SAM/UV Laser Safety Procedures for the SOAR Telescope During Laser Maintenance Operations

Scope

This document provides a description of safety procedures for the SOAR Adaptive Module (SAM) UV laser during maintenance procedures. All staff members who regularly work at SOAR should be familiar with its provisions, even if they do not participate in laser maintenance activities. Safety procedures for routine operation are covered in a separate document.

Description

Attached to the telescope above the floor level area is a high-power ultraviolet (UV) laser that is used for correcting the effects of turbulence of the atmosphere. The laser beam is fully enclosed until it reaches the top of the telescope, then it is expanded to a 25-cm diameter and launched into the atmosphere (Figure 1). When the laser is turned on during operation, the beam is not visible to people and the amount of scattered UV light at the level of the dome and telescope platform is much less than at the sunny beach. There is no danger to personnel during normal routine operation of the laser.

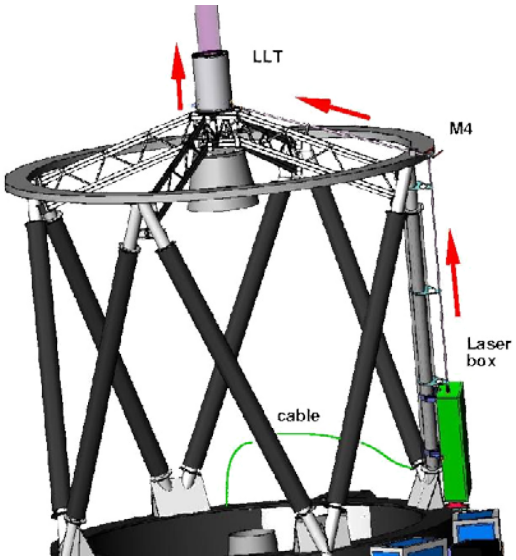

Figure 1. - Laser Beam Path

During normal operation and telescope maintenance (except the maintenance of the laser system itself) the technical personnel, telescope operators, and astronomers are allowed to enter the telescope floor. The UV laser is properly enclosed and is considered safe (Class 1), so there is no hazard to people or property.

Maintenance to the Laser

If the laser requires maintenance, the Authorized Laser Operators shall declare the SOAR dome space a **Laser Controlled Area**. SOAR personnel that have been titled Authorized Laser Operators are the only persons that can declare the telescope floor a Laser Controlled Area.

Authorized Laser Operators are SOAR maintenance personnel who have been trained in laser safety and have detailed knowledge and understanding of the design of the laser system.

Presently, the Authorized Laser Operators are:

- Roberto Tighe
- Andrei Tokovinin

To understand the risk during maintenance of the laser, the UV laser beam is invisible to the eye and can cause severe injuries to the skin (treatable) or permanent damage to the cornea of the eye if exposed to the intense (narrow) laser beam.

Access to the telescope floor area is **NOT** permitted when the area is declared a **Laser Controlled Area**, when experiments or maintenance of the UV laser are being conducted by the Authorized Laser Operators.

Those people who are allowed to enter the laser controlled area are required to follow the following rules, and any other safety rules that the Authorized Laser Operators deem necessary, with no exception:

- Never enter the Laser Controlled Area without the approval of an Authorized Laser Operator.
- Always follow the instructions of the Authorized Laser Operator.
- Any reflective personal items such as watches, rings, necklaces, other jewelry, reflective buttons, or belt buckles are prohibited in the Laser Controlled Area when the laser is in use and if the interlock system has been overridden. An inspection shall be made to determine if personal protective equipment (for example, fall protection equipment required when working above ground level) needs to be modified to prevent the chance of reflecting the UV beam.
- Wear protective glasses (OD >4.5 at 355nm) at all times while in the Laser Controlled Area per the direction of the Authorized Laser Operators.
- Never look into any laser beam. Never place eyes at the level of the beam. Keep hands and body parts well away from the beam.
- Unless authorized, do not touch anything related to the laser.
- If there is a need to work on the electronic or mechanical systems at the laser coffin box or the laser electronics box the UV Laser shall be de-energized. If it is necessary to energize the laser with the enclosure open, for purposes of diagnosis or test, a written procedure should be followed and reviewed prior to performing the work.
- When the telescope floor is declared a Laser Controlled Area, the lighted signs in the control and at the entry to the telescope floor shall be set in “DO NOT ENTER” mode, with a “DO NOT ENTER” sign on a chain across the staircase entry.

Safety Control System

In the unlikely event that there is tampering or a catastrophic failure with the laser system and or the telescope, such as an earthquake, then the following mechanical safety systems have been made to stop the laser:

- Laser Emergency Stop Buttons at the following locations: in the control room, on the laser controller and chiller box mounted on the telescope, on the laser electronics box mounted on the telescope, at the dome floor near the stairway. This immediately de-energizes the laser, and is not the same as a routine shut-down.
- An interlock on the laser box door that would turn off the laser if the box were opened; this acts like the emergency stop button
- The laser rack must be energized using a key switch on the telescope.

If any one of the above safety features were triggered, or following a catastrophic event which might have caused mechanical damage, a thorough inspection of the laser system shall be made before the laser is turned back on.

Informational Safety Features

The following safety features are provided to inform people of the status of the laser:

- Bilingual LASER ON/DO NOT ENTER sign and indication light:
    - in the control room
    - at the door to the telescope floor.

  When the laser is in normal operation, it is safe to go to the observing floor even when it is on, and the "Do Not Enter" portions of the signs will be covered. For maintenance work, these portions should be uncovered. During laser maintenance the warning lights may not be "on" at all times, so if warning signs or "barricades" are present unauthorized personnel should not enter the telescope floor area.
- Barrier chain with warning sign to be placed across the stairway entrance when maintenance activities are underway (not during normal operation)
- The "Safety Procedures for Normal Operations" document will be distributed to all visiting observers who will use SAM
- The SAM LGS computer Graphical User Interface (GUI) that informs operators of the status of the laser and the safety controls. The GUI is informational only and does not override the physical safety controls of the laser.
- MOST IMPORTANT: Prior to initiating all maintenance work on the laser, all personnel in the dome will be made aware that maintenance work is planned and will be reminded of the precautions listed above.