HARP-NEF Front End Assembly

Science Fibers

Calib Fibers

Telescope Beam

HARPN Front End Assembly (w/ Partial Cover Plates)

HARPN Front End Assembly
HARP-NEF
Front End Assembly

Roger Eng

December 6, 2007
1. Atmospheric Dispersion Compensator (ADC) Assy
2. Tip Tilt Mirror & Stage Assy
3. Guide Camera & Re-Imaging Optics Assy
4. Calibration Light Projection Optics Assy
5. Calibration Fibers Assy
6. Calibration Fold Mirror Translation Assy
7. Neutral Density Filter
8. Focal Plane Fibers Assy
Atmospheric Dispersion Compensator (ADC) Assy

- 2 Prism Pairs in Assembly
- Each Prism Pair – Glass Material:
  - Glass 1: OHARA PBL6Y
  - Glass 2: OHARA S-FSL5Y
- Inner Surfaces of Each Prism Pair Parallel Mounted & Perpendicular to Optical Axis
- Prism Pairs Counter Rotate from Each Other
- Rotating Motion - Ring & Pinion Gears and Driven by NEMA-17 Stepper Motors
- Rotary Encoder w/ Home Switch per Prism Assy for Positioning Control
Mechanism – ADC Assy

- Requirement:
  Controlled Counter Rotating Motion between Both Prism Pairs

- Accomplished:
  Counter Rotating Motion -
  Ring & Pinion Gear
  Driven by Stepper Motor
  w/ Rotary Encoder &
  Home Switch Respectively

- Angular Positioning Accuracy:
  Requirement: +/- 0.50 Degree
  Capability: +/- 0.14 Degree
Tip-Tilt Mirror & Stage Assy

- Tip-Tilt Mirror to Re-Direct Telescope Light to Focal Plane Fibers & to Compensate Guiding Errors

- Mirror is Elliptical Shape, 190 mm x 140 mm

- Mirror Bonded on Interface Plate which is Mounted on Tip-Tilt Stage

- Mirror and Stage Assy Mounted on Rigid Structure of Front End Support

- Tip-Tilt Stage & Controller:
  
  By Physik Instrumente (PI)
  Stage – P558 TCD
  Controller – E710
  Both Are Off the Shelf Items
Guide Camera & Re-Imaging Optics Assy

- For Objects Acquisition, Centering & Guiding of the Telescope
- Guide Camera Design – Heritage
  Projects: TRES & MAGELLAN
- A Self-Contained Unit with:
  - Vacuum Window
  - Vacuum Port
  - CCD
  - Thermal Electric Cooler
- Re-Imaging Optics Group –
  - Canon - EF 100 mm, f/2.8 Macro USM
  - Off the Self Commercially Available Unit
  - Remotely Adjustable Focus Capability
Mechanism - Guide Camera & Re-Imaging Optics Assy

- Requirement:
  Focus Adjustment for Guide Camera Re-Imaging Optics Group

- Accomplished:
  Focus Motion –
  Timing Belt & Sprocket Driven by Stepper Motor w/ Rotary Encoder & Home Switch

- Angular Positioning Accuracy:
  Requirement: +/- 1.00 Degree
  Capability: +/- 0.42 Degree
Calibration Light Projection Optics Assy

- Heritage of HARPS at La Silla Design
- Located Between Calibration Fibers and Calibration Fold Mirror
- Contains 2 Separate Optical Paths of 2 Calibration Beams @ 16 mm Apart
- 2 Sets of Identical Optics – Entrance & Exit Sets
  - Entrance Lens Adjustable by Linear & Rotational Motions
  - Pupil Mask Installed at End of Entrance Lens Mount Tube
- Exit Lens Sets Fix Mounted
- Both Calibration Light Beams Contained in the Projection Optics Housing Adjustable Bi-Directionally by Eccentric Cam Motions
Calibration Fibers Assy

- Heritage of at La Silla Design & A Direct Duplication

- Consists of 2 Fibers @ 16 mm Apart

- Each Calibration Fiber Adjustable Tri-Directionally with Micrometer Head Fine Tuning

- Calibration Light Source - Located Remotely Away from Telescope & Instruments

- Hollow Cathode Lamps & Halogen Lamp Provide Visible Light Source Through Calibration Fibers to the Focal Plane Fibers

- Fiber Illuminator to Provide External Light Source
Calibration Fold Mirror Translation Assy

- Fold Mirror Steers Calibration Light Onto the Focal Plane Fibers
- All 4 Configurations Achieved by Linear Motion Translation to Selected Position of Mirror
- Linear Motion Components:
  - THK Linear Motion Stage
  - Spur Gears & Coupling
  - NEMA-17 Stepper Motor
  - Rotary Encoder & Limit Switches
Mechanism – Calibration Fold Mirror Translation

Requirement:

Four Configurations –
1. All Sky Light
2. Sky Light & Calibration Light
3. Both Calibration Light
4. Sky Light & Other Calibration Light

Accomplished:

All Four Configurations Met –
Translation Stage to Move Calibration Fold Mirror to the Appropriate Position

Translation Motion Driven by Step Motor w/ Rotary Encoder & Limit Switches for Homing & Safety

Linear Positioning Accuracy:

Requirement: +/- 0.005 mm
Capability: +/- 0.0025 mm
( Based on 10 mm Lead Screw Pitch of Drive Motor )
Neutral Density Filter

- Located Between Calibration Fibers & Projection Optics
- Mounted Perpendicular to the Calibration Light Beams
- Allows For Adjustments of Flux Exposure of a Calibration Source
- Directly Coupled and Driven by NEMA-17 Stepper Motor through Reduction Gear Head, w/ Home Reference & Rotary Encoder for Accuracy
- Variable Neutral Density Filter:
  - Reynard Corporation
  - Substrate: BK-7
  - 176 mm Diameter x 2 mm Thick
Mechanism – Neutral Density Filter

• Requirement:
  Adjustment of the Flux of a Calibration Source Injected into the Focal Plane Fibers

• Accomplished:
  A Variable Neutral Density Filter is Mounted In Line of Calibration Source, Driven by Stepper Motor w/ Rotary Encoder & Home Switch

• Angular Positioning Accuracy:
  Requirement: +/- 0.10 Degree
  Capability: +/- 0.01 Degree (w/ Gear Reduction)
Focal Plane Fibers Assy

- Heritage of HARPS at La Silla Design
- 2 Fibers Separated by 16 mm
- Fibers Mounted Parallel in Housing Through 2 Pierced Holes
- Angled Reflective Mirror on Front Face of Housing
- Angled Mirror Re-Directs Light from Telescope to the Guide Camera Through Its Front End Lens Group
- Fiber Protector for Protection of the Focal Plane Fibers When Instrument Not In Use
Mechanism – Focal Plane Fiber Protector

• Requirement:
  Provide Protection to Science Fibers when not in Use

• Accomplished:
  A Protective Shield Rotated into Position to Shield the Fiber Head, Driven by a Stepper Motor w/ Rotary Encoder & Home Switch

• Angular Positioning Accuracy:
  Requirement: +/- 2.0°
  Capability: +/- 0.9°
Front End Assembly Handling

- ADC Installation
  - Handled Manually
  - Mechanical Handles Provided
  - Standard Hardware & Tools Used

- Front End Assembly
  - Mechanical Handles Provided for Build-Up Handling
  - Lift Rings & Slings Provided for Hoist Lift & Handling
  - Facility Hoist and Man Lift Used for Integration Installation
  - Standard Hardware and Tools Used