Low-noise fiber amplifiers for quantum technology

Laser beam sources are a key technology for many applications, including quantum technology. The laser beam sources used here typically have to meet high requirements, since radiation of a certain wavelength with high power stability must be used to address atomic transitions or to be able to read out a spin state. Fiber lasers can be a suitable technology for this, as active dopants such as ytterbium, erbium, thulium or holmium can be used to directly generate or amplify a broad spectrum of wavelengths around 1 µm, 1.5 µm or 2 µm.

In order to extend the wavelength range and enable new applications, Fraunhofer ILT is developing spectrally narrowband fiber amplifiers with neodymium-doped fibers for wavelengths around 922 nm as part of the "Innoquant" project. The overarching goal of the project is to develop a technology platform that combines fiber lasers and subsequent frequency conversion stages for potential use in space.

Neodymium-doped fiber amplifiers

Fraunhofer ILT is developing and experimentally implementing a fiber amplifier based on polarization-maintaining, neodymium-doped fibers to amplify narrowband radiation with a wavelength of 922 nm and to simultaneously maintain polarization. To enable a compact design for usage in space, the amplifier is a fully monolithic setup.

Technology platform for usage in space

Using the neodymium-doped fiber amplifier, the Fraunhofer ILT has demonstrated that the amplifier can generate linearly polarized radiation with an output power of more than 1 W and a spectral linewidth of < 80 kHz at a wavelength of 922 nm. Furthermore, higher output powers > 2 W could also be demonstrated, whereby the degradation effects occurring in the fiber must be taken into account. For further power scaling, additional fiber amplifier stages, therefore, need to be used, the functionality of which is currently being investigated.

While the fiber amplifier was implemented as an elegant breadboard structure, Fraunhofer ILT is currently developing a compact mechanical design to further develop the technology platform for use in space.

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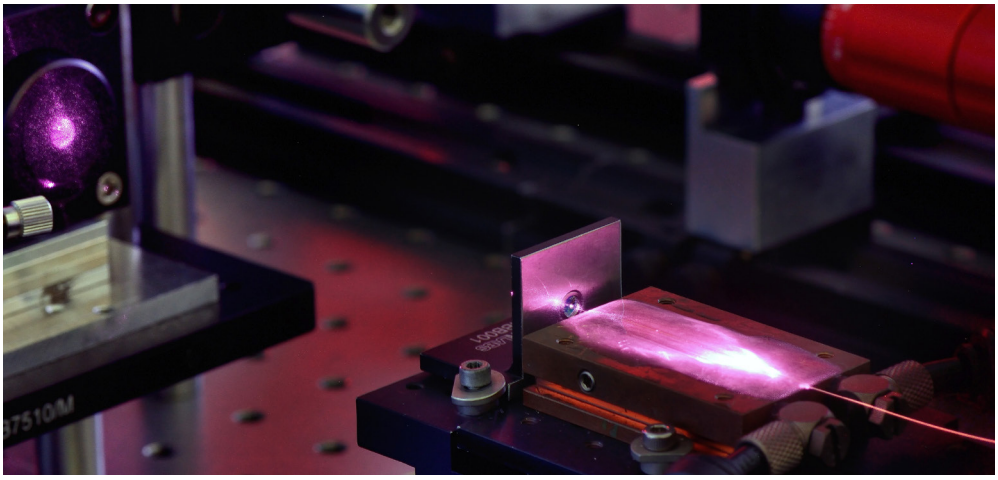

Neodymium-doped fiber amplifier for the "Innoquant" project.