



## SCALABLE USP POWER AMPLIFIER BASED ON THE MULTIROD CONCEPT

### Task

A linear laser amplifier should be developed for the output power range below 200 W and able to provide ultra-short pulses with pulse durations of about 700 fs with diffraction limited beam quality ( $M^2 < 1.2$ ). So that inexpensive seed sources can be used, the amplification should be at least 100 or higher. Without CPA, pulse energies of several  $\mu\text{J}$  should be achieved. Since Fraunhofer ILT's Yb:INNOSLAB platform reaches its maximum efficiency at laser powers above 200 W, an adapted amplifier concept needs to be developed.

### Method

End-pumped rod lasers have become an established solution for ultrafast amplifiers. When Yb:YAG is used as an amplifier crystal, the average output power per rod is limited to about 20 - 40 W. The use of multiple sequential rod amplifiers is a proven concept that, however, becomes costly and complex in terms of component number and adjustment as the number of laser crystals increases. The MULTIROD concept solves this issue by using only one slab-shaped laser crystal comprising multiple rod-shaped pumped volumes and common pump optics for all pumped volumes. In this way, the number of optical components can be minimized and a substantial reduction in complexity can be achieved. In particular, for the amplifier beam path, Fraunhofer ILT offers different customized solutions.

### Result

Up to seven fiber-coupled pump modules, each with 50 W output power at 940 nm, have been used in the demonstrator model. Amplification factors between 5 and 400 were reached. Depending on amplification, the optical-to-optical efficiency varies between 20 and 40 percent. At a pulse duration of one picosecond, a pulse energy of more than 10  $\mu\text{J}$  can be achieved at a B-integral of  $< 2$  without CPA. The maximum demonstrated output power is 150 W. The laser beam is rotationally symmetric (ellipticity less than 5 percent). At an output power of 120 W, a beam quality of  $M^2 < 1.12$  was measured. The setup is extremely compact and has no restrictions with respect to high repetition rates.

### Applications

The MULTIROD amplifier makes it possible to scale the productivity of ultrafast processes for industrial applications.

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2 Detailed view of the MULTIROD amplifier.