KMLabs MTS Mini Ti:Sapphire Laser
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(Note: all IR power measurements of the Ti:Sapphire laser in the notebook were obtained using an IR filter (transmission ~ 85%) at the output of the laser to block out green light, all values have not been corrected unless specified)

CW Operation

- The factory settings of all micrometers were recorded and agreed with the settings given on page 10 in the manual for CW. The layout of the optical elements of the laser is shown in Figure 1.

- The second curved mirror (CM2) was found to have been bumped during shipping. For proper alignment, the pump beam should be hitting the mirror at the mid point between the center and the right edge in the horizontal plane. The beam spot should be centered on the mirror in height.

- The pump beam should pass through the entrance aperture tool placed before the focusing lens (3) and the iris in front of the output coupler (1). One should always use these two points as reference for walking the pump beam into the laser cavity.

- The laser was lasing at 800nm with a line-width of about 1nm and the new separations of the optical elements were recorded as on page 10 in the manual. At 4.5 W of Argon laser, about 750 mW of CW operation was obtained when the system was first lasing on September 6, 2006 (as shown in Figure 2).

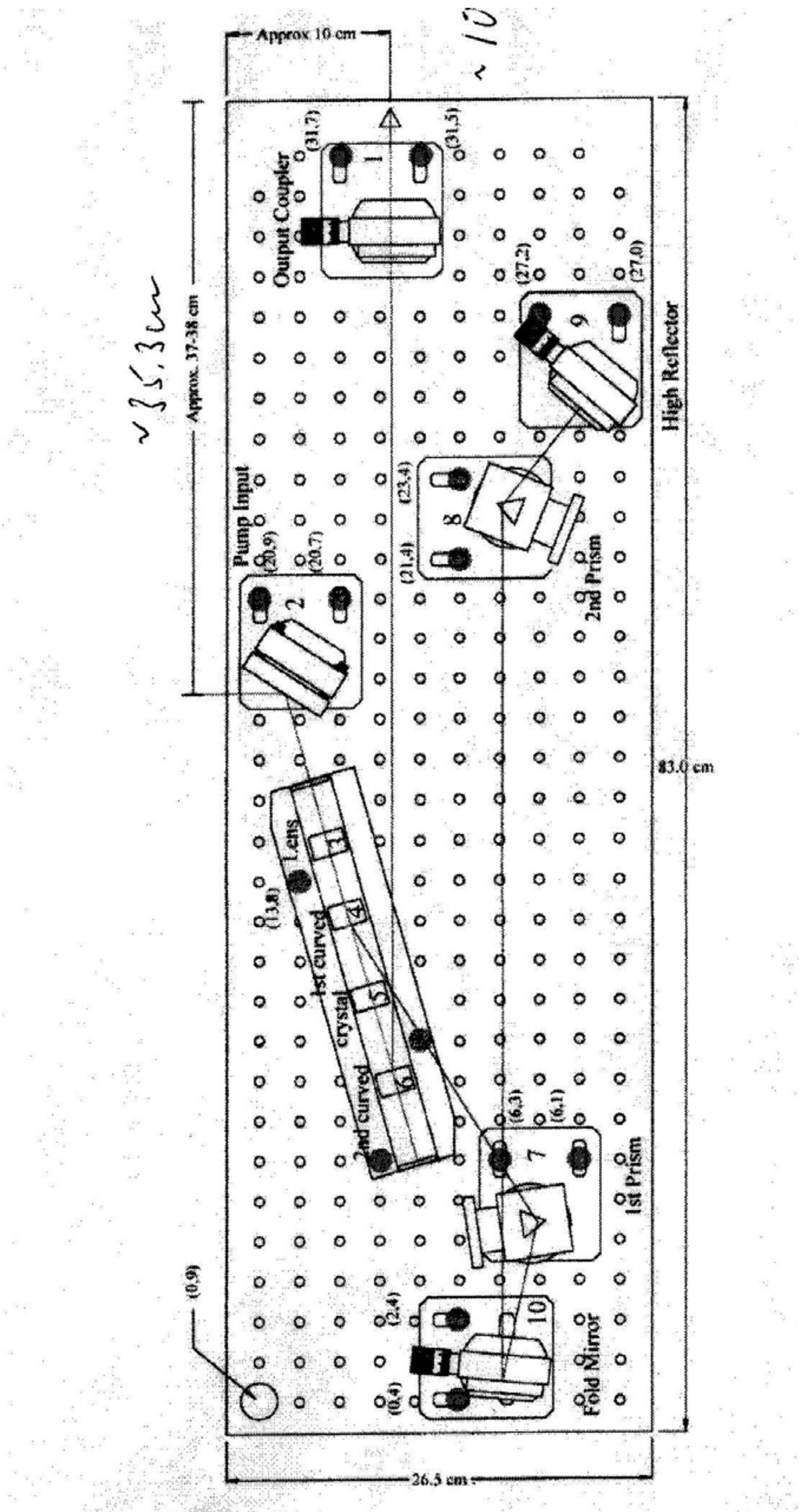

Figure 1. A schematic diagram of the optical elements in the MTS Ti:Sapphire laser.

Cleaning of the optics

- Substantial power drop in the CW operation was observed after a week of operation. All optical elements (including the crystal) except mirror 10 in the laser cavity were cleaned using lens tissue with methanol on September 14, 2006. At 4.5 W of Argon laser, about 800 mW of CW operation was obtained. The cavity elements may require regular cleaning depending on lab conditions. The lab where the laser was set up was particularly dusty. One should be very careful when cleaning the optics to avoid leaving any scratches or dried marks on the coated surfaces.

- The settings on the micrometers after cleaning were given as follows (in mm),
  Lens : 5.99
  Crystal : 3.74
  CM2 : 6.29
  P7 (first prism) : 2.01
  P8 (second prism) : 3.89
  These settings corresponded to a wavelength of 800 nm and a line-width of 1 nm.

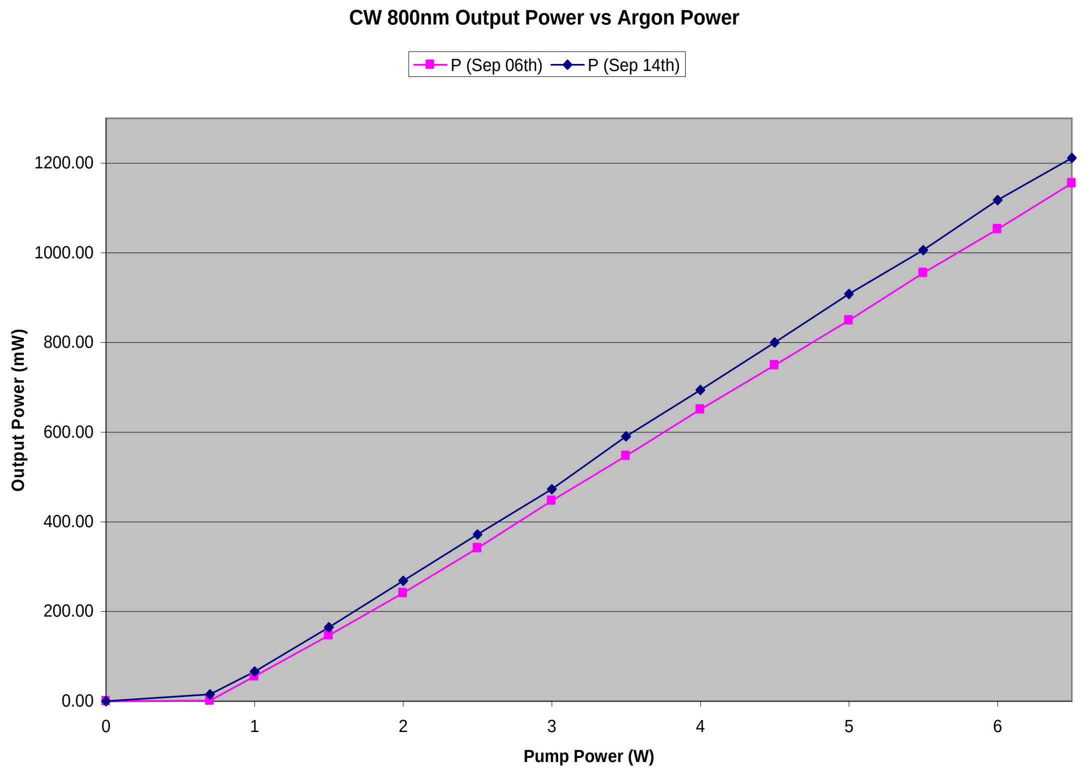

Figure 2. CW output power at 800 nm.

Polarization of the laser

The polarization of the laser was measured using a New Focus 5812 Polarizing Beam-splitter. About 98% of the beam was found to have horizontal polarization (parallel to the optical table).

Mode-locked Operation

- Move mirror CM2 closer to the crystal for mode-locked operation (refer to the instructions for starting mode-locking in the manual). The mirror may need to be moved about 1 mm from the CW setting. If CW lasing is observed on the mode-locked spectrum, try moving the mirror further into the cavity. P7 and P8 may not necessarily be close to the prism apexes to get mode-locking.

- To start mode-locking, shove second prism P8 inward using your thumb to increase the glass length by about 1-2 mm (Pump power at 4.5 W). Mode-locked operation can be verified from the broadening of the spectrum on the spectrometer (from 1 nm at CW to more than 5 or 10 nm at mode-locking) or the pulse train signal from channel E of the KMLabs USB board as shown in Figure 3 (or page 7 in the notebook).

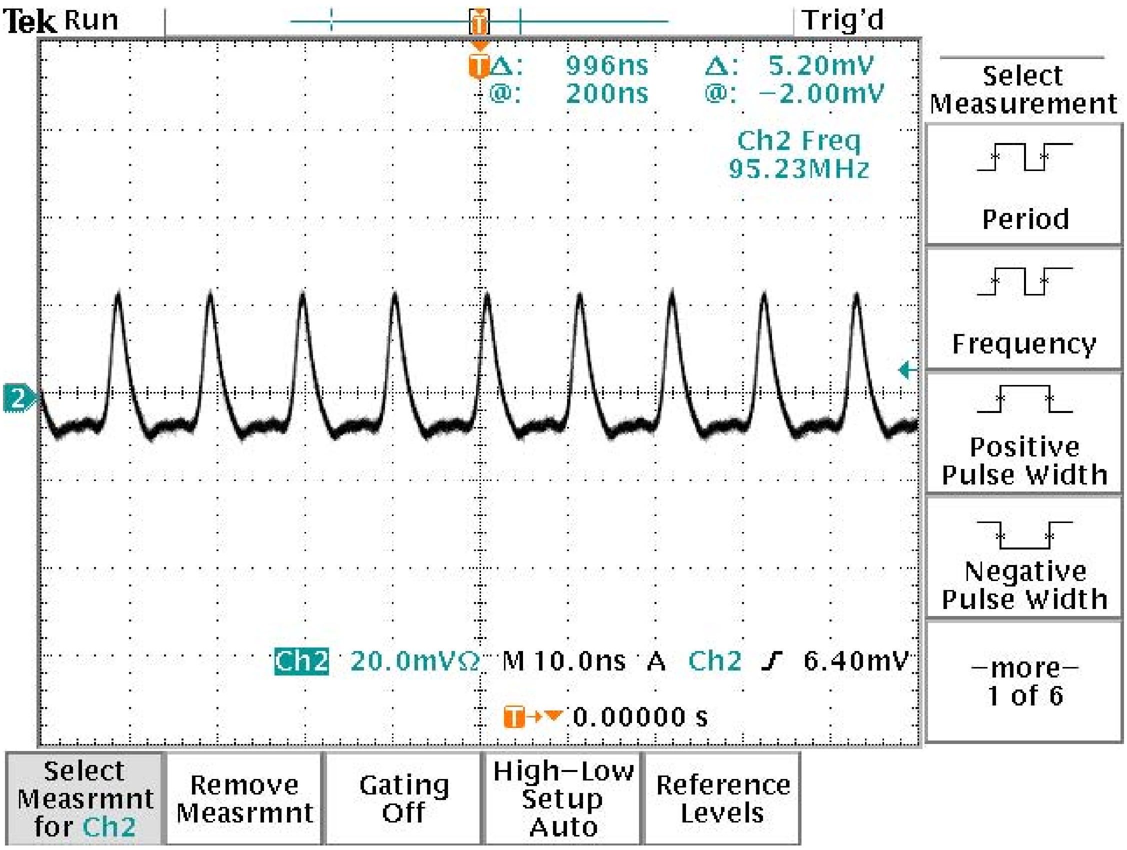

Figure 3. Analog signal (channel E) taken from the photodiode while mode-locking.

- The pulse repetition rate of the laser is about 95 MHz.

- The electronics board needs a photodiode pulse height of more than 30mV to trigger the digital outputs. One can increase the pump power to get sufficient pulse height.

Wavelength calibration

- Increasing micrometer settings on P7 and P8 reduces the amount of glass in the laser. In general, increasing the glass length results in lasing at shorter wavelength.

- P7 and P8 should be adjusted in opposite directions to maintain the bandwidth of the laser while tuning the wavelength.

- The settings (in mm, on page 14) for a long wavelength at 854 nm are:

CM2	: 4.97
Crystal	: 3.50
P7	: 1.00
P8	: 8.50
Power (Argon)	: 4.26 W
Power (CW)	: 220 mW
Power (ML)	: 323 mW

  (Refer to data set taken on September 28 on page 13 in the notebook for different wavelength settings)

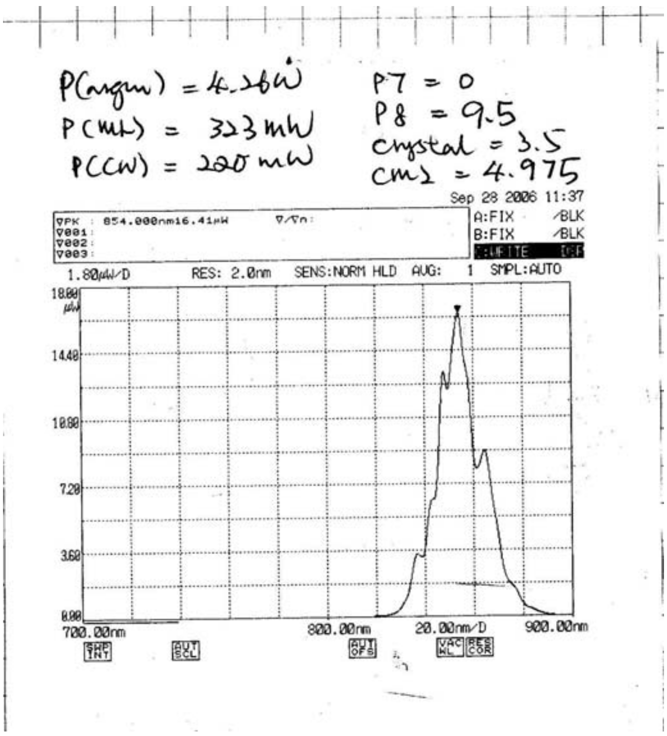

Figure 4. Spectrum of the mode-locked operation at long wavelength.

The settings for a short wavelength at 757 nm (in mm, on page 9),

CM2	: 4.99
Crystal	: 2.52
P7	: 4.49
P8	: 4.44

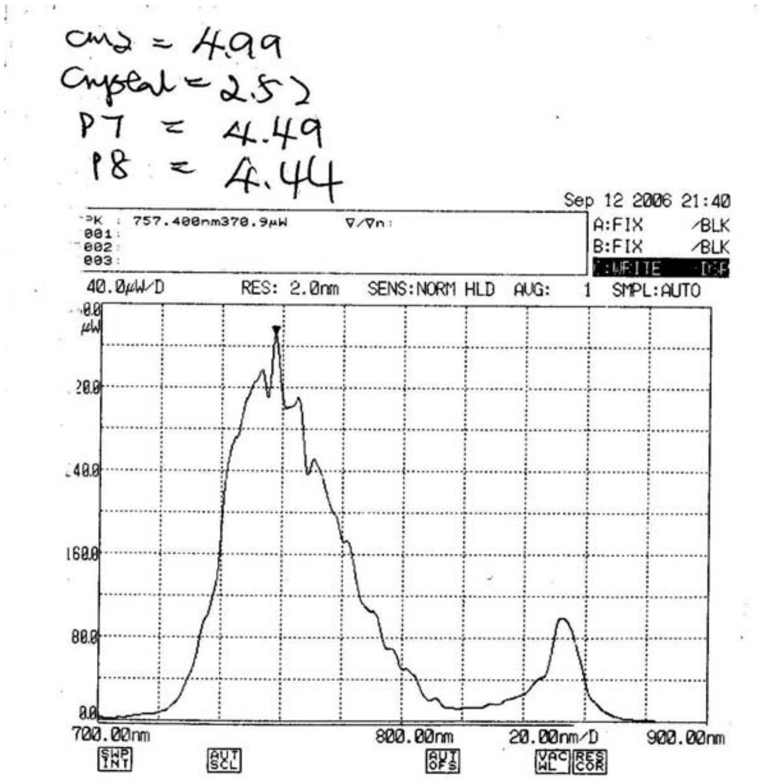

Figure 5. Spectrum of the mode-locked operation at short wavelength.

Please note that the position of the crystal is different from that of long wavelength as the spectrum was taken at earlier time (before cleaning).

- Measurements taken on September 28, 2006 (on page 13 in the notebook) show that wavelength tuning can be achieved by setting different values on P7 and P8. For a micrometer setting of P7 greater than 3.00 mm, the lasing power dropped dramatically. The laser beam was found to be very close to the apex of P7. One has to adjust the output mirror (1) and high reflector (9) to get the power back up.

- For wavelength calibration using the software, one should mount motors on the prisms and put the slits into the cavity before actual calibration. Move the prisms and slits electronically for different wavelengths. Enter the wavelength value and add point into the file. The software will record the positions of prisms and slits automatically. There is no option to enter the positions manually.