A Master Oscillator Power Amplifier Laser System for Polarized Electron Generation for the MIT - Bates Accelerator

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Abstract

Polarized electron beams have proved to be a powerful tool for studies in solid state, atomic and high-energy physics [1-2]. Intense research effort has been devoted to the development of GaAs photocathodes [3-5] and high power laser systems to satisfy the requirements of electron accelerators [6-10].

In this communication we present recent progress in the development of a novel laser system for the generation of polarized electron beams based on commercially available telecommunications components. The system is based on a Master Oscillator Power Amplifier design (MOPA). The specific configuration was built to be used at the MIT - Bates facility [6] but it may be adjusted for other accelerating systems. It comprises of a signal DFB laser diode, a chain of optical amplifiers, which include two very low noise custom-built preamplifiers, a 500 mW booster amplifier and a PPLN crystal wavelength doubling stage. The main issue in the operation of the system is ASE noise built-up in the amplifiers and this is reduced by the incorporation of two Lithium Niobate modulators between the pre-amplifier stages and a final acousto-optic modulator before the booster amplifier. The system produces 100 ps optical pulses at 2856 MHz frequency, modulated in bunches having 1 - 2 us duration at 600 - 800 Hz repetition frequency. The direct emission wavelength of the MOPA may be selected in the range 1530 - 1560 nm depending on the wavelength of the seed DFB source and is doubled to 765 - 780 nm with a birefringent PPLN crystal. As it stands, the system develops 3 to 6 uJ energy per bunch and 0.3 nJ pulse energy after the PPLN crystal at 774 nm. Under these conditions the system extracts 54% of the energy stored in the booster amplifier. Work is underway to optimize the system and further increase the pulse energy, something that will be reported in the presentation.

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