

Keck Adaptive Optics Note #361

Procedures for Laser Safety Observing Addendum to KAON 360

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1. Introduction

This document provides additional information regarding the procedures for communication between the laser safety observers, the observing assistant (OA), and the Adaptive Optics (AO) and laser operators during laser guide star adaptive optics (LGSAO) nights at the W.M. Keck Observatory.

This document supplements KAON 360 "Use of Aircraft Spotters for Keck II Laser Safety". It supersedes KAON 297 and "procedure for plane watch".

Emitting bright lights such as our laser into the night sky presents a potential risk to passing aircraft. In particular, the FAA recognizes the risk of distraction, disruption, disorientation and incapacitation of flight crews exposed to these light sources. It is our responsibility to insure that the use of our laser will not present a hazard to aircraft flying in and around Mauna Kea.

The operational procedures aim at improving our observing efficiency while maintaining the safety and redundancy of the current system, to protect passing aircraft from distraction or injury. The procedures are in accordance with Federal Aviation Administration Advisory Circular, AC 70-1.

Note that the FAA document uses the term "*Laser Safety Observers*" for the personnel that we have referred as "*Aircraft Spotters*" or "*Spotters*" throughout the Keck Observatory technical and administrative documentation.

2. Laser Safety Observers responsibilities

1. The Requirements and Standards as well as Safety Personnel and Operational Procedures are described extensively in KAON 360.
2. Laser Safety Observers will inform the Observing Assistant or the spotters' lead of any illnesses during laser activities on the summit. In addition to the duties described in this document Laser Safety personnel shall be responsible for timely response to communications.
3. Laser safety observers shall be responsible for accurate log completion for aircraft and weather.
4. Spotters shall assist with observing for changing weather conditions.
5. Spotters shall close the fast shutter if there are any concerns for safety as described in KAON 360 (section 4).

3. Laser Safety Procedures during Astronomical Observations

KAON 360 describes in details the communication protocols between the Observing Assistant and the Laser Safety Observers.

The present section adds to these procedures that under the present operational model, the Adaptive Optics operator will take routine control of the laser fast shutter from the laser operator.

Yet this will not compromise any of the laser safety requirements: our redundant safety system requires every propagation permissive must be set to "grant" for the fast shutter to be open (those of the Observing Assistant, Laser Traffic Control System, East Spotter, West Spotter, Telescope Drive Control System, and the boresight camera), unless the laser operator or the lead laser safety agrees under unusual circumstances to override a permissive (e.g., when the boresight camera is giving false positives).

Note that the operating procedure will be that approval for laser propagation in a given direction will be considered valid until either:

- 1) >2 minutes have passed since last propagation.
- 2) A spotter shutters the laser due to aircraft or clouds within 25° of the stated direction.
- 3) The spotters have been given the order to stand down.
- 4) The telescope has been moved and pointed to a direction different from the previous one by more than 2 arc minutes.

Therefore, the AO operator will not need to request permission to propagate in the said direction if the beam has been shuttered for less that 2 minutes and no permissives are set to "deny."

In addition, KAON 360 (section 4.2.5) does not explicitly cover the communication protocol between the Observing Assistant (OA) and the Adaptive Optics (AO) Operator prior to laser propagation:

When desiring to propagate the laser, the AO operator will state to the OA:

"Control, we request permission for laser propagation at the current telescope location."

The OA will then poll the East and West spotters, giving the direction of expected propagation:

"Spotters, we request permission to propagate at altitude 60 degrees, azimuth 180 degrees."

The OA will then communicate with the laser safety observers as detailed in section 4.2.5 and request permission to propagate.

Continuing with the propagation sequence, the OA should then set their permissive to "grant", and inform the AO operator:

"Operator, you are clear to propagate."

If all permissives are set to "grant", the AO operator will then open the fast shutter, allowing the

beam to propagate. Once propagating, the AO operator may shutter the beam for a brief period of time (<15s) to take a wavefront sensor background measurement, and occasionally longer (yet < 2min) to optimize the system.

The AO operator should report any technical problem that could delay the laser propagation by more than 2 minutes to the Observing Assistant. The AO operator needs to inform the OA (and spotters) of expected (or unexpected) downtime, as well as the expected time to next propagation.

If the beam has been shuttered for >2 minutes or observations on a given target are complete, the OA should set his/her permissive to "deny" and relay the message to the spotters:

"Spotters, we request that you stand down for XX minutes (and get into a vehicle if >10 minutes, or come inside the building if >20 minutes, as appropriate)"

Finally, the spotters should radio back their receipt of this order.

4. Procedure for Incident

The generic definition for an "incident" at W. M. Keck Observatory is an "unplanned event that interrupts the completion of an activity and that may (or may not) include property damage, injury, or create an environmental issue."

Shuttering the laser because an aircraft is approaching the beam does not constitute an incident. Possible examples for an incident during the laser operations include:

- The failure to shutter the laser remotely for one of the spotters,
- The suspicion that the laser illuminated an aircraft, or
- The suspicion that an aircraft was not spotted, and may have come very close (less than 20 degrees) from the beam.

1. Such incident shall result in halting the laser propagation onto the atmosphere until corrected.
2. The summit safety lead should be immediately notified.
3. An incident report is to be filled and turned into the Laser Safety Officer as soon as possible.
4. The Laser Safety Officer will follow up with further investigation into the incident and recommendations for LGSAO operations.

The Incident Report form is available from the KeckShare on-line documentation:

http://www.keck.hawaii.edu/admin/Forms/Injuryrptform_auto.doc

and the instructions on how to fill the Incident Report are posted at:

http://www.keck.hawaii.edu/admin/SafetyManual/s_2incrpt.pdf

These two documents are also available from the Laser Operations web page.

5. Laser Safety Observers Reports

Laser Safety Observers shall log and report to the Observing Assistant all visible aircrafts. All spotter logs shall be submitted to the Lead Spotter at the end of each night.

6. References

1. Le Mignant, D. & Stomski, P., "Use of aircraft spotters for Keck II laser safety," KAON 360, October 2005.
2. Le Mignant, D. et al., "FAA Notification of our proposal to conduct outdoor laser operations," KAON 362, updated October 2005.
3. A. Bouchez, R. Lafon, D. Le Mignant and D. Summers, "New procedures for laser spotters" KAON 297, January 2005.
4. G. Tolleth and J. Chin, "Procedure for Plane Watch", January 2005.
5. "Laser Safety Procedure" Keck on-line documentation:
http://www.keck.hawaii.edu/admin/SafetyManual/s_7lasersafety.pdf
6. Wizinowich, P., D. Simons, H. Takami, C. Veiller, and R. Wainscoat, "Coordination and use of laser beacons for adaptive optics on Mauna Kea," KAON 153, 1998.