



Microscope laser safety



PLEASE NOTE:

- While much of the guidance in this document is generic, it was written for users of confocal and spinning disk microscopes in the Wolfson Bioimaging Facility, Bristol University.
- Users of Wolfson Bioimaging Facility multiphoton, STED and TIRF systems must also refer to the specific documents for those systems.
- Users of laser scanning confocals and other laser and LED-based imaging systems outside Wolfson Bioimaging should also familiarise themselves with specific safety aspects of those systems.

Introduction

This **Guidance Document for Microscope Laser Safety** explains arrangements and guidance for working with lasers in the Wolfson Bioimaging Facility.

Use of unmodified commercial confocal microscopes carries negligible risk of injury **if safety rules are followed**.

Users must read and understand the contents of this document to ensure the safety of themselves and others who may be affected by their work, and to comply with regulatory requirements.

All users must also read and sign the appropriate risk assessment (on PPMS for Wolfson Facility) or register on the University's laser user database (if using non-WBF equipment).

What is a laser?

- A laser (light amplification by the stimulated emission of radiation) is defined in the BS EN 60825 as “any device that can be made to produce or amplify electromagnetic radiation in the wavelength range from 180nm to 1mm, primarily by the process of controlled stimulated emission”.

What is different about laser light?

- Laser light is different from most light sources because it is:
 - **MONOCHROMATIC**
 - **COHERENT**
 - **COLLIMATED**
- The intensity of laser light (due to concentration of photons in small area) make it potentially more hazardous (to eyes and skin) than other light sources.
- Some lasers can be pulsed to release a lot of energy in a very short time.

Laser Classification

- Classification of lasers is based upon the measured radiation through a given aperture at a set distance.
- Lasers are classed in order of increasing radiation, from 1 to 4.
- Class 1 lasers are safe under all conditions of operation and present no hazard to eye or skin (e.g. CD/DVD player, laser printer, some laser pointers).
- Class 4 lasers are hazardous for direct and diffuse viewing. They may cause skin damage and may constitute a fire hazard. Multiphoton lasers are generally class 4.
- The lasers on the microscopes within the Wolfson Bioimaging facility are **class 3B** lasers except the Multiphoton & STED lasers (Class 4).

Scope of this document

- This document covers only use of the class 3B lasers in the Wolfson Bioimaging Facility.
- Users of other systems with Class 3B lasers should check those systems have similar safety features and use according to any specific local rules.
- Users of our multiphoton and STED systems, which incorporate class 4 lasers, must also refer to the separate laser safety documents for those systems.

Class 3B Lasers

- Hazardous to the eyes when direct intra-beam exposure occurs.

Spectral Region	Resulting damage to eyes
Ultra-violet (314-400nm)	Photochemical cataract
Visible* (400-780nm)	Photochemical and thermal retinal injury
Infrared (780-1400nm)	Cataract and retinal burn

- Viewing diffuse reflections is normally safe beyond 13cm with an exposure time of less than 10 seconds.

**the Class 3B lasers on the microscopes in the Wolfson Bioimaging Facility within these spectral ranges*

Emergency Procedures

- In the event of an accident or incident involving suspected injury to the eyes, a medical examination should be carried out as soon as possible.
- The injured person should be taken to the Bristol Eye Hospital, Lower Maudlin Street, Bristol, Tel: 0117 928 4613.

Microscope laser safety

Class 3B lasers on all Wolfson Bioimaging Facility confocal microscopes are within enclosed units and have integral safety features to prevent the user from looking directly into the laser beam, the danger of damage to the eyes is negligible, **provided the systems are used correctly.**

Each laser-based microscope system within the Wolfson Bioimaging Facility has safety features which users should be aware of.

The following pages will explain safe operation of our:

- 1) Confocal laser scanning microscopes
- 2) Evident SpinSR spinning disk microscope

Microscope safety features

All the Wolfson Bioimaging Facility microscopes are designed to eliminate the risk of significant laser light being reflected to the eyepieces. However, users should **avoid looking down the eyepieces during image acquisition**. Users of systems outside the Wolfson Facility should check if similar design features are active.

In all confocal systems, the objective lens diverges (scatters) light above the specimen, effectively reducing the laser intensity to safe levels. Users must **avoid laser illumination without an objective lens** in position, **avoid placing reflective material in the light path** and **not remove microscope slide during imaging**.

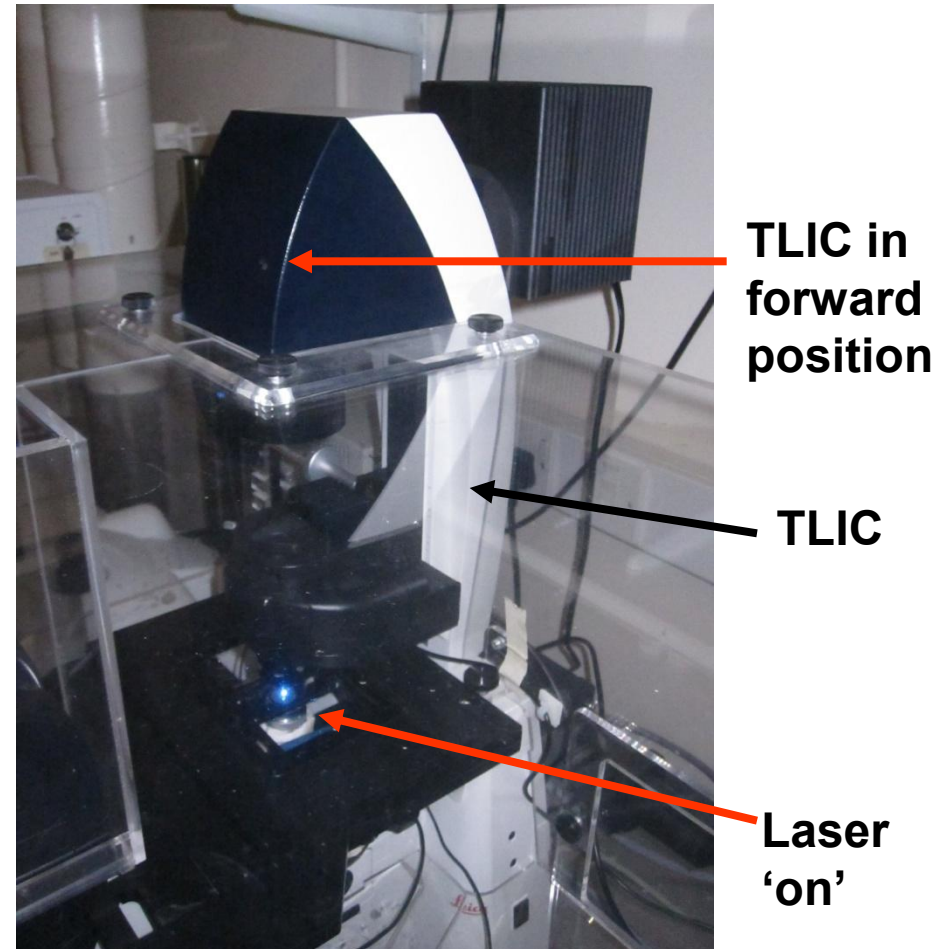
Microscope safety features

Our laser scanning confocals have an interlock that shuts the laser if the transmitted light illumination column (TLIC) is pushed back, because under these conditions it would be possible to look into the laser beam.

Users must not interfere with safety interlocks or tamper with the covers that encase open laser beams. If an engineer need to remove such devices and covers during servicing they will inform users of any risk of laser exposure.

Confocals 7, 8, 9, 11, 12, 13, LSB2

- When the TLIC is pushed back the laser is shuttered so significant levels of light should not reach the eyepieces.
- We still advise not looking down eyepieces during scanning.



TLIC Safety Interlock: Leica confocals

If a user tries to start a scan with the TLIC pushed back, a warning message will appear on the screen:



Only when the user has returned the TLIC to its upright position will laser scanning be enabled.

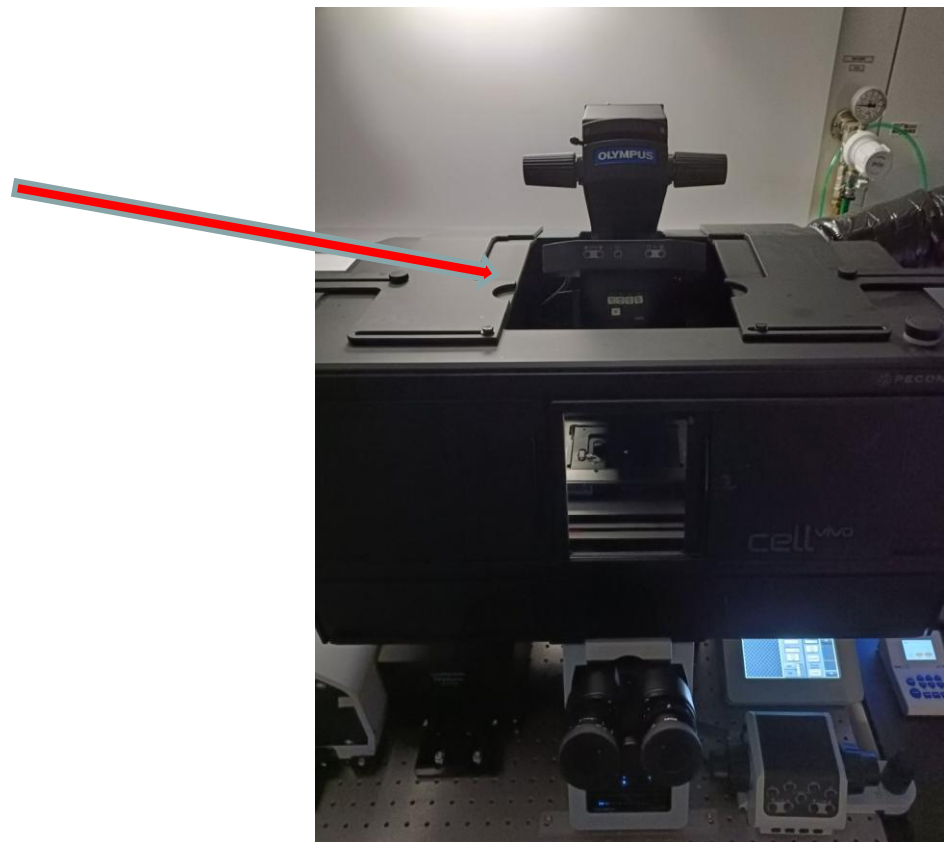
Olympus SpinSR spinning disk confocal

- With the TLC pulled forward, laser illumination is possible



Olympus SpinSR spinning disk confocal

- With the TLC pushed back, a laser safety interlock prevents laser illumination



Avoiding potential hazards

Summary of all systems

As detailed above, when used correctly confocal lasers present negligible risk of harm to the user. However the following rules **must** be adhered to when operating the systems:

- **Never** disable the safety devices fitted to the system
- **Never** change slides when the system is scanning as the laser may reflect off the slide.
- **Never** scan without a lens in position.
- **Never** place anything reflective into the light path.
- **Never** leave an empty position on the objective turret. If removing an objective **always** replace it with a dust cap.

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- In the event of an accident or incident involving suspected injury to the eyes, a medical examination should be carried out as soon as possible.
- The injured person should be taken to the Bristol Eye Hospital, Lower Maudlin Street, Bristol, Tel: 0117 928 4613.