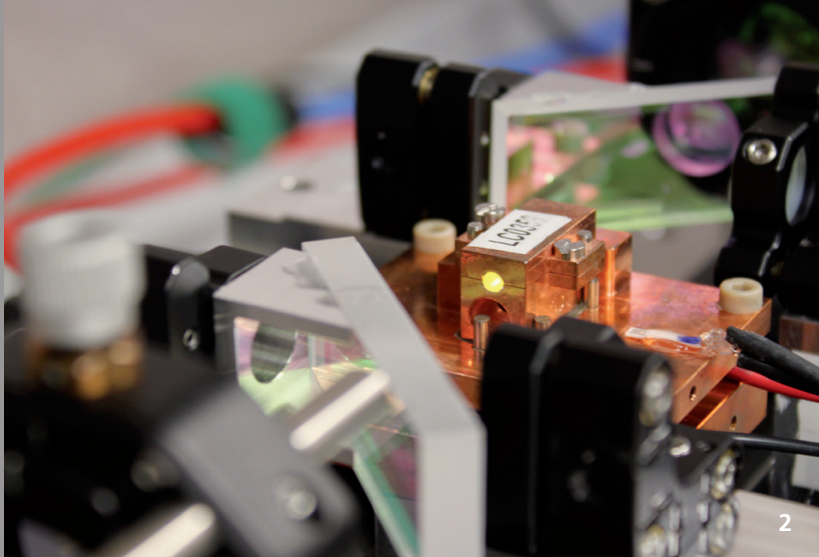


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## RADIATION TESTING ON ER<sup>3+</sup>-DOPED GARNET

### Task

Satellite-based Lidar systems lend themselves to the global and stable measurement of methane concentrations in the atmosphere and have been, for example, developed for the joint German-French climate mission »MERLIN«. A solid-state laser based on an erbium-doped garnet crystal serves as the laser beam source of such a system. There have not been any published studies, however, on these crystals' radiation hardness against proton and gamma radiation.

### Method

Different crystal samples of Er:YAG, Er:YLuAG and Er,Ce:YLuAG were irradiated with protons corresponding to a given mission scenario. The radiation-induced losses were determined for the individual specimens in three different ways:

- Before and after irradiation, transmission spectra of the specimens were measured.
- A test laser oscillator was built and all specimens were used before and after irradiation in this oscillator as a laser medium. The laser threshold and slope efficiency were measured before and after the irradiation for each individual specimen.
- By means of photo-thermal common path interferometry (PCI), the radiation-induced volume absorption was measured in the specimens.

### Result

Proton radiation-induced losses are only measured for specimens irradiated with the ten-fold mission dosage. These amount to about 2 percent/cm for Er:YAG and Er:YLuAG and about 0.5 percent/cm for Er,Ce:YLuAG. All specimens are sufficiently radiation-hard for use in the given mission scenario. Furthermore, it was demonstrated that co-doping with cerium increases the proton radiation hardness. Currently, gamma radiation tests are being conducted.

### Applications

The results show that erbium-doped garnet crystals can be used in radiation-intensive environments. In addition to the aerospace industry, for example, their usage in particle accelerators may also be suitable.

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### Contacts

Dipl.-Phys. Ansgar Meissner  
Telephone +49 241 8906-8232  
ansgar.meissner@ilt.fraunhofer.de

Dipl.-Phys. Marco Höfer  
Telephone +49 241 8906-128  
marco.hoefer@ilt.fraunhofer.de

1 Setup for proton radiation.

2 Test specimen in the laser oscillator.