

# Pulsed Yb<sup>3+</sup> power amplifier based on next generation microstructured active fibers

S. Pilz, L. Di Labio, C. Pedrido, V. Romano, T. Feurer : IAP, Universität Bern,  
B. Neuenschwander, Ch. Nussbaum: BFH-TI Burgdorf,  
U. Dürr, T. Moser: LASAG AG, Thun / G. Dumitru: Inspire /  
F. Sandoz : Silitec SA, Boudry / B. Valk, N. Lichtenstein: Bookham, Zürich

## Fiber lasers and amplifiers

➤ Conventional rod lasers suffer from thermo-optical problems, which manifests itself through a power-dependent temperature profile (causes e.g. a thermal lens and thermal-stress induced birefringence)

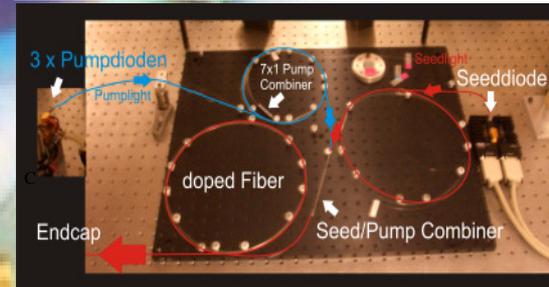
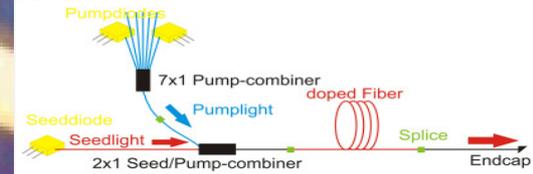
➤ Lasers and amplifiers based on a fiber-design reduce thermo-optical distortions to their special geometry (large ratio of surface-to-active volume). Their beam characteristics are given by the waveguide design and are thus not affected by the environment. However, because of the small core (standard stepindex-fibers), they suffer from nonlinear effects, such as SPM (self-phase modulation), SRS (stimulated Raman scattering) or SBS (stimulated Brillouin scattering).

...advantages:

- 1) excellent beam quality
- 2) high gain (even by single pass → amplifier)
- 3) efficient, diode-pumped operation
- 4) no or reduced free space propagation
- 5) reduced thermo-optical problems
- 6) compactness

...disadvantages:

- 1) nonlinearity
  - 2) small core (for single-mode attributes and step index-fibers)
- new fiber design: LMA & PCF

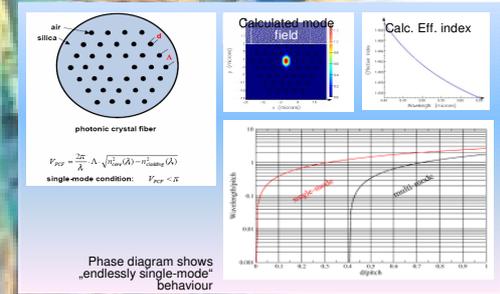


## Large core double clad active fibers ...

... overcome the limitations set by the core size.

Methods to obtain large cores maintaining high beam quality:

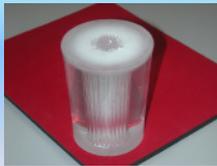
- A) lowering the index contrast between core and cladding;
- B) solid core photonic crystal fibers: very small index contrast between core and cladding as well as the regular microstructure allow for single-mode light guiding in very large doped or undoped cores, thus keeping nonlinearities and damage problems low.



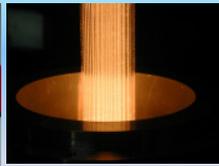
## ...fabricated by granulated sand technology...

From sand to optics:

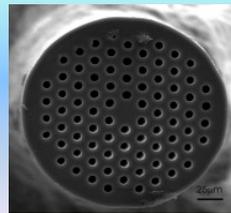
Capillaries embedded in sand are drawn to a microstructured fiber



Preform assembly using Silitec's "sand-technology"

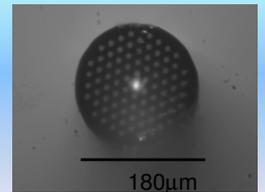


Preform stretching



Drawn fiber

- Fiber diameter: 180.0 μm
- Core diameter: 24.8 μm
- Hole diameter: 7.4 μm
- Pitch: 16.1 μm



Single-mode at 1064 nm

## ... operated with distributed side pumping

- High gain from a single fiber stage;
- Locally optimized pump level along the fiber;
- Further increase in system compactness.

