Time Resolved Magneto-optic System Specifications

The Naval Research Laboratory requires components to construct a time-resolved magneto-optic (TRMO) measurement system. The system will be used to monitor the dynamics of magnetization using the Faraday and magneto-optic Kerr effects at timescales ranging from 20 femtoseconds – 10 microseconds. The primary components of the system will be a Ti:sapphire femtosecond laser with solid-state pump laser and FROG diagnostic tool, a high-speed, programmable delay electrical pulse generator, a gated-intensified CCD (ICCD) camera, a 4 foot x 6 foot optical bench with light-tight enclosure, a motorized linear translator to support mirror components for delay signal generation, and various polarizing optics, mirrors, mounts, and optical detectors. The equipment will be delivered and installed at the Naval Research Laboratory, Washington, DC at a location determined by the Authorized Government Representative.

The following specifications define the minimum requirements for implementation of the TRMO system. Vendors may bid on all or part of the requirement.

1.0 Ti:Sapphire Femtosecond Laser (TSFL) and Diagnostic Tool.

1.1 Femtosecond laser kit.

The vendor must supply a Ti:sapphire laser kit for construction on an optical bench. Only demonstrated and commercially available systems will be considered. The kit must include all components for establishing pulsed optical output using titanium-doped sapphire crystal.

- All laser cavity optical mounts
- Prism mounts with manual translators
- Optics for laser operation at ~800 nanometers
- Ti:sapphire crystal
- Fused silica prisms (2)
- Cavity fold mirror and mount
- Designed for construction onto a ¼" x 20 tapped, 1" spacing optical table
- Final pump input mirror and mount
- Extra-cavity prism pair
- Pump laser input periscope with polarization rotation

The assembled kit, with 5 Watt, CW, 532 nanometer pump laser (see Section 1.2) must provide performance values:

- Tunable from ~750 – 840 nanometers
- Sub-25 femtosecond operation over the entire tuning range
- Sub-15 femtosecond operation when centered at 780 – 810 nanometers
- Output power > 400 mW at 15 fs pulsewidth (external dispersion compensaton)
- TEM00 spatial mode

1.2 Ti:Sapphire Femtosecond Pump Laser.

The vendor is to supply a solid-state pump laser having the following characteristics:

Output wavelength: 532 nanometer
Output power: 5 Watt (stabilized)
Spatial mode: TEM00
Beam diameter: 2.3 mm +/- 10%
Beam divergence: 0.5 milliradian or less
Polarization: 100:1 or greater.
Power stability: +/- 3% or less, non-cumulative
Power stability: +/- 0.5 microradian/C or less (far field angle)
+/- 0.5 microradian/hour at constant temperature
Noise: 0.4% or less
Power supply: 100 – 120 VAC or 200 – 240 VAC, single phase
Cooling: closed loop chiller, if required, is to be provided by the vendor.

1.3 Frequency resolved optical grating (FROG) diagnostic tool.

The vendor is to provide a FROG unit for determination of optical power and pulsewidth. It must have the following capabilities:

Input wavelength range: 700 – 1100 nanometers
Pulse width measurement range: ~ 20 – 200 femtoseconds
Spectral resolution at 800 nm: 4 nm
Intensity measurement accuracy: 2%
Phase accuracy: 0.2% or less
Computer software is to be provided that provides the highest amount of scientific and technical information. Control of the FROG module via USB interface is required.

2.0 Optical trigger unit.

The vendor must supply an optical-to-electrical trigger module to convert radiation from the Ti:sapphire pulsed laser to a trigger signal for the delayed pulse generator. The trigger unit must have the following requirements:

Input wavelength: 800 nanometers
Frequency range: 0 – 95 MHz, minimum
Input power level: 1 mW (f=80 MHz, FWHM < 1 picosecond)
Power supply required; input: 120 VAC, 60 Hz single phase

3.0 Programmable delay electrical pulse generator.

The vendor is to provide a electrical pulse generator having the following requirements:

Timebase accuracy: 1 ppm
Channel outputs: Four independent delay outputs providing TTL, ECL, NIM and VAR output from -3 - + 4 VDC
Rear-channel output: Four channels +/- 32V, 1 microsecond pulse duration; leading edge of output mirrors front channel time delay.
Delay range: 0 – 999 seconds or greater
Resolution: 5 picoseconds

Accuracy: 1500 picoseconds + 1ppm*delay or less
RMS jitter: 60 picoseconds + 10 ppb*delay or less
Trigger delay: 90 nanoseconds or less
External trigger: +/- 2.56 Volts DC, 10 mV resolution, 50 Ohm input impedance, rising or falling edge trigger
Output impedance: 50 Ohm
Trigger-inhibit input required.
Rise time (20 – 80%): 100 picosecond capability on all four rear-channel outputs.
Computer interface: GPIB/IEEE-488
Input power rating: 120 VAC

4.0 Gated Intensified Charge-Coupled Device (ICCD) Camera.

A CCD camera equipped with an intensifier system is to be provided. The intensifier is to operate with a photocathode optimized for 300 – 900 nm optical wavelength, a built-in multi-channel plate assembly, phosphor screen and CCD camera. The unit must meet the following requirements:

Photocathode spectral response: 370 nm – 920 nm
Photocathode quantum efficiency (e-/photon): 35% or greater at 800 nanometers
CCD Pixel Count: 1024 x 1024
CCD size: 12 mm (minimum)
Intensifier resolution: 57 lp/mm or greater
Minimum gate time: 5 nanoseconds or less
Gating ON:OFF ratio (measured at phosphor screen): 1,000,000 or greater
Gate repetition rate: 50 kHz or greater
Intensifier gain: 1 - 10,000x, computer settable
Frame rate: 8 Hz or greater
CCD data: 12 bit (or greater) digital
Image acquisition: one-shot, integrated sequential
Data file format: TIFF
Computer interface: USB or Firewire preferred
Computer control: Must operate under Windows XP. Systems providing interface to National Instruments Labview are preferred.

5.0 Optical table.

The vendor is to provide a non-magnetic optical table and legs meeting the following requirements:

Table dimensions: 48" wide x 72" long; thickness 8" – 10"
Hole grid: 1" square, ¼" – 20 tapped holes
Finish: Black
Supports: Non-magnetic with height-adjustable leveling foot to support top of table at a height of 35.25" +/- 0.25"

6.0 Light-tight enclosure.

The vendor is to supply an enclosure to block external light from the experimental setup and provide filtered air to the workspace. The system must meet the following requirements (see Figure 1):

External dimension: 72" wide x 144" long x 90" high.

Frame construction: non-magnetic material with black finish with modular assembly performed at NRL.

A black vinyl fabric curtain with overlapping velcro fastener is to be used to prevent light and dust from entering the enclosure.

HEPA filtration unit: Airflow 500 – 600 CFM, 24” wide x 48” long x 18” tall, nominal with top mounted flush to enclosure ceiling (see Figure 1.)

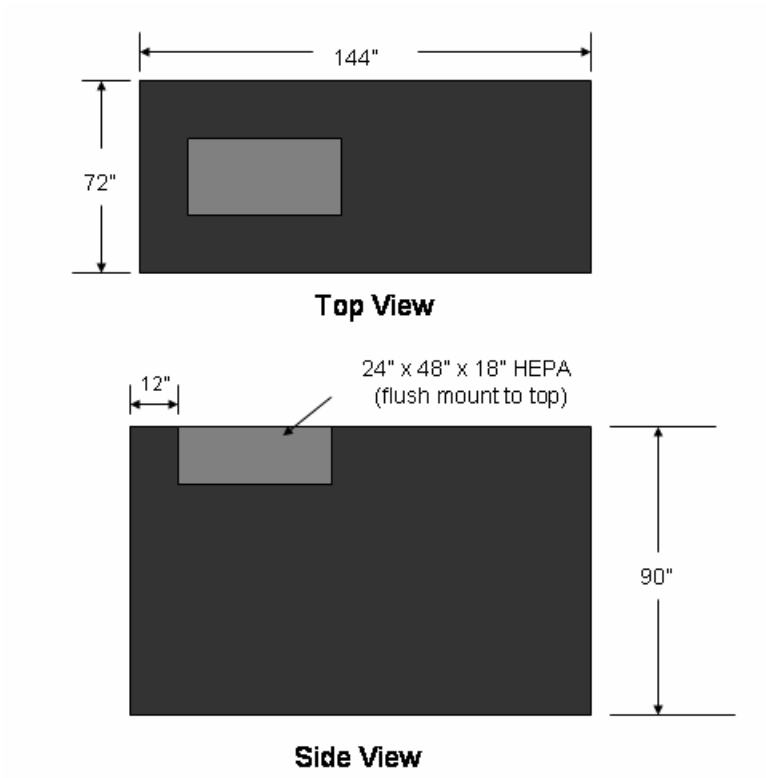

Figure 1. Light tight enclosure plan.

7.0 Linear translator.

The vendor is to supply a computer-controlled linear translator system meeting the following requirements:

Translation range: 40"

Mounting compatible with optical bench hole spacing (1" square grid).

Drive mechanism: stepper motor – lead screw combination;

Position resolution: 0.25 milli-inch or less

Computer control: USB interface with supporting software operating under Windows XP. National Instruments Labview driver interface is preferred.

8.0 Tunable light source. (Option)

The vendor is to provide a tungsten-halogen light source and monochromator meeting the following requirements:

Design: Czerny-Turner, dual-grating turrets

Gratings: Two gratings required.

Grating 1:

Ruling: 1200 g/mm

Peak transmission wavelength: 300 nm

Grating 2:

Ruling: 830 g/mm

Peak transmission wavelength: 800 nm

Focal length: 110 mm, minimum

Beam path: straight-through

Wavelength drive: worm and wheel preferred with anti-backlash gearing.

Wavelength precision: 0.2 nanometers or less

Wavelength accuracy: 0.6 nm or less

Stray light: 10 ppm or less.

Computer control: USB, GPIB, or RS-232 interface required with software. Preference given to National Instruments Labview – supported systems.

Light-source: 100W tungsten halogen, low color temperature, adjustable intensity output with LCD readout.

9.0 Electro-optic Modulator for Kerr Measurement. (Option)

The vendor is to provide a magneto-optic Kerr measurement unit for steady-state measurements of the Kerr and Faraday effects. The system must have the following capabilities:

Photoelastic modulator nominal operating frequency: 50 kHz

Optical material: fused silica

Retardation range (quarter wave): 170 nm – 2 micrometer

Useful aperture: 16 mm

Anti-reflection coating for 632 nm.

Controller and software must be included allowing interface using

10.0 Optical components.

The vendor must supply the following optical components.

1. Plano-convex lens, 25.4 mm DIA, 34 – 34.5 mm distance between flat and focal point, fused silica, AR coated for operation at 800 nm wavelength. Qty: 2 (minimum)
2. Plano-convex lens, 25.4 mm DIA, 34 – 34.5 mm distance between flat and focal point, fused silica, AR coated for operation at 400 – 700 nm wavelength. Qty: 2 (minimum)
3. Mirror, broadband laser, 25.0 MM DIA, fused silica or Pyrex for operation from 480 – 1100 nm, protected silver metallization, with holder and mount for 4" beam height. Qty: 4 (minimum)

4. Glan-Thompson polarizer, 400 – 1700 nm wavelength, 10 mm clear aperture, extinction ratio of 100,000 or greater, surface quality ¼ wave or less, damage threshold of 1W or higher, mounted in 1.00 inch DIA black metal housing, with micrometer-driven rotatable mount allowing polarization rotation about the beam axis to a resolution of 15 arc seconds, 360 degree rotation range, beam height of 4 inches. Qty: 2 (minimum)
5. Quarter-wave plate, 800 nm wavelength, 1.0 inch DIA with rotatable mount for operation at 4 inch beam height. Qty: 2 (minimum)
6. Quarter-wave plate, 632.8 nm wavelength, 1.0 inch DIA with rotatable mount for operation at 4 inch beam height. Qty: 2 (minimum)
7. Retroreflector, 25.4 mm DIA, reflected beam deviation 180 degrees +/- 2 arcseconds, surface quality 40-20 scratch – dig. Broadband hollow retroreflectors are preferred. Mounting hardware for operation at 4 inch beam height required. Qty: 3 minimum.
8. Ultrafast beam sampler, 1 inch DIA x 3 mm thick beam splitter using Fresnel Reflection, single side AR coated for 800 nm wavelength, and mount for 4 inch beam height operation. Qty: 1 (minimum)

11.0 Computer. (Option)

A Windows XP based computer having the following specifications is required:

Operating system: Windows XP Professional
RAM: 1 GB or higher
Integrated graphics.
PCI slots: 2 full-height, minimum
Monitor: 17” minimum
USB 2.0 ports: 5 minimum
Serial RS232 ports: 2, minimum
Internal LAN
Keyboard and optical mouse
80 GB hardrive, minimum
CD drive with read/write capability

12.0 Uninterruptible power supply. (Option)

An uninterruptible power supply with battery backup meeting the following is required.

Power rating: 1400 Watt, minimum
Input power: 208 VAC, +/- 20%, 60 Hz
Output power: 120 and 208 VAC
Battery backup time: 7 minutes at full load, minimum.
Rack-mountable configurations are required.

13.0 Cryostat sample holder.

A duplicate cryostat sample mount is required. This item must be a direct replacement for a Janis STVP-300 flow cryostat, Serial Number 7469 having built-in heater and calibrated temperature sensor.

14.0 Computer interface components.

The vendor is to provide the following Labview-compatible items for installation to PCI computer slots:

- Mechanical relay output module; 2A switching with 2 meter interface cable and connector block.
- Analog output, analog input, counter card
- Video capture card, 4 channel with BNC connector block and 1 m cable
- IEEE 1394 interface card with 3 (minimum) IEEE 1394a ports

15.0 CCD Camera. (Option)

Resolution: 640 x 480 pixels, minimum
Data resolution: 14-bit, minimum
Interface: IEEE 1394.b with 1 meter (minimum) cable
Monochrome
Minimum illumination: 4 lux
Lens mount: C-mount
Frame rate: 15 fps, minimum
Power: 120 VAC adapter required.