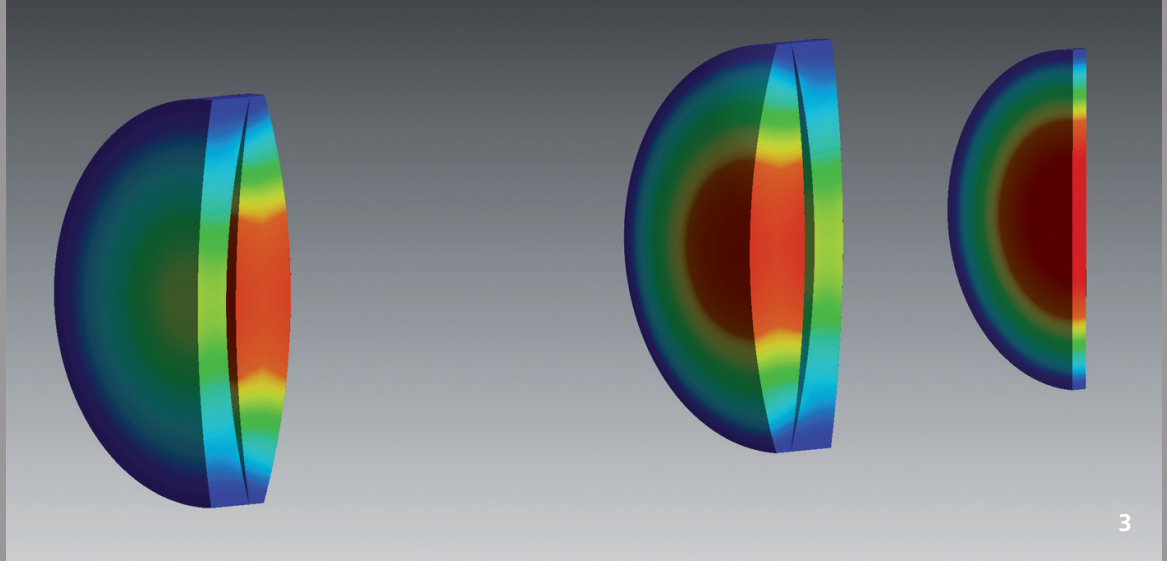

# OPTICS SIMULATION WITH THERMAL ABERRATIONS

## Task

Thermal inhomogeneities in optical systems (temperature profile, deformation, stress distributions), arising for instance from local absorption of laser radiation, may lead to a significant change in optical properties and, in turn, to a reduction in imaging performance. Sophisticated ray-tracing software, which enables system properties to be optimized, is now used to design optical systems. Thermal inhomogeneities cannot, however, be simulated adequately at present; hence the need to augment the capabilities of the optics simulation. The aim is to support end-to-end thermo-optic simulation, which will allow thermally aberrated systems to be analyzed and optimized.

## Method

The link between thermal and optical simulation is achieved by means of an interface between the software packages Ansys (FE method) and Zemax (ray tracing). The thermal simulation (FE) is based on degrees of absorption, which are calculated as part of the ray tracing. Following an approximation step, the ray tracing can be used to analyze the changed beam path taking thermal effects into account.

## Result

Current extensions and improvements within the approximation process enable the simulation of both symmetrical and asymmetrical loads and temperature distributions. This facilitates the analysis of laser systems subject to high thermal loads, which allows investigations of focus shifts as well as of higher aberrations and opens up the prospect of offsetting these factors.

## Applications

This simulation link facilitates research in the field of laser technology as well as other applications such as lighting technology. At the same time, the functionality is not limited to thermal effects and can in principle be extended to all inhomogeneities that influence the refractive index. These include stress distributions caused by thermal or mechanical loads as well as simulation of inhomogeneities arising in polymer lenses as a result of the injection molding process.

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*3 Thermo-optic simulation of laser optics.*