

KOSMOS/COSMOS Safety Document

1. Introduction

This document summarizes safety hazards associated with KOSMOS and COSMOS, and describes the procedures and design modifications that have been adopted to reduce or mitigate these hazards. Unless explicitly indicated otherwise, all descriptions of hazards and mitigations apply to both instruments.

The tables below contain a column identifying the hazard, a column describing the hazard in detail, and a column describing the mitigation for that hazard. The first table comprises hazards posing a risk to personnel; these hazards may also pose a risk to equipment. The second table lists hazards that only pose a risk to equipment.

For some hazards, safety labels are provided as part of the mitigation. Such labels will be provided in both Spanish and English. The service and operations manuals will provide documentation on associated handling procedures; this document will be included as part of such manuals. In addition, mountain staff will be trained regarding instrument safety as part of the commissioning and acceptance of the instrument at each observatory site. *This document is not intended as a substitute for training, and any potentially hazardous procedures should not be carried out by un-trained personnel.*

General observatory safety procedures are not covered in this document, but should be followed at all times.

2. Hazard Summary

Personnel Hazards

Hazard Name	Hazard Description	Hazard Reduction/Mitigation
Instrument Weight	The instrument plus adapter have a combined weight of ~600 lb.	1) A suitable handling cart is provided, which includes provisions for installation/removal on the telescope 2) Installation and removal procedures will be documented; these are (by design) very similar to those for existing NOAO instruments. 3) Procedures for instrument disassembly will be documented. However, disassembly is expected to occur infrequently (less than once/year).
Tip Hazard on Cart	The instrument must be located on the cart at a height suitable for installation on the telescope and for servicing, which raises the center of gravity.	The cart design includes a steel baseplate intended to ensure that the cart will not tip over even if tilted 30 degrees [exact tilt TBC]. The cart caster locations have been moved to increase “footprint”. Cart casters are spring-mounted and appropriately sized.
Rotation Hazards on Cart	1) The instrument is mounted on the cart so it can be manually rotated from vertical to horizontal on the cart with the telescope adapter removed. However, attaching the telescope adapter creates a moment that does not allow safe manual rotation. 2) The rotation of the instrument, even without the adapter, should be restrained manually until the locking pins are installed as the moment is ~ [TBD].	1) Provide safety labels for telescope adapter and locking pins (plungers) on cart. Provide covers for locking pins, to ensure they are not removed accidentally. Note that pins on both sides must be removed to unlock the instrument. 2) Require 2 people to be involved when the instrument is rotated on the cart.
Adapter Weight	The adapter must be removed for major service, and requires lifting equipment due to its weight (~130 lb).	Safety label for telescope adapter, plus documentation of handling procedure (including lift points).

Hazard Name	Hazard Description	Hazard Reduction/Mitigation
Cryogen Hazards	The detector dewars use liquid nitrogen. Cryogen burns are possible; suffocation is possible but unlikely in the dome environment.	The dewars are standard observatory dewars, for which appropriate cryogen safety procedures have been established. KOSMOS and COSMOS will follow the standard procedures.
Electrical Hazards	The instrument electronics box contains standard AC line voltage.	The hazardous voltages are only exposed by removing covers. Safety labels will be provided. The electronics box can be disconnected from power if required.
Slew Hazard	The user software can request telescope motions; large motions (slews) can be hazardous if executed unexpectedly	Slews requested from the user interface will require approval (execution) by the telescope operator.

Equipment Hazards

Hazard Name	Hazard Description	Hazard Reduction/Mitigation
Collision Hazard on Cart	Electronics boxes on the outside of the instrument could be damaged if the cart collides with walls or door frames.	The cart base has been enlarged to define a “footprint” larger than the instrument.
Electrical Hazard to Detectors	Removal of detector controller from dewar creates a static hazard to the CCD	Safety label and training. Mountain staff have extensive training already regarding static hazards for CCDs.
Hazard from Moving Mechanisms	The mechanisms inside the instrument might move while a person is working on them. The motors driving the mechanisms do not have enough power to cause injury, and will stall. There might be contact with optical surfaces, however, which is not desirable.	<ol style="list-style-type: none"> 1) Mechanisms cannot be accessed without removing access covers. 2) Motor motions can be prevented by disconnecting either the power cable or the Ethernet cable to the instrument electronics (preferred solution for day-time servicing). Alternatively, a second person can be stationed at the instrument’s computer console (preferred solution for night-time access). 3) All mechanism access, such as for filter or mask exchange, will be performed by trained observatory personnel (not by observers).

Hazard Name	Hazard Description	Hazard Reduction/Mitigation
Optics Hazards - Exposure	1) The instrument entrance port is “up-looking” and dirt, water and small objects can enter and contaminate or damage optics 2) The instrument rear port is open when the dewar is removed, and dirt, water and small objects can enter and contaminate or damage optics	1) There is a “dark slide” at the front of the instrument that should be closed when the instrument is not in use (i.e., during the day or when not installed on the telescope). The cover can be accessed for debris removal through the guider when the instrument is on the telescope. 2) There is a cover for the rear of the instrument that should be installed when no dewar is installed. The cover attaches to the side of the instrument when not installed, so it will not get lost. 3) There will be labels for the dark slide and the rear cover. 4) The covers and electronics boxes are not necessarily fully hermetic, and water can occasionally drip in the coudé lab storage area, so a cover for the instrument will also be provided, for use when off the telescope. This will provide additional dust protection.
Optics Hazards - Handling	The instrument is designed to allow slit masks, filters, and dispersers to be exchanged, but they can be damaged if they are mishandled, and may also damage other optics elements if dropped on them.	1) All exchanges will be performed by trained observatory personnel. 2) All optics will be installed in their cells prior to the exchange; the cells are designed with captive screws through access covers. 3) Disperser exchanges are scheduled in advance and performed only during the day-time.
Dewar Installation Hazard	The clearance between the rear of the spectrograph camera and the front of the dewar is only ~4 mm. There is thus potential for damaging the dewar window or the rear lens of the camera during installation.	1) Final element of camera is slightly recessed inside camera barrel. Dewar window is recessed inside faceplate. 2) Dewar assembly will be aligned to rear of instrument using alignment pins and installation jack; this allows careful and repeatable installation. 3) Dewar installation is scheduled in advance, performed only during the day-time, and only by trained observatory personnel.

Hazard Name	Hazard Description	Hazard Reduction/Mitigation
Cass Rotation Hazard - Cables	The KPNO cassegrain rotator cannot safely rotate over large angles (many degrees) when the telescope is not at zenith, due to the design of the rotator cable wrap-up.	Until the cable wrap-up is modified, all rotations greater than 1 degree will be done at zenith. This restriction does not apply to CTIO.
Cass Rotation Hazard - Drives	The cassegrain rotators on both telescope may suffer drive damage if the moment around the rotation axis is too large.	Provide appropriate ballast weight for the instrument to ensure rotation moment is within specifications [TBD in-lb]. The instrument may be within specifications without an additional weight.

3. Revision History

Version	Author	Date	Description
3	Jay Elias	Feb. 22, 2011	Public release under version control
4	Jay Elias	Mar. 7, 2011	Add explicit reference to instrument weight hazard. Various edits in response to comments.