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Abstract: We are developing a fiber laser front end suitable for high energy petawatt laser systems on large glass lasers such as NIF. The front end includes generation of the pulses in a fiber mode-locked oscillator, amplification and pulse cleaning, stretching of the pulses to >3ns, dispersion trimming, timing, fiber transport of the pulses to the main laser bay and amplification of the pulses to an injection energy of 150μJ. We will discuss current status of our work including data from packaged components. Design detail such as how the system addresses pulse contrast, dispersion trimming and pulse width adjustment and impact of B-integral on the pulse amplification will be discussed.

A schematic of the fiber laser system we are constructing is shown in figure 1 below. A 40MHz packaged mode-locked fiber oscillator produces ~1nJ pulses which are phase locked to a 10MHz reference clock. These pulses are down selected to 100kHz and then amplified while still compressed. The amplified compressed pulses are sent through a non-linear polarization rotation based pulse cleaner to remove background amplified spontaneous emission (ASE). The pulses are then stretched by a chirped fiber Bragg grating (CFBG) and then sent through a splitter. The splitter splits the signal into two beams. (From this point we follow only one beam as the other follows an identical path.) The pulses are sent through a pulse tweaker that trims dispersion imbalances between the final large optics compressor and the CFBG. The pulse tweaker also permits the dispersion of the system to be adjusted for the purpose of controlling the final pulse width. Fine scale timing between the two beam lines can also be adjusted in the tweaker. A large mode area photonic crystal single polarization fiber is used to transport the pulses from the master oscillator room to the main laser bay. The pulses are then amplified a two stage fiber amplifier to 150μJ. These pulses are then launched into the main amplifier chain.

We are currently constructing a packaged prototype of this system, which will ultimately be deployed on the National Ignition Facility (NIF). In our talk we will discuss the packaged components as well as the numerous technical challenges that needed to be overcome in order to make this system possible. Of particular interest was the quality of recompressed pulses that could be achieved with a CFBG. We will show background free auto-correlation data from pulses with a dynamic range noise limited to six orders of magnitude that were stretched with a CFBG and then recompressed in a standard compressor (figure 2). We will also discuss in detail the impact of B-integral accumulation on the recompressed pulses. Our current system is projected to run at an accumulated B-integral of 7. However, because our injected system bandwidth is much wider than the NIF system bandwidth our system can tolerate this high B-integral.

Essentially, the NIF system will gain narrow our spectra eliminating the portions where the B-integral accumulation takes place.

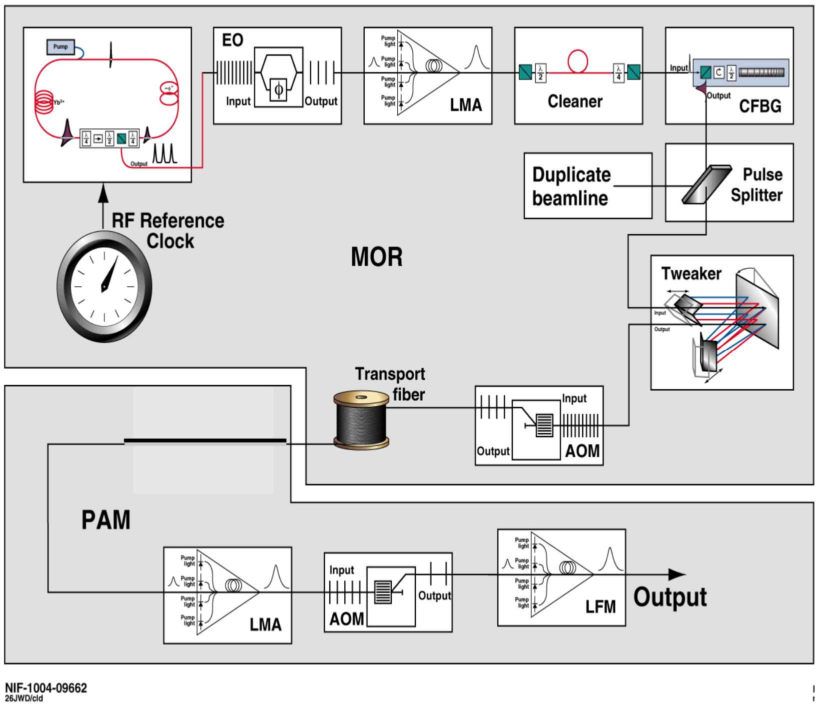

Figure 1: Schematic of the fiber laser front end being developed for high-energy peta-watt class laser systems.

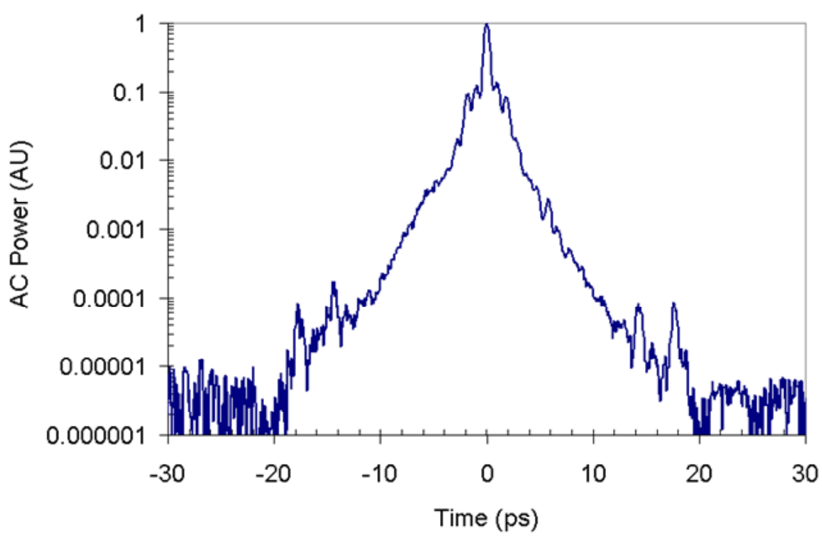

Figure 2: Background free auto-correlation of low energy pulses that were stretched with a chirped fiber Bragg grating and re-compressed in standard parallel grating compressor. Points that are less than –20ps and greater than +20ps are lost in the noise floor of the measurement system.

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