Extreme Photonics Seminar

No. 1

Language: Japanese

Date : Aug.4(Thu), 2016, 15:00–16:00

Location : Cooperation Center, 5F Meeting Room, W524
(研究交流棟5階会議室W524)

Title : 0.5 kW picosecond Yb:YAG regenerative amplifier for deep UV to mid-IR frequency conversion

Speaker : **Prof. Dr. Akira Endo**

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Thin Disk lasers of picosecond pulses near central wavelength of 1 um have already become a standard tool for many emerging industrial and scientific applications. However, higher throughput requires increase in repetition rate and upgrade of existing systems to higher average output power. Progress in high volume nonlinear crystal production and advent of new kinds of conversion crystals has lately enabled to convert 1 um radiation to ultrashort pulses in deep UV or mid-IR spectral regions. The powerful disk lasers emitting pulses near 1 um in a nearly diffraction-limited beam then appear to be an excellent pump source for such frequency conversion.

At the Hilase Centre in Dolní Břežany, several thin disc lasers are developed reaching > 0.5 kW of average output power. Especially the compact PERLA C disk laser generating > 5 mJ pulses in a nearly diffraction limited beam with pulse length 1.3 ps and 100 kHz pulse repetition rate appears to be an appropriate instrument for scientific and industrial applications. The pump laser PERLA C is a compact, thin-disk-based Yb:YAG regenerative amplifier, consisted of a Yb-doped fiber front-end and a chirped Bragg grating-based pulse stretcher. The front-end is followed by a regenerative amplifier with a standing-wave-cavity and a single thin-disk. This amplifier provides >1 mJ pulse energy after pulse compression at 100 kHz repetition rate. The second, high power regenerative amplifier with a ring cavity, which is seeded by 0.1 mJ pulses from the first regen, delivers >5 mJ of energy in a nearly diffraction-limited beam. More than 6 m long cavity contains a single thin disk pumped directly to upper laser level near 968.8 nm (zero phonon line). The regen is switched by an in-house developed BBO Pockels cell with 10x10 mm aperture. Output pulses are compressed to 1.3 ps by a compact compressor using a chirped volume Bragg grating. The next step is an upgrade of the regen to 1 kW, tunability of repetition rate to 1 MHz, and shortening its pulse bellow 1 ps. A more powerful fiber front end which will allow efficient seeding and separate operation of both regens is under development.

The PERLA C system is also an excellent tool for frequency conversion to 4th and 5th harmonic of the Yb:YAG and, on the other hand, for pumping of an optical parametric generator followed by optical parametric amplifiers. This is important since, for example, irradiation of samples by multiple wavelengths for effective or more efficient processing of some materials requires availability of synchronized pulses at several different wavelengths simultaneously. Such systems are under construction with a goal to reach > 10 W in picosecond pulses near wavelength of 2 um and a potential to go to longer wavelengths up to 12 um. In deep UV the aim is to get 10 – 20 W of average power in sub-ps pulses. It is already demonstrated of achieving > 6 W in 4th harmonic frequency.

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