Staff member characterizing a high-power solid-state laser.

Research for partners and customers

Customer- and partner-specific solutions can be realized in joint research projects, in particular in the fields of SWIR laser sources and optical parametric oscillators (OPO) in the MWIR and LWIR spectral ranges for various applications from LIDAR and remote sensing, plastic machining or medical tissue ablation to defense.

In the near future, qualifying the laser-induced damage threshold (LIDT) of SWIR or MWIR laser components and optics will be made available for our partners and customers as part of joint research projects, aiming at the improvement of production processes and in particular the refinement of optical components.

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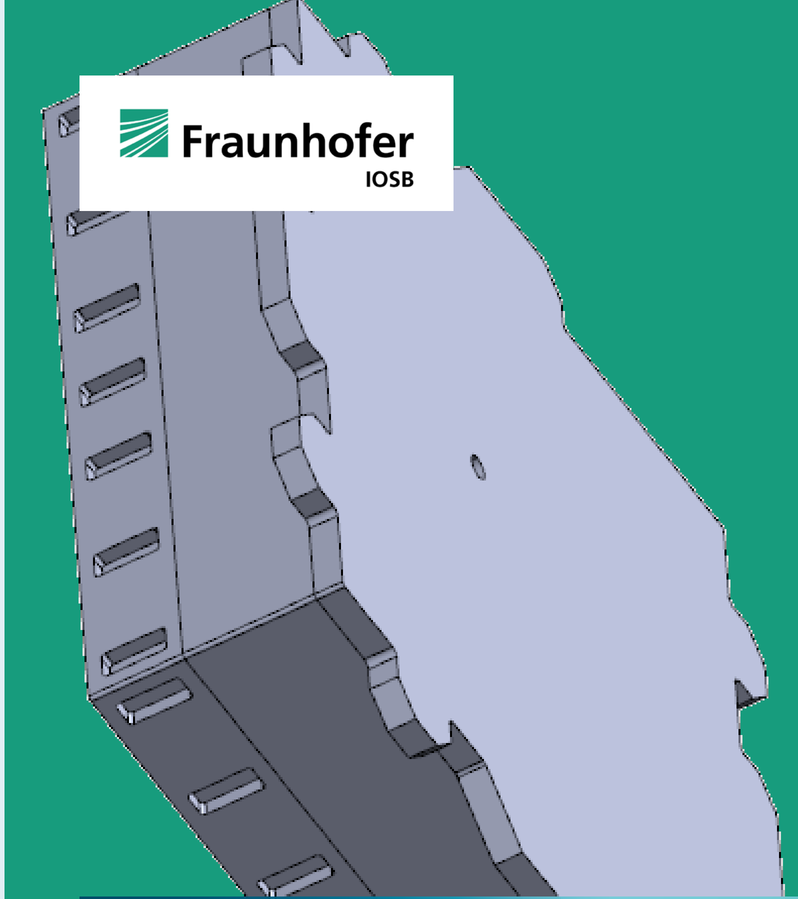
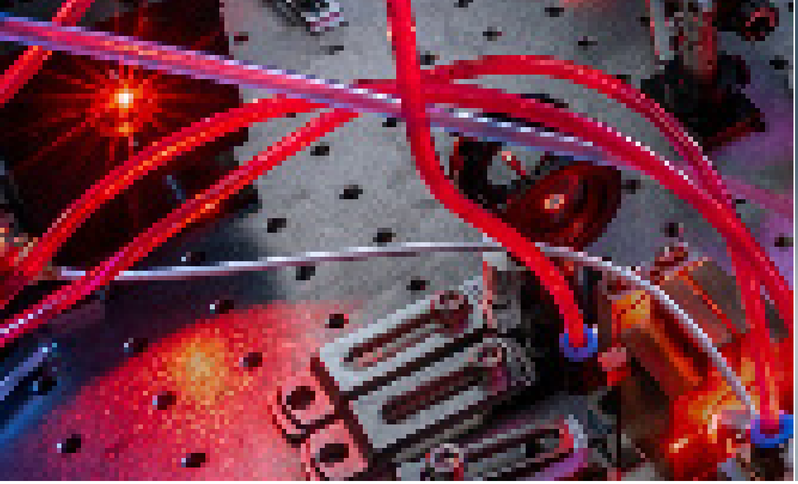
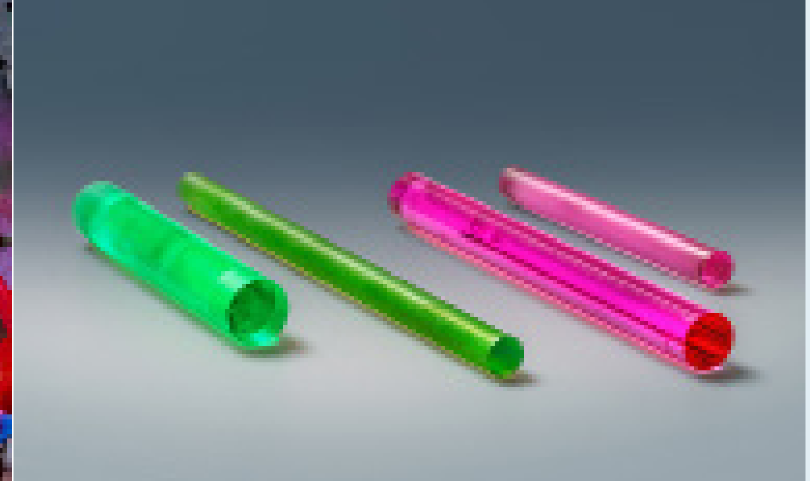


High-power high-energy solid-state lasers

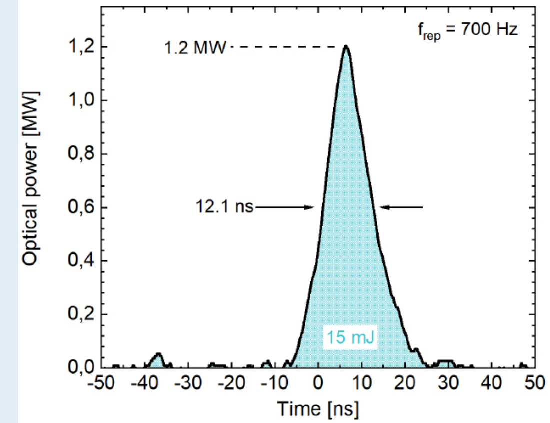
Ruggedized laser sources for demanding operating conditions



Partial view of a high-power solid-state laser test setup on the optical table.



Doped oxide and fluoride laser rods.



Specific pulse shape obtained with a repetitively-pulsed high-peak-power Ho^{3+}:YAG laser design.

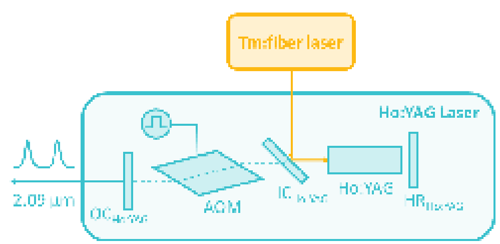
High-power solid-state sources in the short-wave to long-wave infrared spectral range

Future high-power laser sources need optimized designs and novel architectures

Fraunhofer IOSB is performing research and development on high-power solid-state lasers based on crystals doped with rare-earth ions (Er^{3+}, Tm^{3+}, Ho^{3+}) and on non-linear sources based on nonlinear optical materials like ZGP ($ZnGeP_2$), CSP ($CdSiP_2$) or orientation-patterned gallium arsenide (OP-GaAs), which cover the short-wave (SWIR) to long-wave infrared (LWIR) wavelength range from 1.5 µm to 12 µm. Such light sources can be used in various technological applications, including molecular spectroscopy, LIDAR, free-space optical communication, remote sensing, and optronic countermeasures against heat-seeking missiles, and many more.

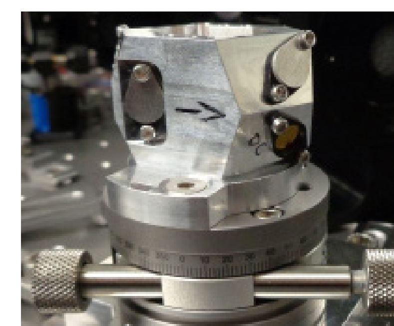
Solid-state laser sources

In addition to studying the underlying physics, creating stable and compact laser designs is an essential part of the research and development activities at Fraunhofer IOSB. This includes continuous improvement of functionalities of high-power solid-state lasers and upscaling of laser output power and pulse energy. Ho^{3+}:YAG lasers pumped by thulium-doped fiber lasers are a typical example, where by optimizing the resonator geometry, highly compact and ruggedized laser sources with over 1.2 MW of pulse peak power have been realized.



Schematic architecture of a compact pulsed Ho^{3+}:YAG laser.

Achieving high beam quality and damage-free long-lifetime operation at high power or pulse energy in such laser designs is one of the key competences at Fraunhofer IOSB. This includes thorough in-depth simulation of high-power lasers already in the design phase and the use of novel architectures for low-SWaP laser topologies like self-aligning resonator topologies, non-planar ring resonators, novel optical resonator components or embedded specific laser control electronics.



Non-planar, image-rotating laser resonator for alignment-free laser designs with high beam quality.