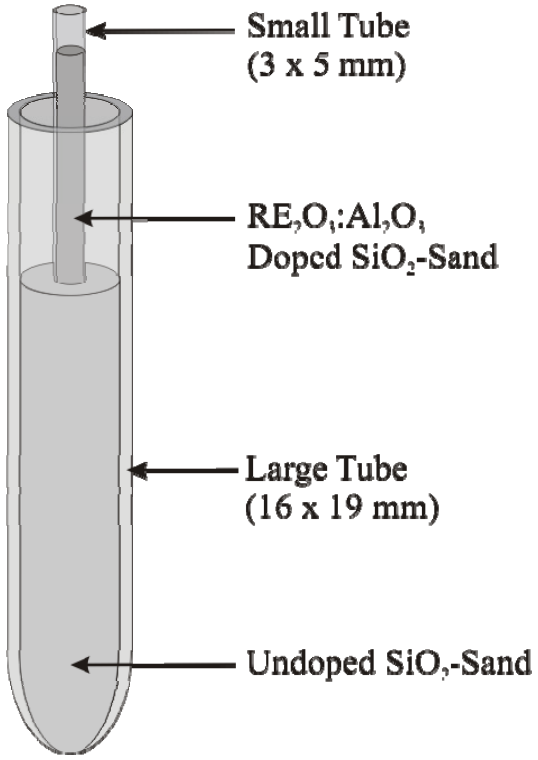
Optional: Vitrification

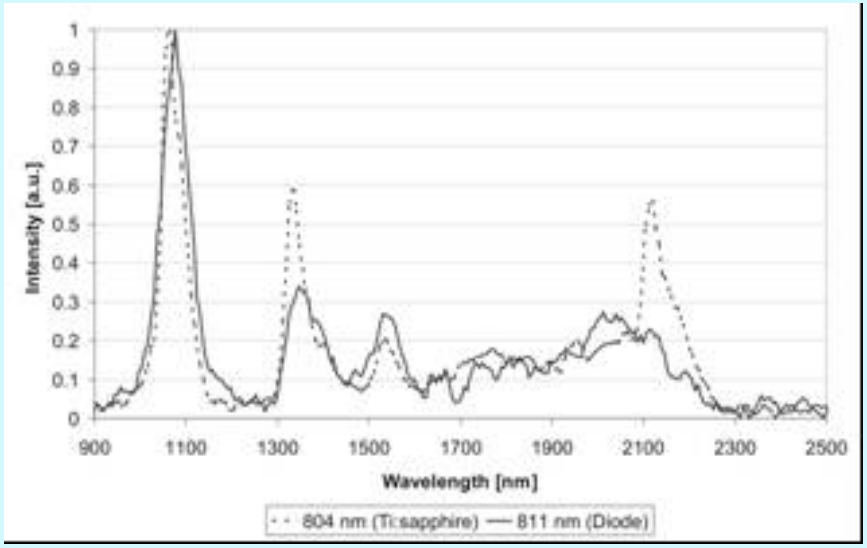




- Evacuation and preheating(~800 °C for 1h)
- (Optional :vitrification)
- Drawing

2.1 Fibers: Broadband light source



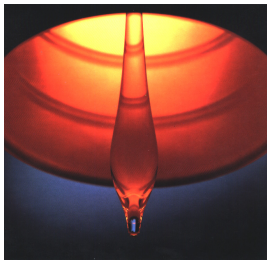


NIR fluorescence spectra of the single-core multiply doped fibre when pumped with the Ti:sapphire laser at 804 nm (dashed curve) and the single-mode single stripe laser diode at 811 nm (solid curve).

An oxide mixture of
Nd^{3+}(0.1 at. %), Ho^{3+}(0.3 at. %), Er^{3+}(0.1 at. %),
Tm^{3+}(0.3 at. %), Yb^{3+}(0.2 at. %), Al^{3+}(7 at. %),
and silica is used to fabricate a single-core fibre

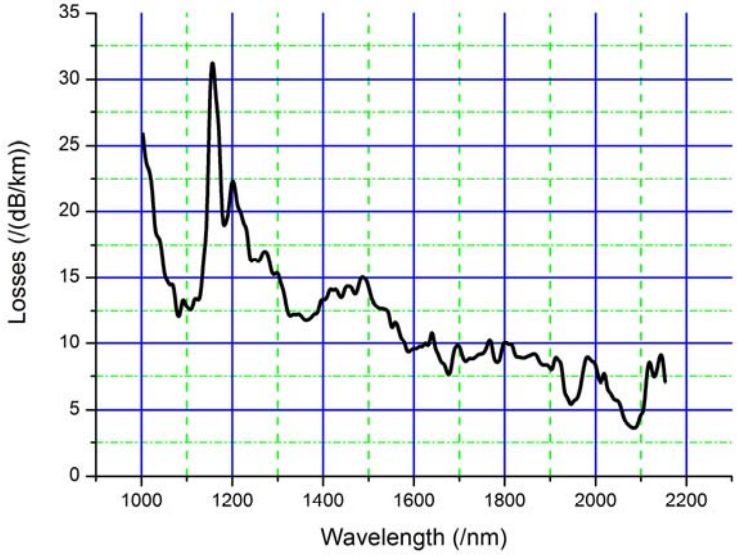
L. Di Labio, 2008

2.2 Fibers: Large core PCF with low OH-core



Fiber diameter:	**170μm**
Core diameter (d):	**21 μm**
Hole diameter:	**7 μm**
Pitch:	**16 μm**
d/pitch:	**0.46**

Attenuation [/dB/km]



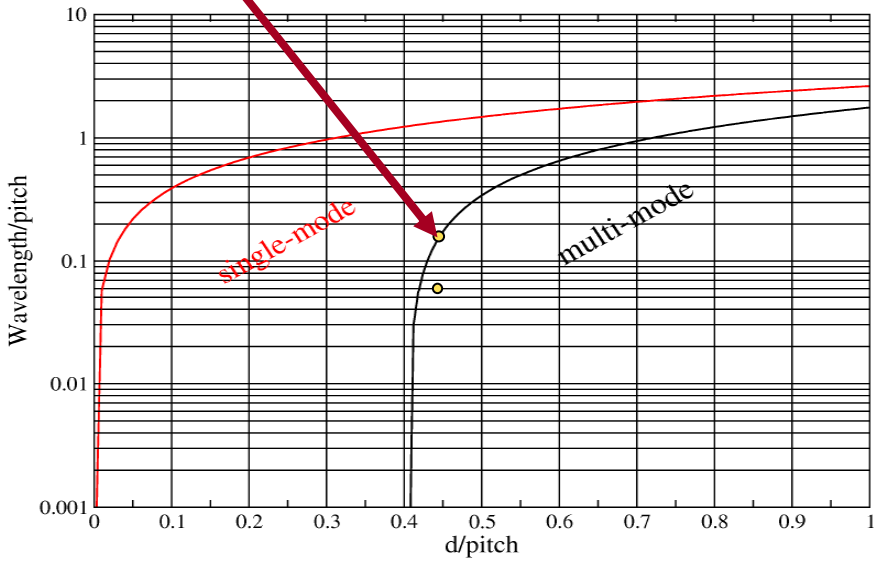
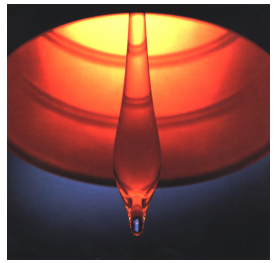


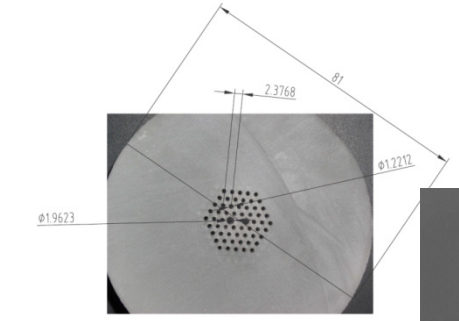
Figure 6: Cut-off phase-diagram

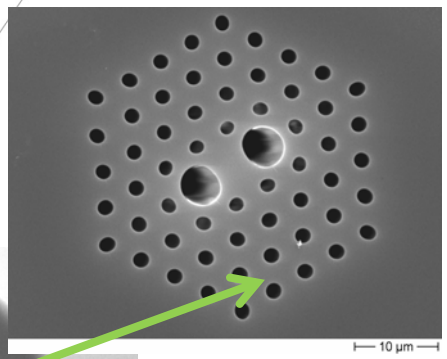
Fiber drawn at Silitec SA, Boudry

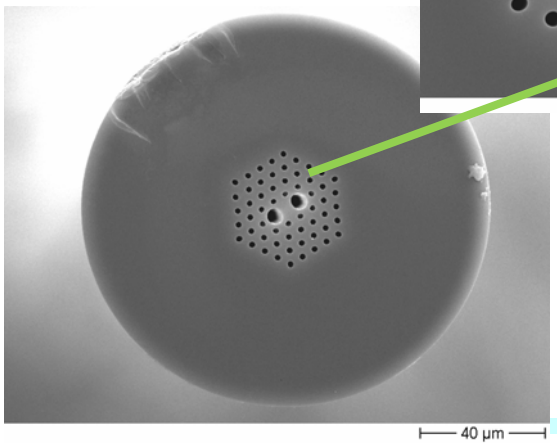
2.3 Fibers: Polarization maintaining PCF

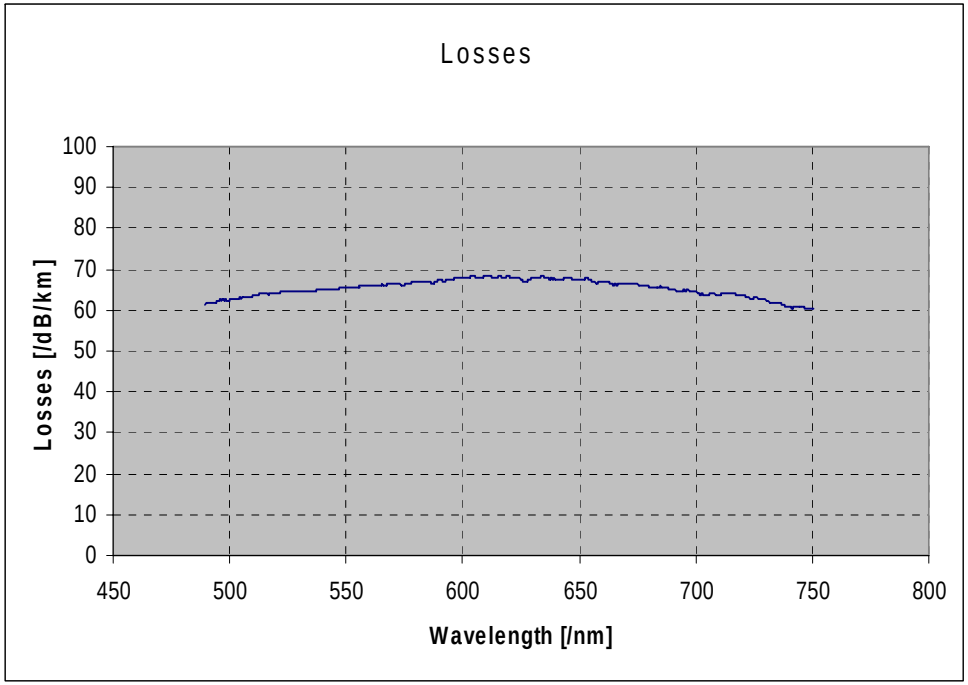


- **Fiber diam.:** **125.0 μm**
- **Core:** **~4 μm x 6 μm**
- **Hole diameter:** **1.5 μm**



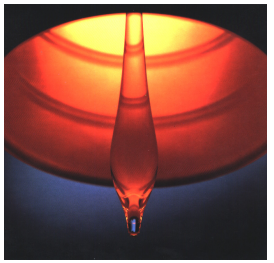


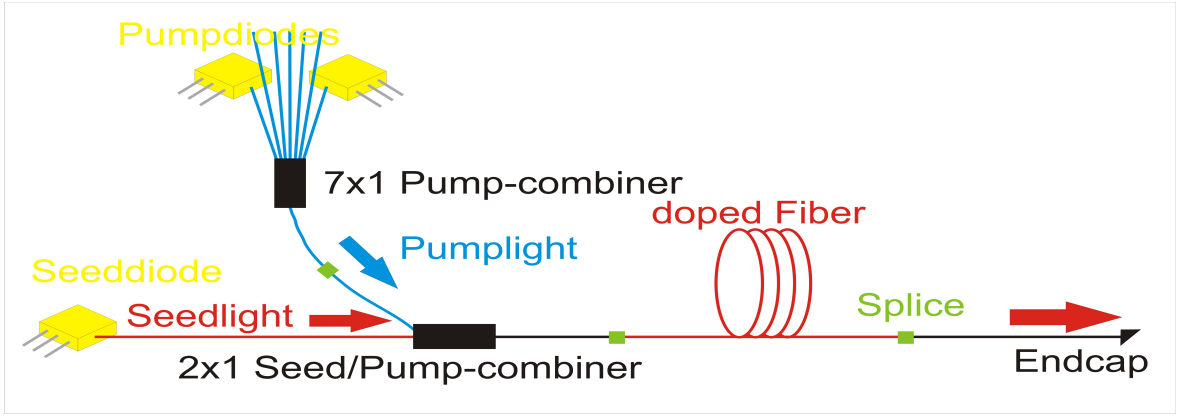


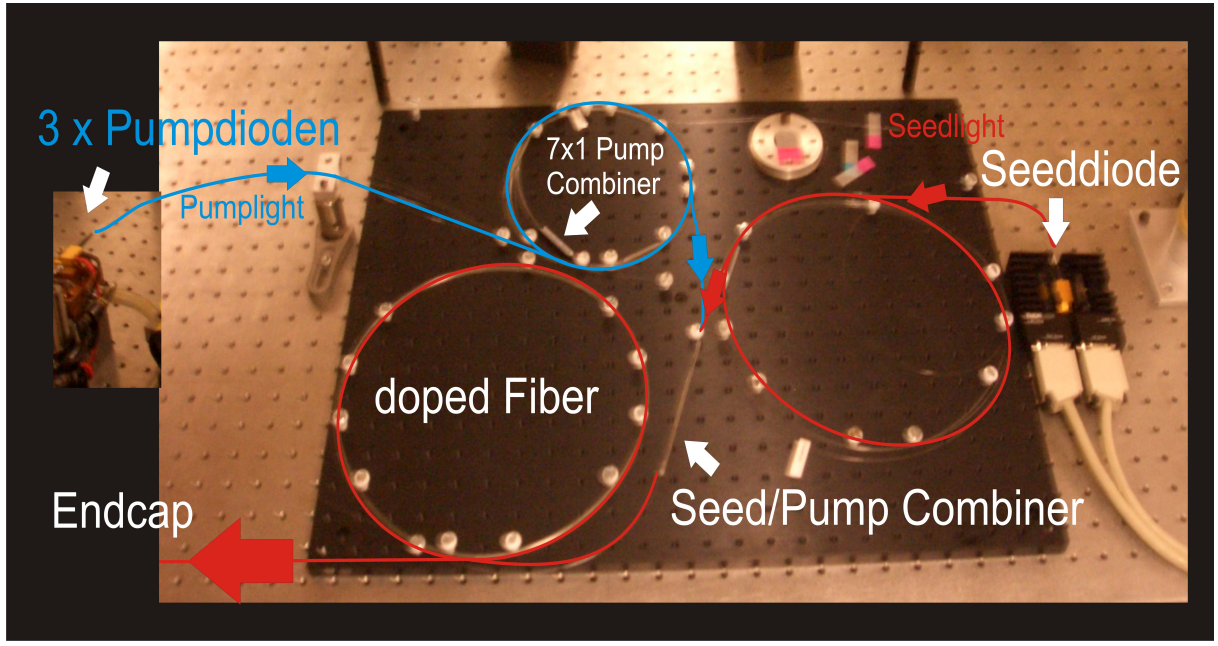


- **Flat spectrum in vis.**
- **Polarization maintaining**
- **(almost) single mode in complete range**

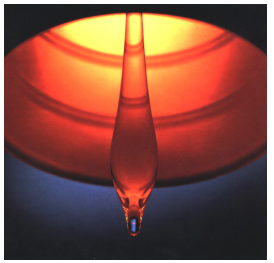
2.4 Systems: ns-pulse amplifier

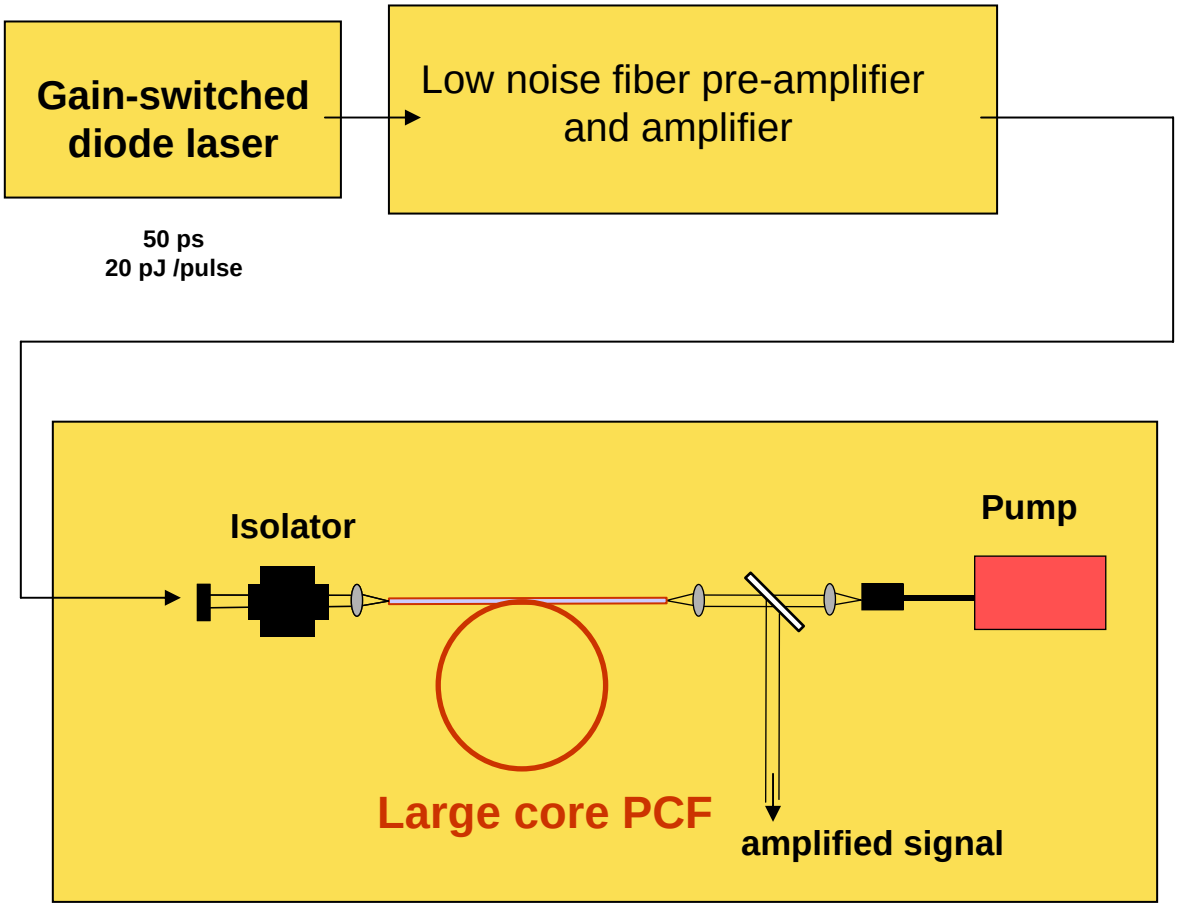






2.5 ps pulse amplifier





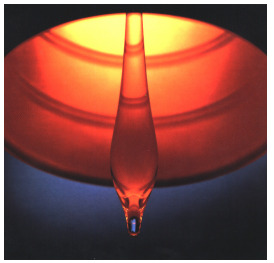
Power amplifier

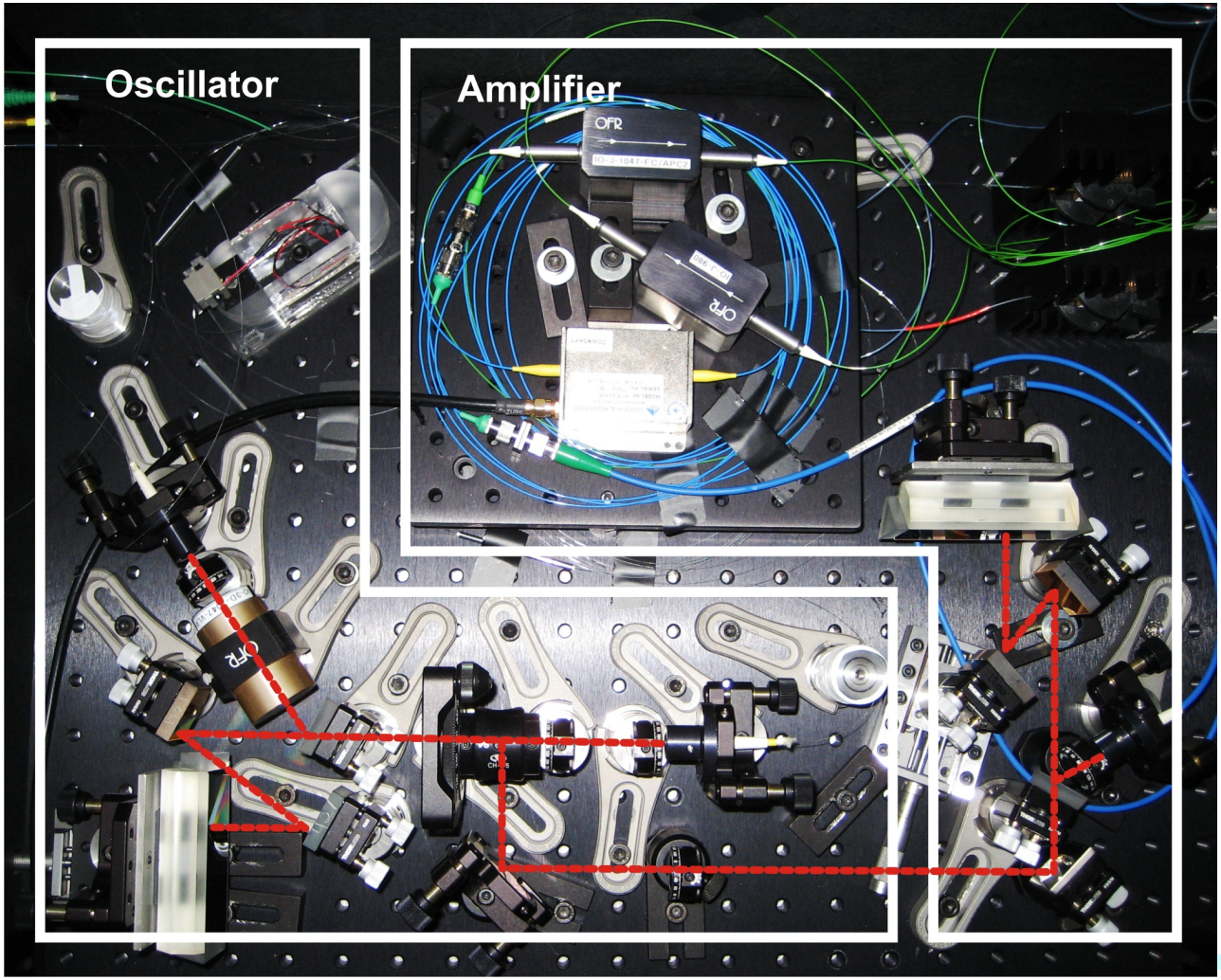
Goal:

>100 kHz

>50μJ/pulse

2.6 fs pulse system





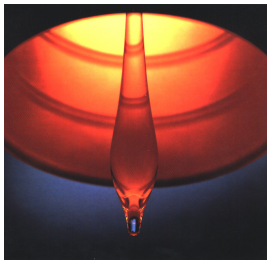
Oscillator:

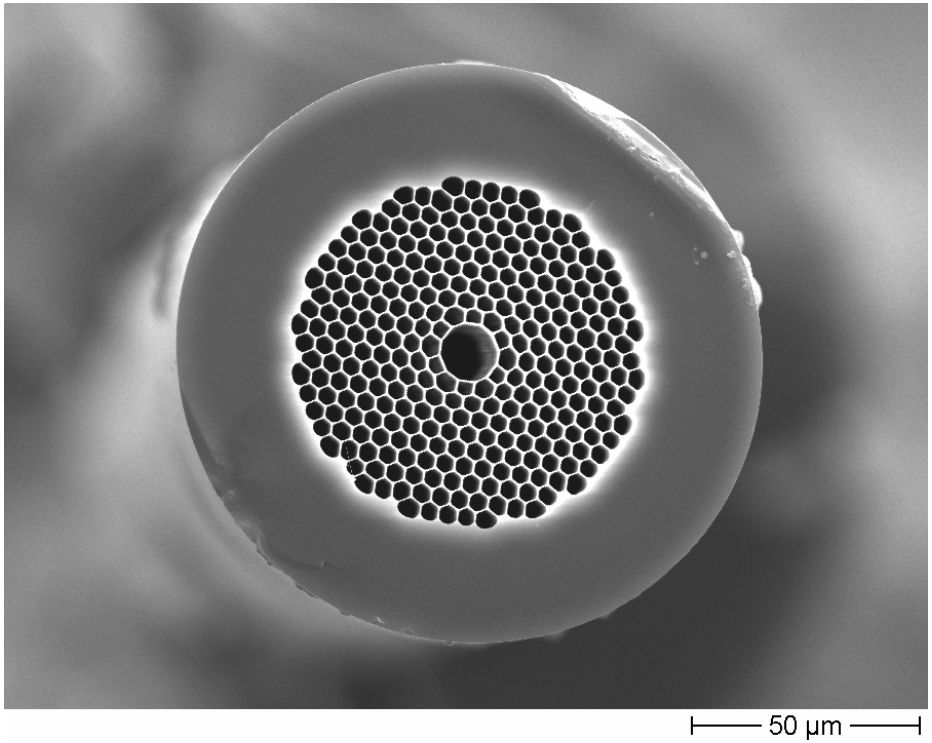
- P = 50 – 100 mW
- E_{Pulse} = 1 – 2 nJ
- t = 50 fs
- Rep. Rate: 50 MHz

Amplifier

- P = 30 – 100 mW
- E_{Pulse} = 30 – 100 nJ
- t = 50 fs
- Rep. Rate: 1 MHz

2.7 Metrology: frequency standard





Struktur einer Hollow Core Photonic Crystal Fiber (HCPCF).

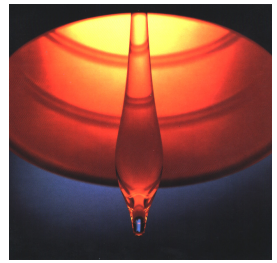
Realisation von Wellenlängennormalen mittels Gas gefüllten Hollow Core Photonic Crystal Fiber(HCPCF).

Anwendungsgebiete:

-Metrologie

-Telekommunikation

3. Conclusions



- Collaboration between IAP Uni Bern and UAS-TI (BFH-TI)
- Based on „personal union“ and on common labs and projects
- Might be a good model for innovative projects

- We are looking forward to starting new projects