

## Specification for Titanium Sapphire Laser System

The Naval Research Laboratory (NRL) has a requirement for a broadly tunable, mode-locked, titanium-sapphire laser system. This system is required to fulfill obligations in a nanoscience project. The laser system comprises a Titanium-sapphire "oscillator" and its required solid state "pump laser." The laser is to be used for time-resolved photoluminescence microscopy experiments that incorporate both direct-excitation mode and multi-photon excitation mode. Sufficient sensitivity to measure single quantum dots is required. This necessitates a system that is highly reliable and stable (i.e., minimal fluctuations in power) for long-term experiments. This requires the pump-laser to be diode-pumped. The system will be implemented in an ordinary laboratory space, which calls for an instrument that is insensitive to dust, humidity, and fluctuations in laboratory temperature. The Titanium Sapphire Laser system must meet or exceed the following minimum specifications:

1. The laser must have a wavelength tuning range with a single set of optics that extends from 750 to 980 nm. Peak average power must equal or exceed 0.8 watts. The pulse autocorrelation must be less than 200 femtoseconds. The pulse repetition rate must be greater than or equal to 76 MHz.
2. The laser must have a thermally-compensated resonator so that the system automatically and passively offsets the effects of thermal fluctuations in the laboratory that cause drift over long periods of operation. This will improve long term stability.
3. The laser must provide a means for being passively modelocked for reliability. A variable saturable absorber must be employed for preferential control between CW and modelocked operation since this configuration improves reliability and control of the spectral purity of the modelocked output.
4. The oscillator shall include a starter mechanism which actively and reproducibly initiates modelocked operation.
5. The oscillator shall have internal pump laser steering optics for maximum control of the pump beam position into the Ti:Sapphire crystal. These mounts must provide independent translational and rotational positioning of the green pump beam.
6. The oscillator must be able to be pumped from the side so that no turning mirror is required outside the laser itself to direct the green beam into the cavity. This configuration also allows the laser to be positioned at the corner of an optical table for optimum control and conservation of space.
7. The oscillator must include a separate CW cavity arm to facilitate alignment and to provide the capability to produce tunable CW output from the laser.
8. The pump-laser must exceed 6 watts output to ensure sufficient laser power for up-conversion.
9. The pump-laser must be hermetically sealed so that no dust can enter the cavity

and so that no alignment or cleaning of optics is needed.

10. The footprint of the pump-laser head must not exceed 19 x 7 inches to fit on an existing laser table. The pump-laser power supply must be rack mountable because of tight existing laboratory space.
11. The pump-laser must be single frequency (<5 MHz over 50 msec) to ensure the lowest possible noise and the longest possible coherence length. The laser noise must be less than 0.02% rms from 10Hz to 1GHz.
12. The diode bar material must have no aluminum in the active area to ensure the longevity of the diode bars in the pump-laser, and to eliminate the main failure mechanism of diode lasers: catastrophic optical damage due to oxidation of aluminum at the diode facet.
13. Diode bars must be field replaceable without requiring rethreading of lines through the umbilical cord between power supply and pump-laser.
14. The pump laser power supply must provide an adjustment to vary the output power of the pump laser.
15. The contractor shall offer the Government at least the same warranty terms, including offers of extended warranties, offered to the general public in customary commercial practice. These warranty terms must be included in the system price. The period of the warranty shall begin upon acceptance.
16. The laser must be installed by trained technicians at the Naval Research Laboratory, Washington, D.C. The one day installation shall include training for two NRL personnel.
17. A full set of all written documentation customarily provided to the public with a commercial item shall be provided. This shall include users manual(s) or equivalent as well as copies of any software, and any manuals for the software included with the system, if customarily provided. This documentation must be received at NRL with the system hardware, unless other arrangements are agreed to by the NRL representative