



Next Generation Adaptive Optics System

Safety Shutters for Laser (Draft)

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REVISION HISTORY

Revision	Date	Author (s)	Reason for revision / remarks
1.0	March 04, 2009	JC	Initial release

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INTRODUCTION

As part of the Next Generation Adaptive Optics (NGAO) System, a Safety System (SS) will be provided to safe guard personnel and equipment. The NGAO System will include Class 4 laser(s) which can be hazardous to personnel and equipment if not operated properly. The safety system will provide proper safety interlocks to ensure the laser(s) are operating within safety guidelines. As part of these interlocks, the SS must be able to shutter the laser when demanded. In order to provide redundancy, multiple shutters must be in place throughout the system to ensure the laser can be shuttered. This document provides a layout and description of the shutters for the laser beam in the NGAO System.

References

1.1 Referenced Documents

Documents referenced in the requirements are listed in Table 1. Copies of these documents may be obtained from the source listed in the table.

Ref. #	Document #	Revision or Effective Date	Source	Title
1	TBD	TBD	WMKO	NGAO Safety System Requirement
2	KAON #511	2.1	WMKO	NGAO System Design Manual

Table 1: Reference Document.

1.2 Acronyms and Abbreviations

Table 2 defines the acronyms and abbreviations used in this document.

Acronym/Abbreviation	Definition
AO	Adaptive Optics
KAON	Keck Adaptive Optics Note
NGAO	Next Generation Adaptive Optics System
OEM	Original Equipment Manufacture
SS	Safety System
TBD	To Be Determined
WMKO	W.M.K. Observatory

Table 2: Acronyms and Abbreviations.

2 LASER FACILITIES AND SHUTTER LOCATIONS

The Laser Facility is defined as the subsystems from the laser, where the laser beam originates, to the launch telescope, where the beam is propagated onto the sky. In the NGAO Safety System Requirements (Ref #1), the safety shutter must have redundancy to ensure the beam can be terminated even if one shutter fails. Figure 1 shows the laser facility (Ref. #2) and locations where shutters will or may be introduced to provide this redundancy.

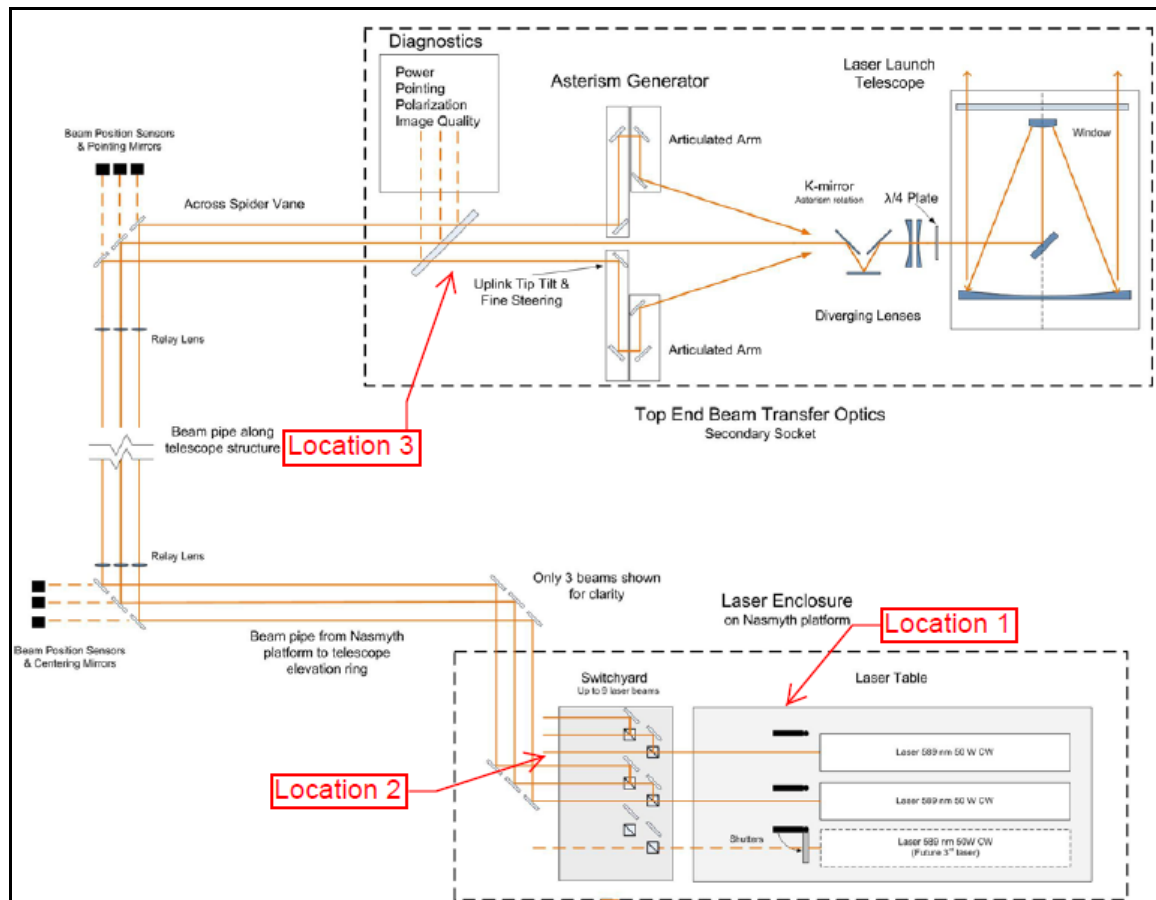


Figure 1: Laser Facility and Shutters

Location 1 shows the laser shutters provided by the laser vendor. Each laser will be provided an output shutter as a requirement of the laser system. There may be additional shutters within the lasers themselves; but they will not be considered in the redundancy discussion. This shutter is closed during reconfiguration of the switch yard. Location 2 is subsequent to the switch yard. Shutters will be provided to enable or disable the beams going to the Beam Transfer Optics. Location 3 is prior to the asterism generator and subsequent to the diagnostics. The shutter is placed here to allow the diagnostics to operate with the shutter closed. The shutter at this location is likely to be what is known as the fast or final shutter for controlling on-sky propagation. Shutters located in these locations or a combination of these locations will provide the redundancy necessary for the laser shutter.

3 SHUTTER CHARACTERISTICS

The shutters used for the termination the beam should have the following characteristics in order to meet the safety system requirements.

3.1 Failed Safe Operation

The shutter shall operate in a failed safe mode. The shutter may be pneumatically or electrically controlled. The shutter shall terminate the laser beam if the shutter is not energized.

3.2 Shutter Position Sensing

The shutter shall have devices to determine its position. The devices will be sensed by the safety system to ensure they are in their proper positions. The devices themselves shall also be failed safe. Disconnection of the devices will result in an open position.

3.3 Shutter Speed

The shutter shall terminate the beam in a time that is acceptable to meet the requirements of the Maximum Permissive Exposure for personnel. This includes termination of the laser beam for personnel working in the immediate area as well as on-sky propagation for aircrafts.

3.4 Shutter Size

The shutter opening shall be sufficiently sized to enclose the full aperture of the lasers at the point of contact. Depending on the number of lasers and the location of the shutter, the aperture may be sufficiently large where it may have difficulty to meet the speed requirement. Most OEM shutters are made for lasers apertures with beam diameters of several mm. Larger beam sizes will require specially design shutters.

3.5 Beam Dump

The shutter will also support the function of a beam dump to absorb the laser beam energy. For multi-beam system such as NGAO, the shutter itself may not be capable to absorb the high power, especially if the aperture is large. If the shutter is not able to support the higher powers, the shutter may have to be a reflective surface to steer the beam into a beam dump.

3.6 Glycol Cooling

If the shutter will serve the function of a beam dump, the shutter will need liquid cooling to remove the laser energy. The NGAO system is likely to have laser energy greater than 90W. The liquid for removal of the heat will be a mixture of 50/50 propylene glycol and water.