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P2.055 Nd:YAG Lasers for ITER Divertor Thomson scattering

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LD pumped Nd:YAG lasers developed for ITER Divertor Thomson Scattering (DTS) diagnostic can operate with high power 3ns/(1–2)J/(50–100)Hz at wavelengths 1064nm and 946nm.
1064nm Nd:YAG laser technology is well established and, when creating the laser, we are mainly focused on quality of the laser radiation. The laser beam quality is usually affected by thermally induced lens and birefringence in laser rods. Owing to the use of SBS Phase Conjugation mirror to compensate for the aberrations flat-top output beam with a nearly perfect beam quality was achieved in a wide range of output power.
946nm laser with similar parameters is a challenge solution, because the achieved laser power exceeds characteristics of existing lasers operating at this wavelength by more than 10 times. It is lasing on quasi-three-level transitions, where a population inversion can be achieved at high pump intensity only. Conventional MOPA optical schemes with Q-switched master oscillator are not applicable here, because the stimulated emission cross section for 946nm is 5 times smaller than for 1064nm. The ring cavity regenerative power amplifier with relay optics provided a zero diffraction length and image-rotation, which allowed obtaining output energy of 1×50Hz at 3ns pulses with beam divergence of 1.25×DL.
Stable properties of the beam quality of the developed lasers are extremely important for ITER application, since it determines predictable absence of breakdown of all optical elements of complex relay system used to deliver laser radiation on a distance of 40 meters into the divertor plasma. The laser beam quality meant low beam divergence, absence of hot spots on optical elements, reproducible and close to a Gaussian temporal shape.
This paper deals with approaches used under the laser design development and with the detailed properties of the laser operation. The state of the art and outlook of further developments are also presented.

Presenter: KORNEV, Aleksei (Lasers and Optical Systems Ltd.)

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