

# Spectra-Physics Tsunami Mode-Locked Ti:Sapphire Laser

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## 1 Emergency Contact informations

Name and Description	Contact Information
UM Emergency (Fire-Police-Rescue) - 24 hour Call Immediately for any Emergency Including Injured or Sick Person Chemical Spill or Fire	#911
Environmental Safety(Main Office) Biosafety, Environmental Affairs, Occupational Safety and Health, Radiation Safety, Risk Managemen	301-405-3960
Laser Safety Officer (Steve Hand) Program Consultation and Administration	301-405-3985
University Health Center Occupational Health Medical Consultation and Evaluation	301-314-8172
Workers' Compensation Office	301-314-8171
Facilities Management, Work Control Repair of Facility Equipment Deficiencies, e.g. fume hoods, emergency eyewashes, ventilation, etc	301-405-2222
Professor Thomas E. Murphy Laboratory P.I.	301-405-3602 tem@umd.edu

## 2 Basic identification

- Vendor: Spectra-Physics
- Model: Tsunami 3960-LLS
- Serial Number: 1370G
- Optical power: 2W @ 810nm
- Repetition rate: 82MHz
- Pulse Width: 150fs
- Bandwidth: 10nm(adjustable)
- Beam diameter:<2 mm
- Laser Classification: Class IV
- Location: 5'x12' optical table 3(Fig. 1 )
- Beam propagating direction: along the long side of the optical table at a height of 14.5cm above the optical table. If configured to pump the Spectra-Physics OPAL system, this beam will be directed toward the OPAL system. If output is used to conduct experiment, there will be one or more routing mirror that route the beam from toward OPAL system to toward the particular experiment

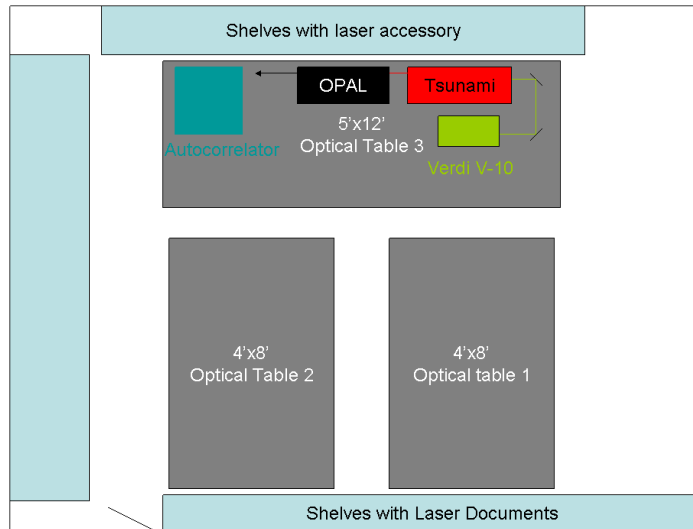


Fig. 1: Location of Lasers and documents

### 3 Laser Safety

The Spectra-Physics Tsunami Laser is a Ti-Sapphire laser capable of generating pulses of 2W average power. Direct and scattering light of the laser beam is capable of causing permanent damage to eye if unprotected. Fire hazard is possible if direct or scattered beam hit a combustible material. The normal operation wavelength is at 800nm, which is beyond the visible spectrum of human eye, however the beam would appear red due to light at edge of the emission spectrum. While it is useful for routing and alignment purposes, keep in mind that the brightness of this beam does not corresponds to the actual intensity since most power will be in the invisible infra-red spectrum. To ensure the safety of the user and coworkers in the laboratory, the following precaution is highly recommended:

- For alignment purpose, wear the proper eyewear(OD 5@800nm), and give proper warning to everyone with access to the laboratory
- For normal operation without enclosure, an eyewear of OD>7@800nm is required
- Enclose the laser beam path if possible
- When routing the beam, be sure to use an optical attenuator to reduce the beam power before trying to adjust routing mirrors. The high power (>2W) of the beam required that a reflective style attenuator to be used. To prevent unwanted beam from hurting the user or coworkers, use a beam stop to stop this reflected beam from propagating

- Maintain the beam height at the default height if possible. If it is necessary to adjust the beam height for any reason, ensure that everyone with access to the laboratory know the beam path of the laser.
- Move any combustible material away from the beam path
- Maintain a designated rapid egress
- Use caution when using combustible liquids and gases in the area of the laser
- Avoid direct exposure to the laser light. The intensity of the beam can cause flesh burns or ignite clothing
- Turn off the pump laser or close shutter when not in used
- To reduce possibility of eye damage, maintain a high ambient light level in the laser operation area during normal operation.
- Unless for alignment purpose, keep the protective cover on the laser at all times
- Avoid wearing reflective objects such as jewelry and watch while using the laser

#### 4 Location of protective eyewear, documents and related accessories

- Laser eyewear “Laser Vision” OD7+@750-1010nm, kept in shelf next to laser
- Printed manual at the file cabinet at the other side of laboratory. Refer to this manual for operation and maintainance
  - Newer pdf manual is available on website, <http://www.photonics.umd.edu/>  
. Refer to this manual when replacing mirrors
- Additional mirrors and other parts in black Spectral-Physics box kept in file cabinet next to laser
- 3910 regulator/filter purge unit in shelf next to laser
- Spectrum analyzer: Reed Instrument Laser Spectrum Analyzer plus oscilloscope
  - Optical head on optical table 3, controller and oscilloscope on table 3 rack right above the laser
- High power photodetector: Spectral Physics Thermocoupler Photodetector

- On table 3, next to laser
- Low power photodetector(<1W):
  - HP Lightwave multimeter 8153A on rack of optical table 1
  - HP 81525A 23dBm@800nm freespace InGaAs photodiode in “Power Sensor module” drawer of the cabinet next to laser
- Autocorrelator, oscilloscope and function generator
  - on table 3

## 5 Operating Authorization

To access this laser, one needs to take the Laser Safety Online Training program available on [http://www.des.umd.edu/risk\\_comm/edu/guide.html](http://www.des.umd.edu/risk_comm/edu/guide.html), obtain training from an experienced user of the laser and obtain the approval of the Laboratory PI.

## 6 Maintenance

It is recommended to replace the distilled water in the chiller once every 6 months. Be certain that the water is replaced with distilled water only. Deionized water will cause metal pipes to dissolve into the water, and subsequently condensed on the crystal surface .

Note that the laser is currently configured to operated at femtosecond broadband mode. In this mode, the wavelength of the laser is adjusted by the birefringent filter(Fig. 2). Furthermore, the tuning slit module had been removed, hence only the slit bandwidth selector is adjustable(Fig. 2). Note also that the laser had been updated to be pumped by frequency doubled diode pump laser, hence some mirrors might have different part numbers than what is listed on the printed manual. Consult the pdf manual for more information.

Under no circumstance should any BNC cables connecting the laser head and its control electronics be removed or replaced. The mode-locking electronics had been tuned for these specific BNC cables, hence replacing these cables would result in failure to mode-lock. In such case, a service call will be needed to get this laser to mode-locked again.

## 7 Operation

Turn on the chiller before turning on the pump laser. Wait 10 mins after pump laser power settled before optimizing Tsunami output power. Adjust M1 first before adjusting M10(Fig. 2). Try to adjust M1 and M10 such that it reach 2W and the LED bar on the control electronics reach its maximum. Verify the laser bandwidth, ensure that there is no CW breakthrough, adjust the birefringent

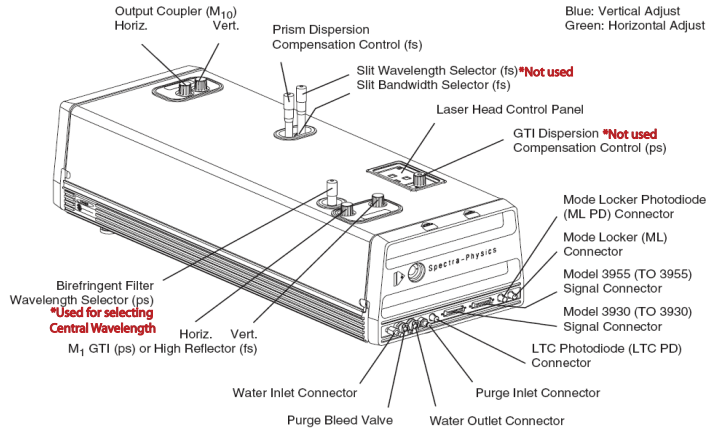


Fig. 2: Tsunami laser adjustment knobs

filter and the bandwidth selector if necessary. If needed, adjust pump laser power such that 2W output power is maintained. In the case of using Verdi V-10, the pump power should be between 9.0W-9.6W. If 2W output cannot be reached without raising this pump power to beyond the normal operating power, clean optical components inside Tsunami, the two routing mirrors between Tsunami and pump laser and the output coupler on the pump laser. Be sure to follow the instruction on Chapter 9 on the manual. *Use only fresh spectroscopic grade acetone* and good quality lens cleaning paper (*Do not use the lens cleaning paper you bought from chemical store*) on cleaning all optical components.

The laser needs a warm-up period of around 1/2 hr, be sure to verify the output power and wavelength after 1/2 hr. A small drift in power or wavelength is possible ~ 30 mins after any adjustment, but the drift should not be as severe as in the initial warm-up period. Be sure to monitor the laser bandwidth if accurate polarization or wavelength dependent experiment is conducted.

If the laser power drops slowly to below 1W after turning on the laser, verify that the chiller is turn on and is operating normally. Keep the chiller temperature at 18°C as a higher temperature will cause the laser power to drop while a lower temperature might cause condensation on the Ti-Sapphire rod resulting in permanent damage.

In some cases, mode-locking could be unstable. If the two BNC cables have not been changed, the most likely reason is that the beam has deviated from its original path. In such case, this problem could be easily corrected by moving the beam with M1 and M10 mirrors. Adjust these mirrors for optimization, and if necessary, increase the pump power. It is also possible that the phase delay setting on the control electronics is off, adjust the knob on the control electronics box if necessary.

Mode-locking could be unstable if the laser center frequency is set beyond 840nm or below 780nm. Purging the laser chamber might solve the problem,

however since mirrors in this laser is only designed to work for 720nm-850nm, it is necessary to replace these mirrors if other wavelength is intended (refer to figure3-5 in Pg 3-6 and Fig3-7 in Pg. 3-9 in the manual for detail) .