LASER PULSE CHOPPING OF A 1.053µm LASER BEAM

A.K.L. Dymoke-Bradshaw[1], P.A. Kellett[1], C.N. Danson[2] and D.A. Pepler[2]
[1]Kentech Instruments Ltd. [2]Rutherford Appleton Laboratory

INTRODUCTION

A 25ns long 1.053µm laser beam has been successfully chopped with a Pockels cell driven by a solid state pulse generator to give pulse widths of ~100ps. Using this technique it should be possible to provide any pulse length from 100ps to several nanoseconds. A computer controlled pulse generator able to provide a range of pulse lengths is under construction. More recent developments in pulse generator technology may enable significantly shorter pulses to be chopped.

EXPERIMENTS

A Pockels cells, type 1112, made by Fast Pulse Technology Inc. driven by a newly developed pulse generator, has been tested on the Vulcan laser system with the aim of chopping a short pulse from the 25ns "Q" switched long pulse oscillator.

The Pockels cell uses two DKDP (KD_2PO_4) crystals and is "V" coated for use at 1.053µm. The optional "C" type connectors were used to try to improve the electrical bandwidth of the cell. In this configuration the quoted optical rise time of the cell is 85ps. The electrical performance of the cell was measured with a Tektronix sampling system looking at the transmitted and reflected electrical pulse from a S52 pulse generator (rise time of the measuring system is about 30ps). The results are shown in figure 1. These indicate that the Pockels cell electrical rise time is about 150ps.

The pulse generators used to drive the cell were two made by Kentech Instruments Ltd. The first was a 150ps 2.2kV pulser and the second a 65ps 3.8kV pulser that has recently been developed. Waveforms from these pulse generators are shown in figure 2. These pulsers use avalanche transistor technology to produce pulses with good reliability and low jitter (approximately 10ps rms).

The Pockels cell is placed between two "V" coated polarisers. The half wave voltage is expected to be about 3.2kV on these double crystal cells at 1.053µm. By operating below the half wave voltage one can expect to obtain somewhat faster optical than electrical speed due to the Sin^2 transmission coefficient. The second higher voltage pulse generator is probably too narrow to obtain efficient switching and much of the 3.8kV will be lost due to the relatively slow electrical performance of the cell.

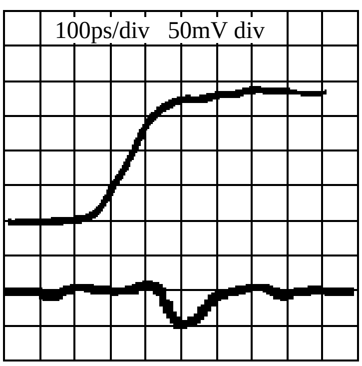
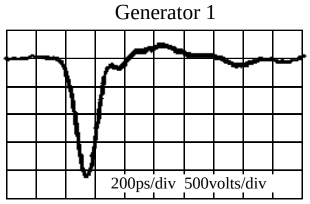


Figure 2
The transmitted (upper) and reflected (lower) pulses of a 200mV 30ps rising pulse into a 1112 Pockels cell

Generator 1



Generator 2

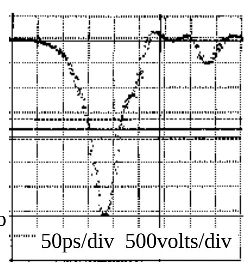


Figure 2 The waveform from the two pulse generators.

The transmitted pulse was passed through an etalon, with a round trip spacing equivalent to 333ps, and then detected with a Hadland 675 S1 streak camera. Some typical results of the streaks are shown in figure 3.

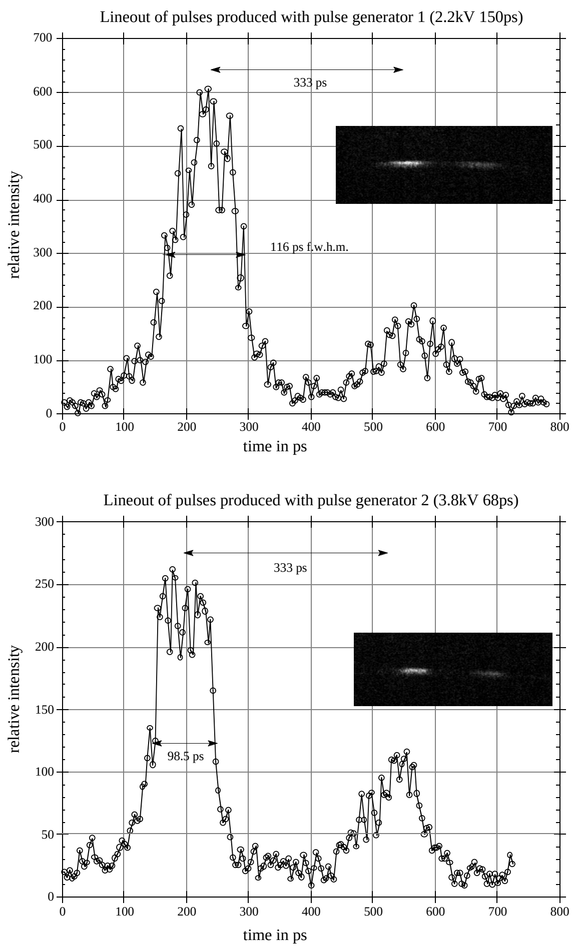


Figure 3 Lineouts of typical images obtained of the laser pulse after chopping, showing pulse widths down to around 100ps.

DISCUSSION

This technique shows that pulse lengths of the order of 100ps are obtainable. In order to improve on this several options are available. Firstly, a type 1111 cell may be used. This has a single crystal and consequently twice the half wave voltage. This would require 4 generators like the second one used here to achieve efficient switching. This cell is likely to be faster than the pulse generators.

An alternative would be to use the Pockels cell nonlinearity further and so obtain increased optical bandwidth for the same electrical bandwidth by pulsing the cell though a full wavelength of rotation. Pulse generators to do this are available and are capable of about 7kV in 75ps and consequently fairly fast optical response ought to be obtainable. The disadvantage of this technique is that the pulse generators can only produce pulses of few nanoseconds long and consequently a second slower pulse would follow the first unless some additional method of holding the chopping off is used.