Next Generation Adaptive Optics System

Laser Launch Facility Constraints at the Prime Focus Location

(Draft)

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Prepared By Jason Chin

REVISION HISTORY

Revision	Date	Author (s)	Reason for revision / remarks
1.0	March 06, 2009	JC	Initial release

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INTRODUCTION

As part of the Next Generation Adaptive Optics (NGAO) System, a Laser Launch Facility (LLF) will be provided to receive the laser beams from the laser system(s) and propagated them onto the sky. The subsystems of the LLF will be installed from the laser location on the elevation ring to the prime focus location on the K2 telescope. A majority of the LLF subsystems is located in the secondary socket including the laser launch telescope. This document describes the infrastructure constraints at the prime focus location for the LLF. The document will also address the added LLF weights that will impact the secondary module balance as well as the overall telescope balance.

2 REFERENCES

2.1 Referenced Documents

Documents referenced in this document 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	KAON #570	0.3	WMKO	NGAOLaserFacility
2	KAON #511	2.1	WMKO	NGAO System Design Manual

Table 1: Reference Document.

2.2 Acronyms and Abbreviations

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

Acronym/Abbreviation	Definition
AG	Asterism Generator
AO	Adaptive Optics
CG	Center of Gravity
KAON	Keck Adaptive Optics Note
LF	Laser Facility
LLF	Laser Launch Facility
NGAO	Next Generation Adaptive Optics System
SS	Safety System
TBD	To Be Determined
TBV	To Be Verified
WMKO	W.M.K. Observatory

Table 2: Acronyms and Abbreviations.

3 LASER FACILITIES SYSTEM

The Laser Facility is defined as the subsystems from the laser system(s), where the laser beams originate, to the launch telescope, where the beam is propagated onto the sky. In the NGAO Laser Facility (Ref #1), the LF is layout as shown in Figure 1. The highlighted area in red will be the focus of the remainder of this document.

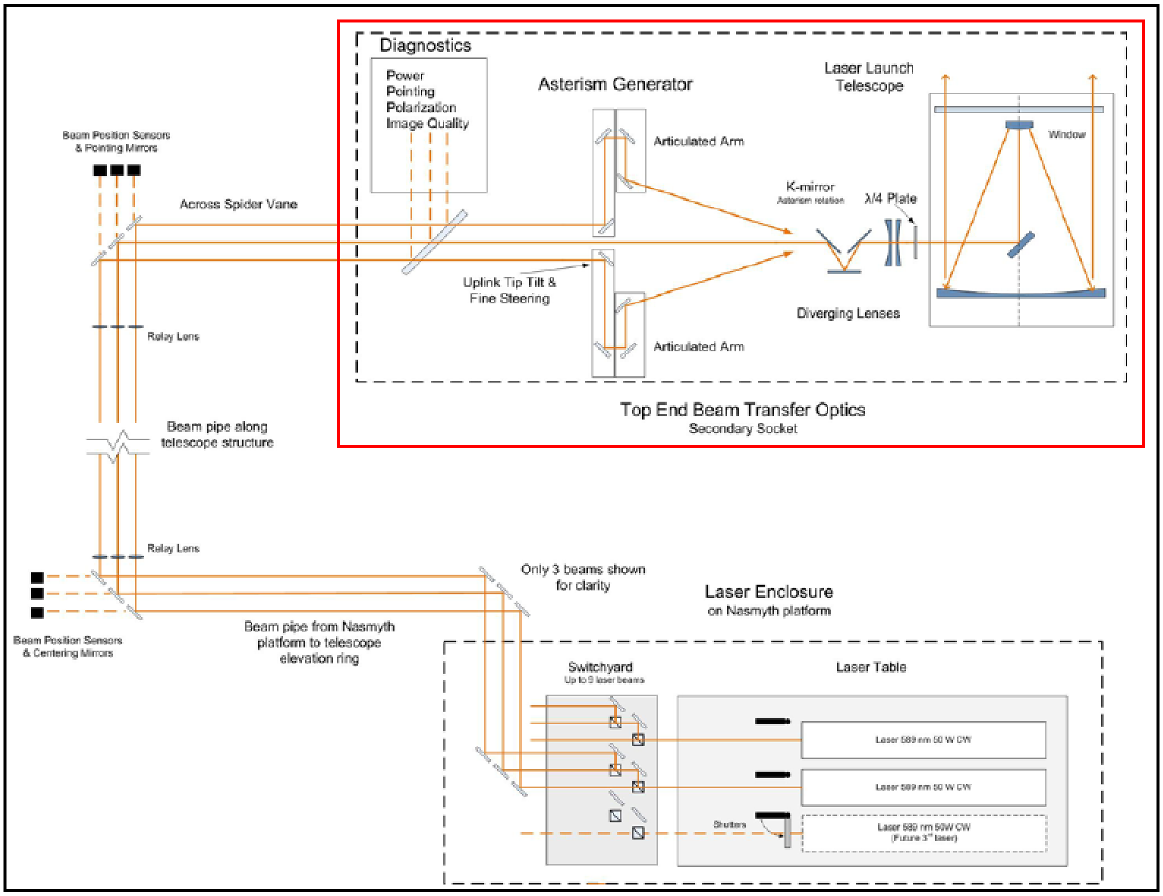

Figure 1: Laser Facility and Shutters

The laser beams starts at the bottom right of Figure 1 out of the laser systems. The diagram shows the laser enclosure on the Nasmyth Platform; however, it the laser enclosure can also be attached to the elevation ring of the telescope. The beams will travel from the laser systems to the switch yard where the laser beams entering are separated into the individual lasers required to generate the asterism. From the switch yard, the beams will travel on the telescope steered along the telescope structures to the secondary socket.

At the secondary socket location, the LLF will support an asterism generator (AG), refocusing optics and rotator for the asterism, and a launch telescope. In addition, there will be diagnostics, safety system interfaces, and a sizeable electronics interface for control of the many mechanisms for the LLF at the secondary socket.

4 LLF DESIGN AT THE SECONDARY SOCKET

Figure 2 shows a possible design for the LLF at the telescope secondary socket. The main components such as the launch telescope, AG, rotator and the electronics for interfacing will reside within the f/15 secondary module (SM). The SM fits inside of the secondary socket on the telescope. In addition, an interface panel will be necessary on the telescope itself for the communications and infrastructure for the LLF. These infrastructures include electrical power, pneumatics, and glycol. Other interface signals include motion control for the motion devices in the LLF, safety system signals, and diagnostics.

The size and requirements of the units in yellow in Figure 2 must be capable of interfacing with the SM within the constraints of the module. These constraints include safety, volume and weight, electrical power, glycol, possibly pneumatics, and installation impact. Installation is critical as the SM is used all year around. Minimizing or eliminating down time is a major concern during the installation phase.

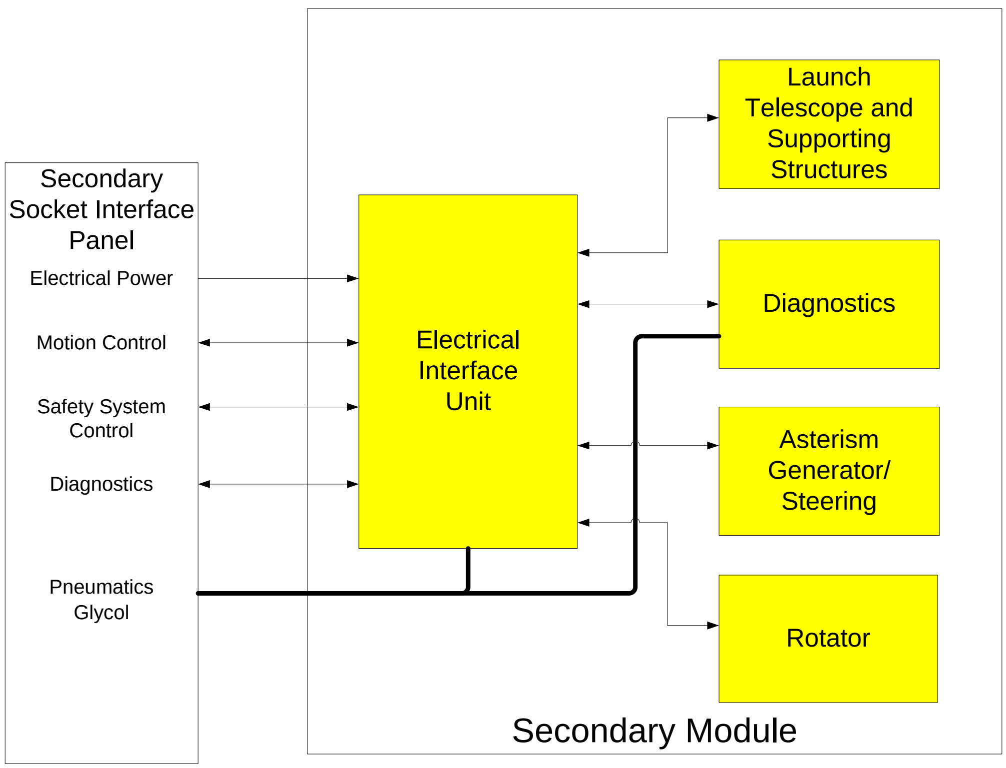

Figure 2: LLF Design at Secondary Socket

5 TELESCOPE SECONDARY SOCKET INFRASTRUCTURE

5.1 Volume and Weight

The LLF must be able to fit inside the SM and provide sufficient volume around the LLF components. This volume is necessary to service and maintain the LLF as well as existing equipment inside the f/15 module. Equipment inside the SM include the motion control for focus and pointing of the f/15 mirror, vacuum system for the f/15 mirror, and f/15 mirror diagnostics including accelerometers.

To understand the volume and weight constraints in the SM, the K1 LGSAO LLF configuration (Figure 3) is used as a comparison. The item in purple is the launch telescope, the item in turquoise is the electronics interface, the Beam Transport Optical Bench (BTOB) in blue provides the function of steering and focusing, and mounting hardware is shown in green and grey. There are no components for a rotator and AG in the K1 system. The diagnostics are included on the blue optical bench. The item in red is the counterweight for the module that was redesigned for the K1 LGSAO Project.

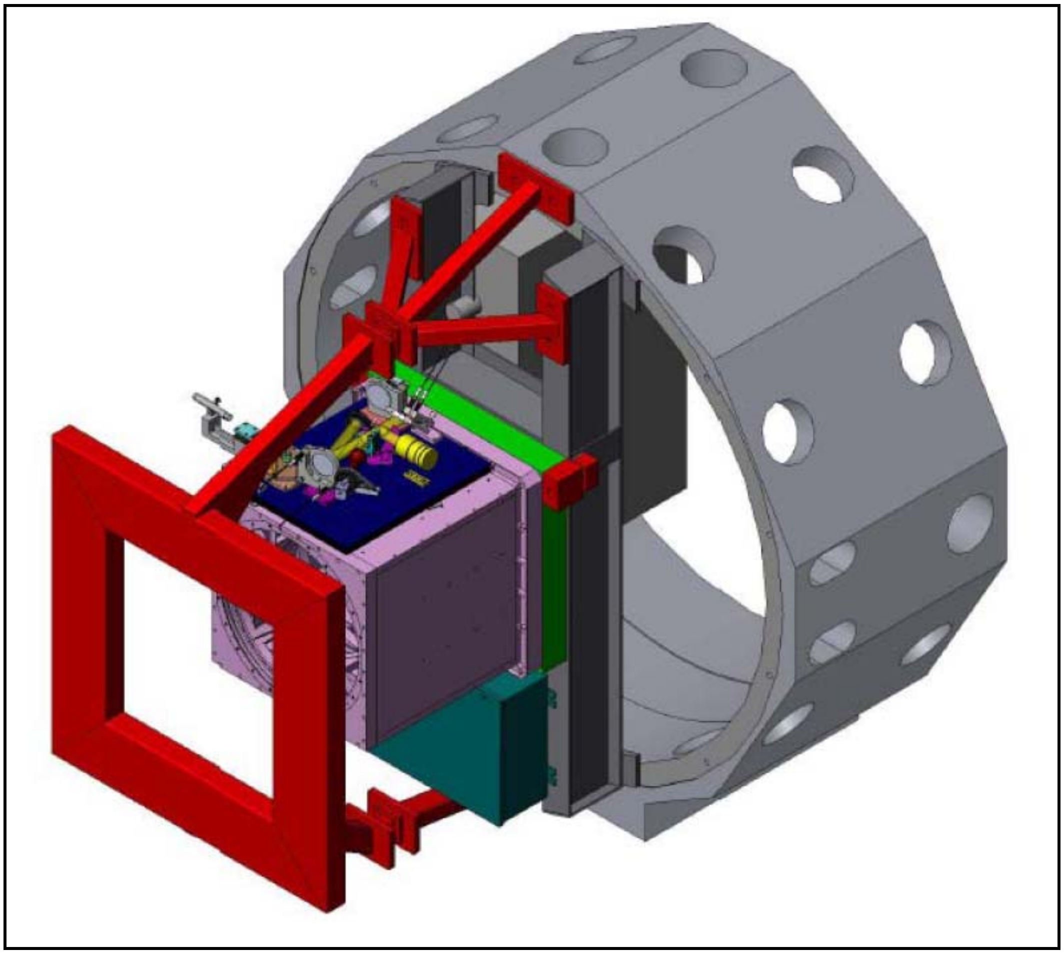

Figure 3: K1 LGSAO LLF Configuration

The weight of these components is estimated in Table 3. Prior to the launch telescope mounting on K1, the remainder of the components added a total of 94 Kg to the f/15 SM module. To compensate for this weight, 109 Kg was removed from the telescope secondary socket. Prior to this removal, 227.2 Kg reside in the telescope secondary socket to compensate for the Atmospheric Differential Compensator unit in K1.

#	Item	Weight (Kg)
1	Launch Telescope	118
2	Beam Transport Optical Bench	15
3	Electronics Interface	10
4	Supports and Mounting	100?
5	Counterweight	?

Table 3: K1 LGSAO f/15 SM weights

As for NGAO, it is likely additional weight will be added for the rotator and the AG, as well as general increase in weight due to multiple laser beams. Some of this additional weight can be compensated by additional reduction in the counterweight on the SM. Similar to K1, it is likely weights will be removed from the secondary socket, if available. If not available, weights will be added to the Cassegrain end of the K2 telescope.

Figure (TBD) provide different views of the K1 SM. For servicing, a conservative 18" or greater is needed to attain access to equipment.

A conservative estimate of the allowable weight that can be added to the SM is (TBD). This is based on experiences with the ESI instrument as well as analysis of the telescope model.

5.2 Electrical

Currently, a 20 amp (TBV) circuit is available at the SM module. If additional power is necessary for the LLF, it must be provided from the breaker panel on the elevation ring located next to the left elevation wrap.

5.3 Glycol

A mixture of 50/50 propylene glycol and water is available at the secondary module. The pressure is TBD and the flow is TBD. These values should be de-rated by TBD% due to the increase head pressure when the telescope points to zenith. Modifications to the infrastructure may be needed if a higher cooling capacity is needed for the LLF.

5.4 Pneumatics

Dry air is available at the telescope socket at 100 psi and TBD flow rate. An existing regulator is used to reduce the pressure for the f/15 vacuum system to TBD psi. LLF can used this regulated pressure on the SM or add its own infrastructure to meet its requirement.

6 MODULE AND TELESCOPE BALANCE

The LLF will impact the telescope and module balance with the added components. A thorough calculation shall be made to determine the proper weights to be added or removed to the module and telescope. The following sections provide requirements for balancing and a possible procedure for K2.

6.1 Balancing Requirements

6.1.1 F/15 SM

The SM shall be balance about its center of gravity (CG) to maintain personnel and equipment safety as the module is inserted and removed from the telescope.

6.1.2 Telescope Balance

The telescope shall be balanced for the SM with all instruments. It is likely some weight redistribution is necessary during telescope reconfigurations; but this should be kept to a minimal. The possible telescope configurations are ESI/SM, Transfer Module-Tertiary/SM. Secondary baffling should be considered during these weight calculations as well.

6.2 Procedure

The following is a possible procedure for balancing of the SM and telescope.

1. Measure existing f/15 module weight. (TBD). This should already be known.
2. Add all components to f/15 module. Add or subtract the weight to the module counterweight system to balance the module itself.
3. It is likely the modified SM will be heavier than the original SM. If weights are available at the SM CG, remove as much as possible to compensate for the modified SM.
4. Weigh the modified SM (TBD). Note the difference between weight of the SM before and after modifications (TBD).
5. It is also likely some weight will be added to support the LLF at the telescope socket. Add this weight to the delta calculated in step 4. Examples of this are the interface panel for the LLF and associated cabling. The total weight must be removed from the secondary socket. If weights are available at the secondary socket, remove the same amount of weight calculated. If this weight is available, the procedure is done.
6. If the weight is not available in the secondary socket or insufficient to be removed, the remaining weight to be taken off must be compensated by adding weight to the Cassegrain location. Due to the difference in moment from the telescope CG, a factor of 1.6 must be multiplied to provide the necessary weight at the Cassegrain location.