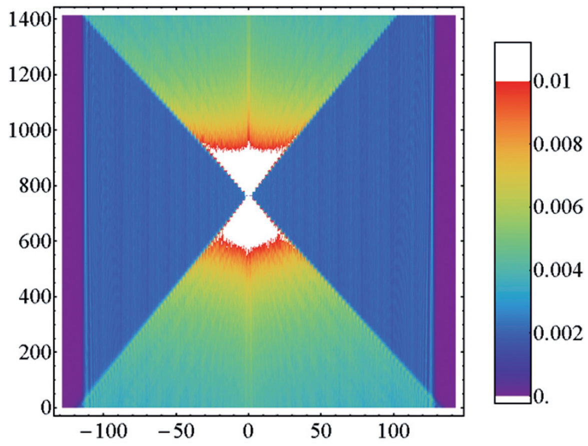
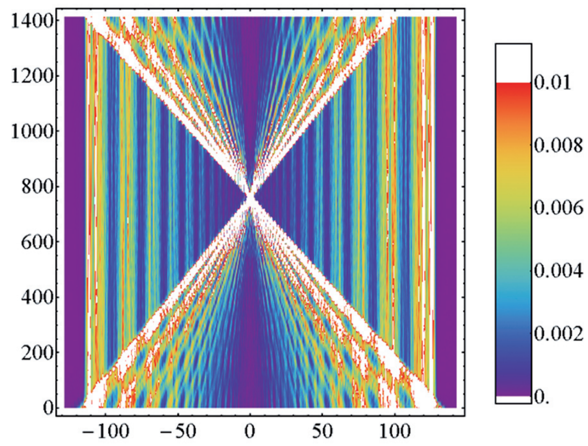


1



2

MODELING AND SIMULATION OF UNSTABLE LASER RESONATORS

Task

On account of increasingly higher output powers for material processing applications combined with brilliant beam quality, two concepts for multi-kW systems have become commonplace in industry for gas lasers: the multiple folding of stable resonators, and unstable resonators. The advantage of unstable resonators relates to the excellent utilization of the active medium. Current research is focusing on analyzing the dynamics in various operating states (transient behavior, startup, power modulation, power scaling).

Method

To explain, predict and control the laser output power that varies over time and the intensity distribution of transiently operated multi-kW systems, a simulation was developed that can describe the beam distribution in the resonator, the influence of spatially and temporally distributed radiation quantities in the resonator, and the influence of the active medium.

Intensity distribution of the 1st mode (Fig. 1)
and the 50th mode (Fig. 2) of an unstable resonator.

Result

Almost the only way to describe unstable resonators is by using numerical calculations, since no analytical solutions are available for this resonator type. The frequently encountered fractal properties of the eigenmodes of these kinds of resonators pose specific numerical challenges when calculating the modes (numerical resolution, convergence, etc.).

Applications

The presented modeling and simulation is particularly suited to radiation propagation in unstable resonators and can therefore be used to optimize existing multi-kW systems for material processing both in cw mode and in pulsed mode.

Contacts

Dipl.-Phys. Urs Eppelt
Phone +49 241 8906-163
urs.eppelt@ilt.fraunhofer.de

Prof. Wolfgang Schulz
Phone +49 241 8906-204
wolfgang.schulz@ilt.fraunhofer.de

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
DQS certified by DIN EN ISO 9001, Reg.-No.: DE-69572-01