

Jaws Laser System

Cr:forsterite Multi-Terawatt Amplified Laser

The Jaws multi-terawatt laser system is the first commercially available terawatt pulse laser operating in the near infrared at 1240 nm. The 1240 nm fundamental radiation as well as the second and third harmonics of the Cr:forsterite laser are convenient for a number of applications in time-resolved spectroscopy, telecommunications, photochemistry, photobiology, plasma physics, x-ray generation, and material processing.

The 1240 nm wavelength gives a Cr:forsterite based system several advantages over 800 nm Ti:sapphire based systems. The longer wavelengths are less damaging to biological samples and have a deeper penetration depth making Cr:forsterite an ideal source of ultrashort pulses for biological and medical applications. Wavelength range is also well outside the visible and shows significantly less pulse broadening in atmosphere than 800 nm, an advantage in LIDAR and atmospheric studies.

The design allows the Jaws multi-terawatt system to be assembled on a single 1.2x3.0 m optical table. The subsystems (oscillator, stretcher, amplifiers and compressor) used in the Jaws multi-terawatt laser

are all Del Mar Photonics standard production products. This modular approach greatly reduces the system cost and lead time when compared to other terawatt systems available. An additional advantage is that Cr:forsterite can be directly pumped at 1064 nm removing the need for more expensive frequency doubled pump lasers.

Del Mar Photonics terawatt femtosecond laser is based on the chromium-doped forsterite ($\text{Cr}^{4+}:\text{Mg}_2\text{SiO}_4$) gain medium, consisting of an oscillator, regenerative amplifier and a four stage multi-pass power amplifier. The system can generate 80 fs pulses at a center wavelength 1240 nm, with pulse energies of 89 mJ giving a peak power range of 1-2 terawatts at 10 Hz.

Terawatt peak power is achieved by a technique known as chirped pulse amplification (CPA). The femtosecond seed pulse is temporally stretched (chirped) with a diffraction grating before being amplified. After passing through the pre-amp and 4-stage power amplifier, the pulse is then recompressed using another grating to achieve 80 fs pulses.

Modular subcomponents

2 Terawatt peak power

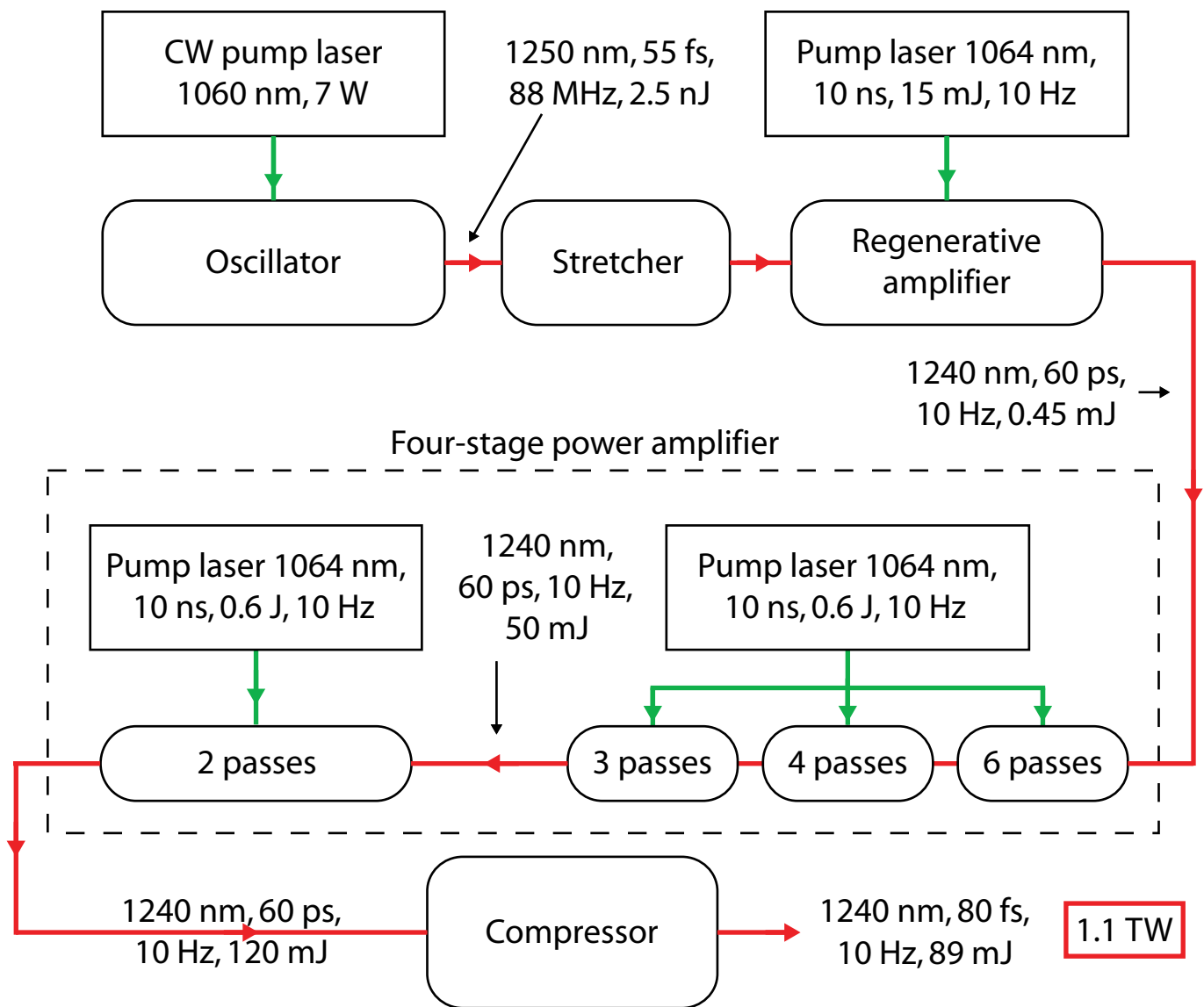
80 fs, 90 mJ pulses

Small footprint

Includes pump lasers

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The Jaws multi-terawatt system consists of a seed oscillator, stretcher, ring regenerative amplifier, 4-stage power amplifier, and compressor. The setup, including pump laser, can be placed on a single 1.2x3.0 m optical table. The oscillator produces 55 fs, 1250 nm pulses at 88 MHz. These pulses are stretched to 60 ps then fed into the ring regenerative amplifier. A single gold coated grating, dielectric plane mirror, and dielectric curved mirror are used in a standard stretcher scheme. The repetition rate is cut to 10 Hz and the pulses are amplified from 2.5 nJ to 0.45 mJ. The amplified pulses are then sent through the 4-stage power amplifier. The four stage amplifier consists of 4 multipass amplifiers with 2 separate pump lasers. Optimal number of passes for each stage are used to produce the highest amount of energy extraction efficiency. After the power amplifier, the 120 mJ pulses are fed into a Treacy two grating compressor. Final output from the complete Jaws multi-terawatt system: 80 fs, 89 mJ pulse at 1240 nm.

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