L.6: Developmentof long pulse (60 ns) XeCl Excimer laser

Conventional excimer lasers generate short pulses of ~ 10 ns duration (Fig. L.6.1). Such short pulses restrict their use in a number of applications and investigations, which require high beam quality, due to smaller number of possible round trips through cavity. Long (> 50 ns) excimer laser pulses with improved beam properties are desired for fiber optic beam delivery of high energy, low peak power UV pulses without damaging the core material for various applications. The increase in number of cavity round trips, improves the laser beam quality and pointing stability that enhances their potential in various applications in different fields. A long pulse XeCl excimer laser, using a novel auto pre-pulse excitation scheme, is developed at Excimer Laser Section, Laser Material Processing Division of RRCAT.

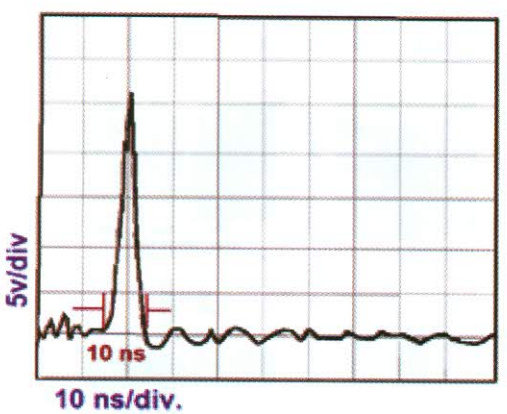

Fig. L.6.1: The short pulse of XeCl excimer laser with conventional exciter

The XeCl excimer laser was pumped by a compact and simple spiker-sustainer circuit using saturable inductors. The long pulse XeCl excimer laser was realized by a high voltage auto pre-pulse scheme and the system mainly consisted of laser head, UV spark pre-ionizer, high voltage auto pre-pulser and gas circulation. The auto pre-pulse scheme used spiker and sustainer energy banks, which were switched by a common high voltage thyratron switch. The pulser capacitor bank was directly connected to the pre-ionizer which was integrated with the system. Similarly the sustainer part of capacitor bank with saturable inductor was connected to the laser head directly. The excitation mechanism for the long pulse operation is a 3 step process - pre-ionization of the gas medium, creating initial discharge by fast rising HV pulser and sustaining the discharge by sustainer circuit realised by a single switch. The pre-ionizer circuit with 10 nF capacitor was directly connected to the inductively ballasted pin pre-ionizer. The sustainer circuit, capable of generating fast rising voltage pulses, was made of a capacitor bank of 40 nF with a single turn saturable inductor using ferrite cores. All the capacitor banks were charged to 25 kV with a single high voltage DC power supply and the discharge was initiated by triggering the thyratron switch. The electrical sequence associated with this mode of excitation (ie. pre-ionizing the gas media, creating the glow discharge and sustaining the discharge for longer duration) follows, and finally generate longer duration laser pulses. The photograph of the laser system in operation is shown in Fig. L.6.2.

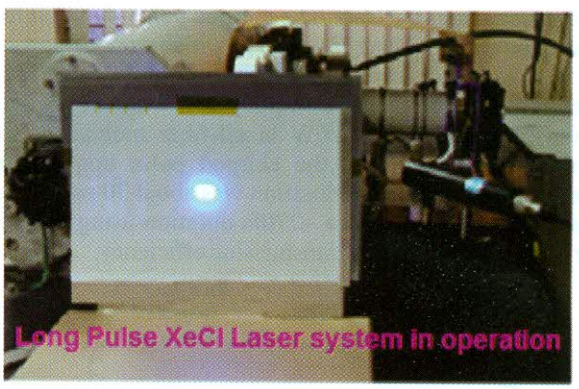

Fig. L.6.2: Long pulse XeCl laser in operation.

The Fig. L.6.3 shows the pulse shape of the output of XeCl excimer laser with auto pre-pulse scheme. The pulse duration of the laser was observed to be 60 ns with 100 mJ output energy.

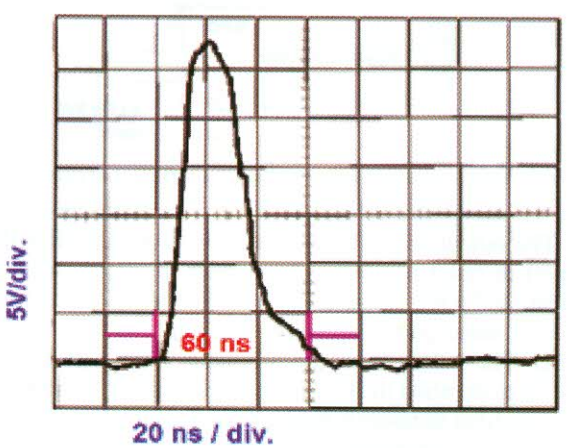

Fig. L.6.3: The long pulse of XeCl excimer laser with auto pre-pulse scheme

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