



KAON # 758

Next Generation Adaptive Optics System

**Keck II Laser Removal Plan**

**Preliminary Design**

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**Version V1.0**

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**REVISION HISTORY**

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## **1 INTRODUCTION**

As part of the NGAO system installation, the Keck 2 laser will be removed to provide the adequate room for the new laser(s) on the elevation ring. The existing Keck 2 laser has two major parts, the laser enclosure on the elevation ring of the telescope and the laser room on the dome floor. Auxiliary equipment is also located at the observatory such as the Keck 2 AO electronics enclosure and control room. The amount of equipment that must be removed will heavily depend on the requirements of the new laser, the possibility to re-use existing infrastructure for NGAO or other systems, and the amount of funds available. This document provides a plan for removing the Keck 2 laser system.



## 2 REFERENCES

### 2.1 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.

<b>Ref. #</b>	<b>Document #</b>	<b>Revision or Effective Date</b>	<b>Source</b>	<b>Title</b>

**Table 1: Reference Document.**

### 2.2 Acronyms and Abbreviations

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

<b>Acronym/Abbreviation</b>	<b>Definition</b>
AO	Adaptive Optics
DD	Detailed Design
DMO	Dye Master Oscillator
MRI	Major Research Instrumentation Program
NGAO	Next Generation Adaptive Optics System
NGL	Next Generation Laser

**Table 2: Acronyms and Abbreviations.**

### **3 PLANNING AND REVIEWS**

The plan is structured in three phases. Phase 1 will accomplish the necessary steps to provide adequate room for the new laser system. In theory, only phase 1 is needed for NGAO to proceed; therefore, the costing will consider this part of the MRI NGL proposal. In phase 2, the laser room on the dome floor is removed. In phase 3, all remaining equipment will be removed as well as software references that must be resolved. The three phases are detailed in subsequent sections of this document.

The installation of the Keck 2 laser system required a telescope shutdown. It is likely that a shutdown will improve the efficiency of the tasks and may be a necessary requirement for phase 1; but not for phase 2 and 3. Further considerations must be made during the detailed planning phase to determine if a shutdown is necessary or desired to improve efficiency.

In addition to supporting the preliminary design and detailed design phases, removing the Keck 2 laser will add two additional reviews. The first review is held prior to the activities to assure all aspects of the plan are captured with an emphasis on safety. The Keck 2 laser uses an ethanol based dye which is highly flammable. Care must be taken to remove this dye. A second review will be held at the end of the effort to verify equipment has been removed and properly stored.

### **4 PHASE 1: REMOVAL OF THE LASER TABLE AND ENCLOSURE**

Based on the existing laser designs, the NGAO lasers will be integrated onto the Keck 2 elevation ring similar to the existing Keck 2 laser table. The Keck 2 laser table (optical bench) contains the optical preamplifier and amplifier for the Keck 2 laser system. This enclosed table is mounted to the elevation ring within a laser enclosure for personnel to operate and service the table (Figure 1).



Figure 1: Laser Table and Enclosure

In this phase, the goal is to remove the existing laser table and its supporting equipment on the elevation ring and the side launch telescope on the telescope structure. The removal of these two components will allow the NGAO laser system to proceed in its installation. The laser enclosure itself as well as the supporting platform for the floor grating and enclosure will remain.

In order to remove the laser table, the flammable ethanol dye must be drained from the system. Although it is only necessary to remove the amplifier and preamplifier dye loops, the plan calls for removal of all dye in the system, including the DMO. This additional step eliminates the hazardous substance from the entire system. Once the dye is removed from the dye lines, the lines will be flushed with de-ionized water and capped for storage.

Once the dye lines are removed, the remaining interfaces such as electronics cabling, glycol and pneumatics will be disconnected from the laser table and enclosure (Figure 2). Since it is likely the new laser system will require similar interfaces, some of the infrastructure equipment such as enclosure interlocks will remain to support the new laser system. After the interfaces are disconnected and removed, the laser enclosure ceiling and walls can be removed temporary to access the laser table. This structure can be removed as a single unit once it is unbolted from the elevation ring and floor gratings (Figure 3). This enclosure will be reinstalled as it is planned to be reused for the NGAO system.



**Figure 2: Laser Table Interfaces**



**Figure 3: Laser Enclosure Structure**

After removal of the enclosure, the laser table and auxiliary electronics unit can be removed from the elevation ring. The floor and structural supports will remain for NGAO. The final step of this Phase 1 is to remove the L4 optic and its structures (Figure 4). Extreme care is needed to remove the 50cm lens without damage.



**Figure 4: L4 Lens and Structure**

## **5 PHASE 2: LASER ROOM REMOVAL**

In this second phase, the goal is to remove the laser equipment from the laser room; but leave the room in place for other possible uses. Examples of possible uses include a thermally controlled room for running experiments, a clean room, or possibly a room to install a new laser system that can be fiber fed onto the telescope. None of the task in this phase will require the telescope to be shutdown.



During this phase, some equipment in the laser room must remain in tact or moved to other areas such as the computer room to maintain operability for other subsystems. These may include the equipment to operate aircraft detection for the Keck 1 laser system or the Keck 2 laser server to interface with the Keck 2 AO System. Although the laser is not available during these periods, it is possible to run the AO System in NGS mode.



**Figure 5: Laser Room on Dome Floor**



**Figure 6: Laser Room Equipment**

## **6 PHASE 3: AUXILIARY EQUIPMENT REMOVAL AND SOFTWARE CLEANUP**

In this final phase, the goal is to remove the remaining equipment from the summit facility. These include cabling, fibers, and dye lines on the telescope, as well as electronics in the AO enclosure. The software



references will be resolved for the remaining computer servers to be removed. Computers such as Keck 2laserpc in the control room can be disabled as well. In this final phase, all documentation will be updated as necessary for proper removal of the Keck 2 laser system.

**7 MANAGEMENT**

**7.1 Resource Estimate**

The following table provides the effort estimates for Phase 2 and 3. Phase 1 is assumed under the MRI Next Generation Laser Proposal.

<b>Personnel</b>	<b>DD</b>	<b>FSD</b>	<b>DC</b>
AssoSci	125	40	146
Tech	0	0	1062
AsstAdmin	2	2	4
Subtotal	127	42	1212
Procurements \$	\$ -	\$ -	\$ 4,000
<b>Total Labor (Hrs)</b>	<b>1381</b>		
<b>Total Procurements \$</b>	<b>\$ 4,000</b>		

**Table 3: Resource Estimate**

**7.2 Risk**

The major risk for the laser removal is associated with whether a telescope shutdown is necessary to complete the activities. The risk is associated with the activities at the laser table on the telescope and is part of Phase 1. This falls under the MRI NGL proposal and is not part of the NGAO activities. Once a more thorough plan is provided in the DD phase, this risk can be retired.

**7.3 Schedule**

The Keck II Laser removal is scheduled to take place as soon as the LGSAO system is taken off line, currently planned for August of 2013. The requirements are that Laser Unit #1 has arrived and tested and the summit facilities are ready for the new laser. As mentioned earlier, only Phase 1 is needed to support the initial laser. Phase #2 and #3 are not needed and can be completed at a later stage. The schedule is shown in Figure 7.

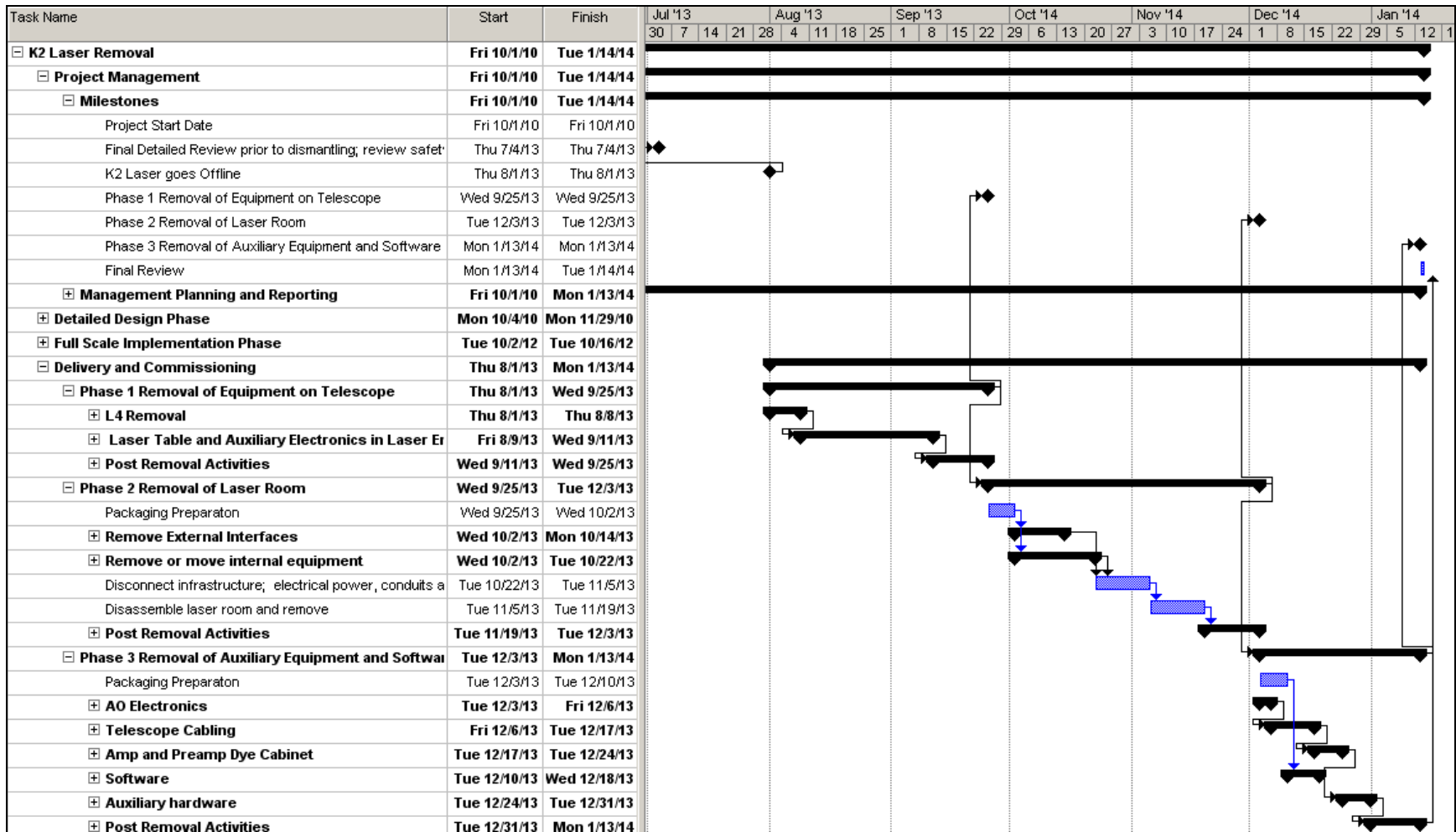


Figure 7: Keck II Laser Removal Plan



#### **7.4 Plans for the Next Phase**

During the next phase, a more through laser removal plan will be completed. This plan will be inclusive of the work necessary for the MRI proposal portion or Phase 1.