Ref: NTU/EEE/CINTRA/SWP/1000	Date of Issue: 08-MAR-2017	Date of Review: 08-MAR-2017
Title:	Safe Work Procedure on using Picosecond pulsed laser with multiple wavelengths in CINTRA Laboratory	
Audience:	Researchers & Students working on Picosecond pulsed laser with multiple wavelengths	

1. Aim

The purpose of this document is to provide safe operating procedure when perform Picosecond pulsed laser with multiple wavelengths in CINTRA laboratory so as to prevent injury to any person, especially eye injury due to laser use.

2. Scope

The procedure is applicable to those working on the Picosecond pulsed laser with multiple wavelengths system. Class 3B tunable pulsed with three center of wavelength: 266 nm, 355, and 532 nm can be used during operation. The output power ranges from 2 to 250 mW.

3. Definitions

EEE – refers to the School of Electrical and Electronic Engineering
LSR – refers to Laboratory Safety Representative
PI – refers to the Principal Investigator

4. Responsibilities

4.1. Lab Safety Representative (LSR) – Appointed by the Safety Chairman to be the person to ensure safety procedures are implemented in CINTRA.
4.2. Principal Investigator – supervising the researcher shall ensure that all safety measures in the risk assessment be carried out and observed.
4.3. Researcher – the person conducting the experiment shall conduct risk assessment for the experiment whenever there is a change in the process or material used in the experiment. He should ensure that the risk assessment be conducted prior to the commencement of the experiment.

5. Preparation

5.1. Plan and arrange the optical path of the laser before turning it ‘on’.
5.2. Wear proper PPE, especially goggles appropriate to the wavelength range of work.
5.3. Be familiar with the laser operation interface: Trigger, Intensity and Repetition Frequency.

Figure 1: Image of the user interface of the laser.

5.4. Be familiar with the following specifications of the laser depending on the output wavelength used:

Optical output			
Center wavelength*	266 ± 1 nm	355 ± 1 nm	532 ± 2 nm
Maximum average output power	> 2 mW	> 5 mW	> 250 mW
Pulse width (FWHM)	< 70 ps	< 70 ps	< 70 ps
Spectral width	<< 1 nm	<< 1 nm	<< 1 nm
Output	collimated beam**	collimated beam	collimated beam
Divergence	< 2 mrad	< 0.5 mrad	< 0.5 mrad
Beam diameter	1.0 mm ± 0.2 mm	1.5 mm ± 0.2 mm	2.1 mm ± 0.2 mm
Beam quality	M^2 < 1.1 (vertical), M^2 < 1.5 (horizontal)	M^2 < 1.2 (typ. ~ 1.1), TEM_{00}	M^2 < 1.1 (typ. ~ 1.02), TEM_{00}
Max time delay between outputs	< 1 ns	< 1 ns	< 1 ns
PER	> 25 dB	> 25 dB	> 25 dB
Power stability (12 hours, $\Delta T_{ambient}$ < 0.5 K)	< 3 % rms	< 3 % rms	< 3 % rms

Figure 2: Specifications of the laser Versatile Picosecond Laser Module Vis-UV 266-355-532.

5.5. Fully understand system setup and operation theories before any use.
5.6. Example of set-up

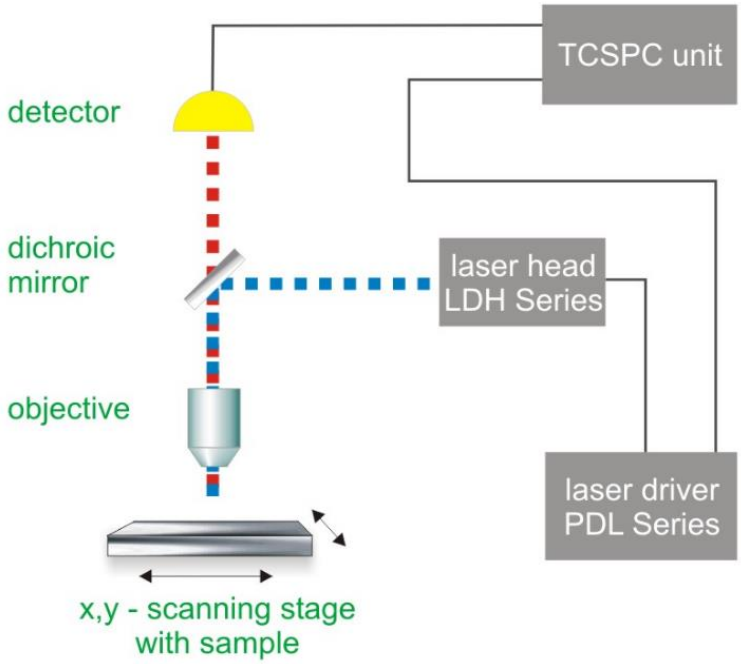

Figure 3: Generalized setup of a fluorescence lifetime imaging microscope

6. Safety Precautions

6.1. Only licensed users are allowed to operate the system. Trainees or students must be supervised during operation.
6.2. Users inside curtained area must wear laser safety goggles when appropriate.
6.3. Never look directly into laser beam, its specular reflection and fiber output end when laser is on even with goggles.
6.4. Handle bare fiber and lensed fiber with care and discard unwanted bare fiber into dedicated container.

7. Personal Protective Equipment Required

The following personal protective equipment must be worn:

- Laser safety goggles.
- Covered shoes (to be worn at all times when in a laboratory environment).

Version History

This Table below reflects the summary of changes made to the document. The full change information is indicated with yellow highlight in the document content.

Revision	Section	Details of changes	Author	Effective date	Approved by
000	-	Initial Release	Umar Saleem	08 March 2017	A/P Wang Hong