

## Hires Upgrade Installation Plan

- 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 Optical Alignment Procedure Step 1<sup>1</sup>
  - 1.6 Install cross disperser (XD) alignment telescope & perform Optical Alignment Procedure Step 2<sup>2</sup>
  - 1.7 install & position Hextek lasers, mirror assemblies & establish targets (see Optical Alignment Procedure Step 3<sup>3</sup>)
- 2 Perform Optical Alignment Procedure Step 4<sup>4</sup>
- 3 Remove Hextek mirror & insert Hextek (HT) alignment scope (see Optical Alignment Procedure Step 5<sup>5</sup>)
- 4 Establish benchmark(s) on mirror mount, measure position of old dewar, note & record readings (see Optical Alignment Procedure Step 6<sup>6</sup>)
- 5 Remove old dewar – Optical Alignment Procedure Step 7<sup>7</sup>
  - 5.1 Disconnect LN2 auto fill line
  - 5.2 Disconnect LN2 vent line
  - 5.3 Disconnect ion pump
- 6 Perform Optical Alignment Procedure Step 8<sup>8</sup>

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<sup>1</sup> Bring HIRES to nominal focus with Decker D5 and Th-Ar lamp; verify with foc.pro. Measure distance (L) from camera mirror to old field flattener and record along with camera focus stage setting at nominal HIRES focus.

<sup>2</sup> Mount alignment telescope on cross disperser stage (XDAT) - 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/L2 surfaces should align to within 1 arcminute. Steve Vogt wants this step first because of concern the entire frame may bend when unloaded by the cross disperser removal.

<sup>3</sup> Mount diode lasers (DL1-DL3) on camera mirror (CM). Set up mirror flats (F1-F3) and reflect laser beams to conveniently placed targets (T1-T3). Note target positions as "pre-retrofit" references. Targets should be high quality graph paper with "markable" surface.

<sup>4</sup> Remove and replace Hextek camera mirror (CM) a few times; log repeatability of targets' (T1-T3) pre-retrofit positions.

<sup>5</sup> Remove camera mirror (CM) and replace with Hextek alignment telescope (HTAT).

<sup>6</sup> Pickup existing hires dewar lens (field flattener) with Hextek alignment telescope (HTAT) and note alignment (in case of need to re-install old dewar).

<sup>7</sup> Remove old dewar, noting any shims etc.

<sup>8</sup> Check alignment of cross disperser alignment telescope (XDAT) with Hextek alignment telescope (HTAT) - should be within 1 arcminute (about as good as we will have gotten back here in the optical lab at pre-ship). If cross disperser alignment telescope (XDAT) does not align well with Hextek alignment telescope (HTAT), adjust

- 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 Optical Alignment Procedure Step 9<sup>9</sup>
- 10 Remove Hextek mirror & install Hextek alignment telescope (see Optical Alignment Procedure Step 10<sup>10</sup>)
- 11 Confirm/establish alignment/optical path
- 12 Install new dewar – Optical Alignment Procedure Step 11<sup>11</sup>
  - 12.1 Install LN2 overflow pan
  - 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 Optical Alignment Procedure Step 12<sup>12</sup>)
- 14 Remove Hextek alignment scope & install Hextek mirror (Optical Alignment Procedure Step 13<sup>13</sup>)
- 15 Perform additional alignments and adjustments as necessary
- 16 Remove cross disperser alignment scope
- 17 Install new footlocker
  - 17.1 Place and prepare unistrut
  - 17.2 Install footlocker frame (with heat-exchanger, plenum, & coolant lines)
  - 17.3 Install lower dewar side panel
  - 17.4 Assemble electronics box cable pipe

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both as necessary to pickup best axis compromise for L1 and L2. (Note: if this becomes necessary, all prior alignment info for old dewar would be lost at this point).

<sup>9</sup> Reinstall camera mirror (CM) - note pre-retrofit alignment with cross disperser alignment telescope (XDAT) - adjust camera mirror (CM) for best alignment using adjustment nuts (N1-N3). Note new target positions (now called the "zero point" positions).

<sup>10</sup> Remove camera mirror (CM) and reinstall Hextek alignment telescope (HTAT). Position should be reproducible to within 1 arcminute. Check for a return off the biconvex lens, which should be within 40 arcseconds.

<sup>11</sup> Install new dewar - adjust focus stage/shims to establish proper distance (L') from camera mirror to the dewar mirror (DM); get focus stage approximately centered on range.

<sup>12</sup> Tip/tilt/center new dewar as required observing center mark and reflection from dewar mirror (DM) with Hextek alignment telescope (HTAT).

<sup>13</sup> Reinstall camera mirror (CM) - verify that targets are still at "zero points".

- 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 Optical Alignment Procedure Step 14 (Power up new dewar).
- 19 Modify darkslide
- 20 Seal, tape, & flock critical/reflective surfaces
- 21 *Additional wiring and electrical connections*
- 22 Perform Optical Alignment Procedure Steps 15, 16, & 17<sup>14</sup>
- 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 Optical Alignment Procedure Step 18<sup>15</sup> - remove lasers, mirror assemblies, & targets as necessary. But if at all possible, leave these in place temporarily.
- 25 (After reviewing new photo inventory) take additional photos as necessary

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<sup>14</sup> Step 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 camera mirror adjustment nuts to piston Hextek, holding targets at zero points?).

Step 16 - Run detailed imagery tests varying camera mirror (CM) tip/tilt via adjustment nuts (N1-N3) and targets to map tip/tilt space.

Step 17 - Set camera mirror (CM) tip/tilt at best compromise position and lock down. Record new distance (L') from Hextek to dewar mirror.

<sup>15</sup> Remove lasers, mirror flats, and targets as required. But leave everything up for a while if possible, just in case some testing or realignment is necessary in the near future.

## 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>16</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 dewar mirror - flat alignment mirror on front of new dewar  
DLx DL1, DL2, DL3 diode lasers 1 thru 3 mounted on CM  
Fx F1-F3 – mirror 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 old field flattener (OFF)  
L' distance from CM to DM (note: to DM, not to NFF)

Steps

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- 7 Remove old dewar, noting any shims etc.

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<sup>16</sup> This procedure addresses the alignment aspects of the installation in detail



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- 12 Tip/tilt/center new dewar as required observing center mark and reflection from dewar mirror (DM) with Hextek alignment telescope (HTAT).
- 13 Reinstall camera mirror (CM) - verify that targets 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 camera mirror adjustment nuts to piston Hextek, holding targets at zero points?).
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- 17 Set camera mirror (CM) tip/tilt at best compromise position and lock down. Record new distance (L') from Hextek to dewar mirror.
- 18 Remove lasers, mirror flats, and targets as required. But leave everything up for a while if possible, just in case some testing or realignment is necessary in the near future.

Optical alignment is now complete.