

## Hires Upgrade Installation Plan<sup>1</sup>

- 1 Map old Hires; initial set-up
  - 1.1 Record position of old dewar, measure distance between field flattener & camera mirror, note shims on hard pads
  - 1.2 note & record settings of all (three) micrometer positioners: inspect micrometer belts
  - 1.3 note configuration & attachment of darkslide
  - 1.4 tag and label all wiring, conduits, & plumbing connected to footlocker & dewar
  - 1.5 perform OAS 1
  - 1.6 Install cross disperser (XD) alignment telescope & perform OAS 2
  - 1.7 install & position Hextek lasers, mirror assemblies & establish targets (see OAS 3)
- 2 Perform OAS 4
- 3 Remove Hextek mirror & insert Hextek (HT) alignment scope (see OAS 5)
- 4 Establish benchmark(s) on mirror mount, measure position of old dewar, note & record readings (see OAS 6)
- 5 Remove old dewar – OAS 7
  - 5.1 Disconnect LN2 auto fill line
  - 5.2 Disconnect LN2 vent line
  - 5.3 Disconnect ion pump
- 6 Perform OAS 8
- 7 Remove old footlocker
  - 7.1 Disconnect cooling lines
  - 7.2 Unplug connectors at interface plate
  - 7.3 Unplug fiber optics connections inside
  - 7.4 Unplug cables from electronics box
  - 7.5 *Disconnect and remove controller (EE folks)*
  - 7.6 *Disconnect and remove other electronics (EE folks)*
- 8 Remove fiber optic bulkhead fitting from footlocker
- 9 Reinstall Hextek and perform OAS 9
- 10 Remove Hextek & install HT alignment telescope (see OAS 10)
- 11 Confirm/establish alignment/optical path
- 12 Install new dewar – OAS 11
  - 12.1 Install LN2 overflow pan

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<sup>1</sup> This plan refers to the Optical Alignment Sequence (OAS), make certain this procedure follows the steps outlined by the OAS

- 12.2 Attach LN2 auto fill line
- 12.3 Attach LN2 vent line
- 12.4 Connect ion pump
- 13 Align and adjust new dewar with alignment telescope; measure, note & record values to mirror mount benchmarks (see OAS 12)
- 14 Remove HT alignment scope & install Hextek mirror (OAS 13)
- 15 Perform additional alignments and adjustments as necessary
- 16 Remove XD alignment scope
- 17 Install new footlocker
  - 17.1 Place and prepare unistrut
  - 17.2 Install footlocker frame (with HX, plenum, & coolant lines)
  - 17.3 Install lower dewar side panel
  - 17.4 Assemble electronics box cable pipe
  - 17.5 Adjust and install lower panel; install drain hose
  - 17.6 Connect top panel and fiber optic bulkhead fitting
  - 17.7 *Install controller (EE folks)*
  - 17.8 *Install auxiliary box; connect plenum to lower brace*
  - 17.9 *Complete fiber optic connections (EE folks)*
  - 17.10 *Connect ground wire circuitry (EE folks)*
  - 17.11 *Complete all connections between electronics box & footlocker (EE folks)*
  - 17.12 Install remaining panels
  - 17.13 Connect coolant lines
- 18 Perform OAS 14
- 19 Modify darkslide
- 20 Seal, tape, & flock critical/reflective surfaces
- 21 *Additional wiring and electrical connections*
- 22 Perform OAS 15, 16, & 17
- 23 Remove old field flattener from old dewar and pack in carrying case; to be sent out for further testing and inspection of Sol Gel coating
- 24 Perform OAS 18 - remove lasers, mirror assemblies, & targets as necessary
- 25 (After reviewing new photo inventory) take additional photos as necessary

## Loose Ends & Questions

- 1 Metal blank or glass to replace window on old dewar?
- 2 Label/mark hard points if removal is necessary for modification/shimming
- 3 Square mirror on Z Gauge plate with center mark, cross hairs; 2" OD min.
- 4 Test lasers at 32 F
- 5 Check with Grant regarding:
  - 5.1 Available parking space within Hires
  - 5.2 Dehumidifier
- 6 Fab spare Hextek wrench
- 7 Check alignment of alignment telescopes
- 8 Order Bimba cylinders
- 9 What to do with old cabling – leave rolled up near connectors?

## Tool, Fixture, & Equipment List

- 1 ~~Spare camera mirror mount & alignment telescope (aka HT scope)~~ Shipped
- 2 ~~Alignment scope for cross disperser alignment fixture & mirror (aka XD scope)~~ Shipped
- 3 Micrometers, standard set [Jeff]
- 4 Z-Gauge brackets & plate (H-9575) [Terry]
- 5 Dewar face measurement/alignment fixture [Terry]
- 6 ~~Hextek mirror/mount crane~~ [Keck]
- 7 Unistrut [Jeff]
- 8 Shims for support collar hard pads [Jeff] – GFC to make drawing
- 9 ~~Box for old field flattener~~ – not needed at this time; window to remain on dewar for now
- 10 Hand winch [Jeff]
- 11 Assorted/standard tools, supplies [Jeff]
- 12 Fastener/hardware [Jeff]
- 13 ~~Hardware for fiber optic conduit termination at footlocker~~ – will use what on existing footlocker
- 14 Flocking [Jeff]
- 15 Tape [Jeff]
- 16 Tie wraps [Jeff]
- 17 Curtain clips/clamps [Jeff]
- 18 Digital camera – will take Canon from engineering [GFC]
- 19 Walkie-talkies; 7 (qty) needed [Ted]
- 20 Work plan [GFC]
- 21 Engineering notes [GFC]
- 22 Fittings assortment for coolant lines; nipples [Jeff]
- 23 Smart level [Jeff]
- 24 Vernstar lasers (3 qty, min.; better to take 6 or more) [Jeff]
- 25 Hires photo album [GFC]
- 26 Jack's tech report [GFC]
- 27 Darkslide components; spacers, new cone ring; 2" air cylinder (qty 2) [Jeff] – GFC to order (ordered 12/02/03)
- 28 Dehumidifier (if not available at Keck) – [GFC, Dave]
- 29 Poly filter masks [Jeff]
- 30 Tyvek suits & utility caps [Jeff]
- 31 Nitrile gloves [Jeff]

- 32 Clean room wipes [Jeff]
- 33 Head lamps (LED type) [Jeff]
- 34 Dial gages for Hextek adjustment screws [Jeff]
- 35 High quality graph paper, with high contrast lines and durable surface [GFC]
- 36 Set of colored pencils [GFC]
- 37 Hardboards (qty 3) with scribed axes for referencing graph paper [GFC/Jeff]
- 38 Extra diode lasers, mounts, small flat mirrors on adjustable mounts [Jeff]

## Boxes, Crates, Items to Ship

- 1 *Spare camera mirror mount & alignment telescope - shipped*
- 2 *Cross disperser mirror & mount - shipped*
- 3 Dewar – crate W-08
- 4 Footlocker – custom built – will contain:
  - 4.1 CCD Controller
  - 4.2 Footlocker Interface Chassis
- 5 VME Crate
- 6 Miscellaneous equipment may ship with VME crate

## Optical Alignment Procedure<sup>2</sup>

Steve Vogt

### Definitions:

XDAT alignment telescope mounted on cross disperser stage  
HTAT alignment telescope mounted on spare Hextek mirror mount  
L1 front camera lens (bi-convex)  
L2 rear camera lens (meniscus)  
CM camera mirror  
OFF old field flattener (on existing HIRES dewar at summit)  
NFF new field flattener  
DM flat alignment mirror on front of new dewar  
DLx DL1, DL2, DL3 diode lasers 1 thru 3 mounted on CM  
Fx F1-F3 - flats which reflect DL1-DL3 to T1-T3  
Tx targets T1-T3 onto which reflected beams from DL1-DL3 land respectively  
Nx N1-N3 tip/tilt adjustment nuts on rear of CM (to be defined in CAD model)  
L distance from CM to OFF  
L' distance from CM to DM (note: to DM, not to NFF)

### Steps

- 1 Bring HIRES to nominal focus with Decker D5 and Th-Ar lamp; verify with foc.pro. Measure L and record along with camera focus stage setting at nominal HIRES focus.
- 2 Mount XDAT on cross disperser stage - pickup axis of L1,L2 using 3 out of the 4 surfaces (or as many as we can see); compare with HIRES installation notes. L1-L3 surfaces should align to within *TBD*. I want this step first because I'm worried the entire frame may bend when unloaded by the cross disperser removal.
- 3 Mount DL1-DL3 on CM. Set up flats F1-F3 and reflect DL1-DL3 beams to conveniently placed targets T1-T3. Note T1-T3 positions as "pre-retrofit" references. T1-T3 targets should be high quality graph paper with "markable" surface (use magic markers - erase as needed with solvent rag?)
- 4 Remove and replace CM a few times; log repeatability of T1-T3 pre-retrofit positions.
- 5 Remove CM and replace with HTAT.
- 6 Pickup existing hires dewar lens (OFF) with HTAT and note alignment (in case of need to re-install old dewar).
- 7 Remove old dewar, noting any shims etc.
- 8 Check alignment of XDAT with HTAT - should be within *TBD* (about as good as we will have gotten back here in the optical lab at pre-ship). If XDAT does not align well with HTAT, adjust both as necessary to pickup best axis compromise for L1 and L2. (Note: if

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<sup>2</sup> This procedure addresses the alignment aspects of the installation in detail

this becomes necessary, at this point, all prior alignment info for old dewar would be lost).

- 9 Reinstall CM - note pre-retrofit alignment with XDAT - adjust CM for best alignment using N1-N3 adjustment nuts. Note new T1-T3 positions (now called the "zero point" positions).
- 10 Remove CM and reinstall HTAT.
- 11 Install new dewar - adjust focus stage/shims to establish proper L'; get focus stage approx centered on range.
- 12 Tip/tilt/center new dewar as required observing center mark and reflection from DM with HTAT.
- 13 Reinstall CM - verify that T1-T3 are still at "zero points".
- 14 Power up new dewar.
- 15 Bring camera to optical focus using focus stage and Decker D5 +Th-Ar lamp source. Shim stage again if necessary to get focus near mid-range of stage (or use N1-N3 to piston CM, holding T1-T3 at zero points?).
- 16 Run detailed imagery tests varying CM tip/tilt via adjustment nuts N1-N3 and T1-T3 to map tip/tilt space.
- 17 Set CM tip/tilt at best compromise position and lock down. Record new L'.
- 18 Leave DL1-DL3 and F1-F3 if possible?

Optical alignment is now complete.