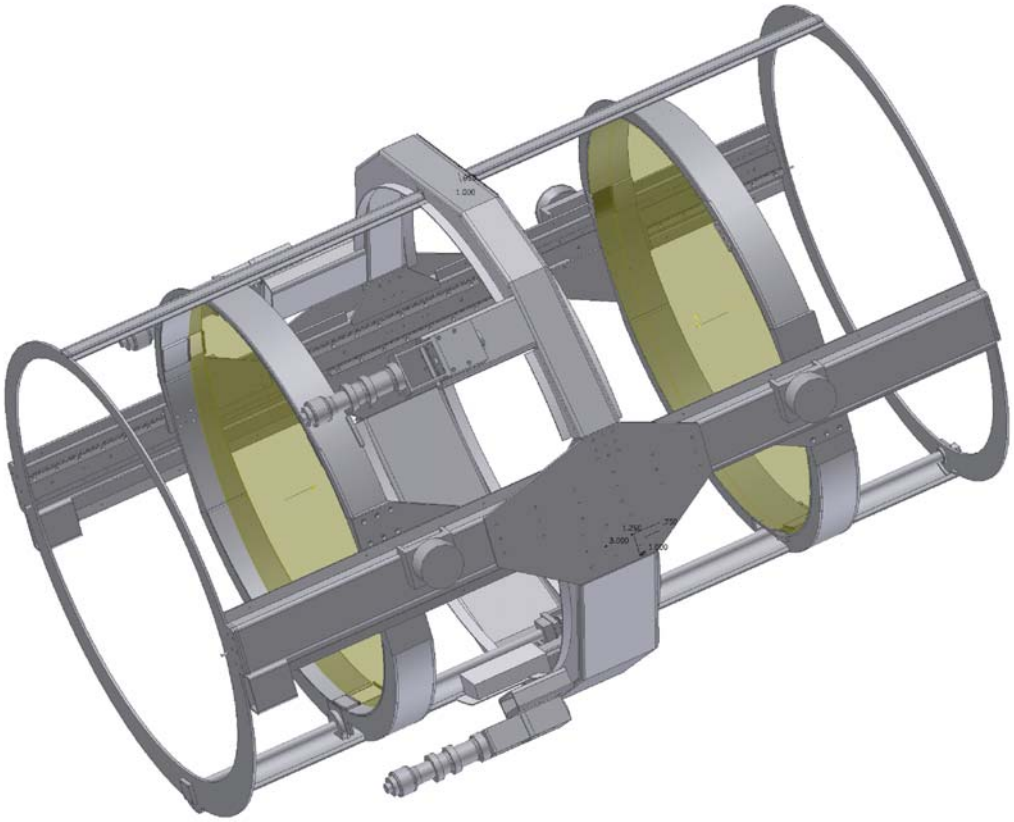
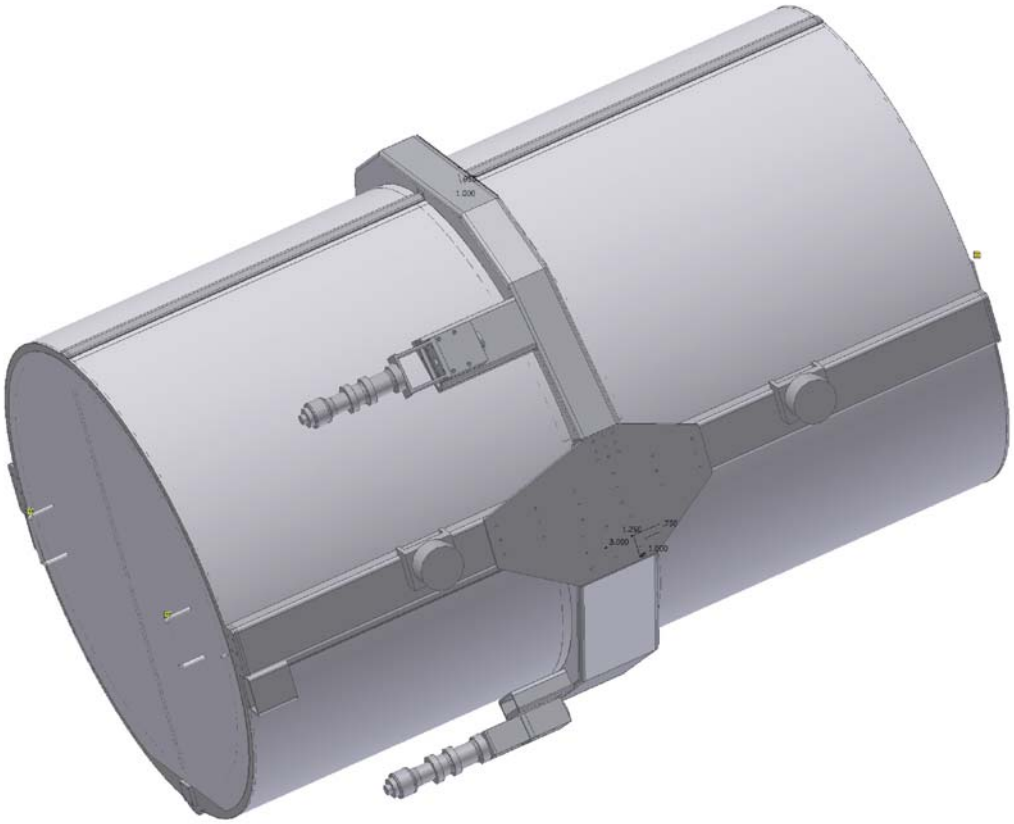
This report presents the detail design of the Cassegrain ADC for Keck I.



The Figure shows the Cassegrain ADC without cladding or covers. As in the preliminary design the prisms move toward and away from the center of the instrument, maintaining a

constant center of gravity. This design incorporates a single ball screw to control prism separation, with two ball slides maintaining perpendicularity and lateral placement of the prisms to the optical axis. The structural components are rectangular tube to support the moment loads generated by the ball screw located near the edge of the optics. The structure and cell materials are steel to meet the thermal and stiffness requirements of the design.

The ball screws are left hand thread on the aft prism and right hand on the forward prism. These are driven from the center by a Galil motor, gearbox and toothed belt. Since, at any time one prism is being lifted while the other is being lowered, the net torque to move the prisms is only the torque required to overcome friction. The ball screw drive has been moved from the top of the instrument (pointed at the horizon) to the bottom to gain clearance on the chain drive used to install forward Cassegrain instruments. The prism separation range is from 20 to 1700 mm.



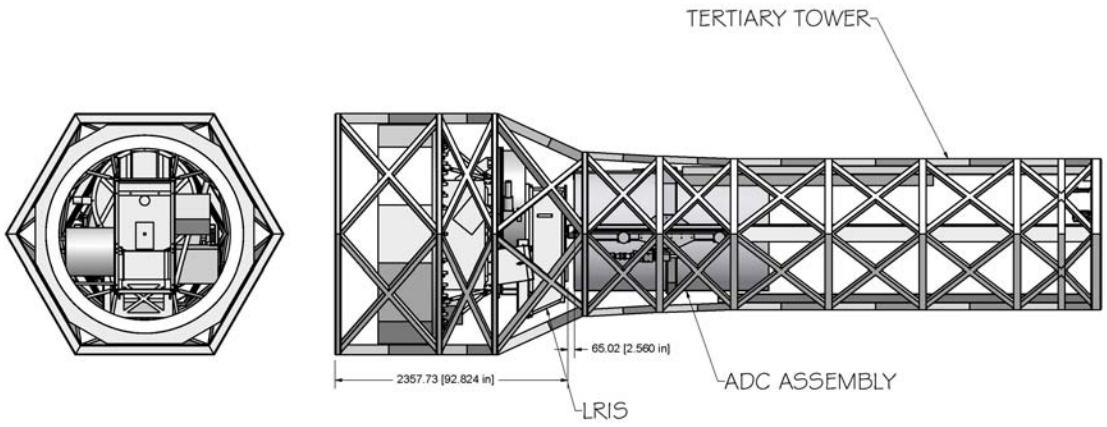
ADC with cladding and covers.

The cladding and covers are aluminum. The inside is flocked with Ultra-Pol, a black adhesive backed polishing fabric.

Location, Weight and Mounting

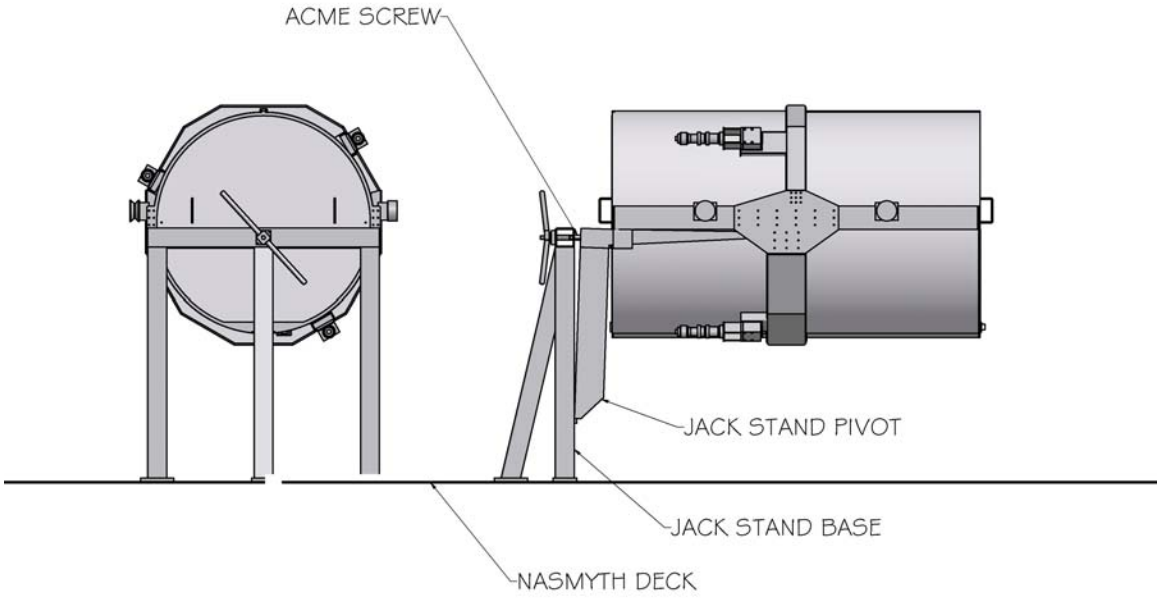
The total instrument weight is 1250 lbs. The electronics will be mounted in the Hires electronics vault.

The instrument will mount into the tertiary tower on defining points to be installed be Keck. The locations of these points have been agreed to between Keck and Lick and are specified in the ICD. The Z position of the instrument is in front of LRIS and must clear the front hatch of LRIS. Keck is going to revise this hatch from a door to a sliding hatch.



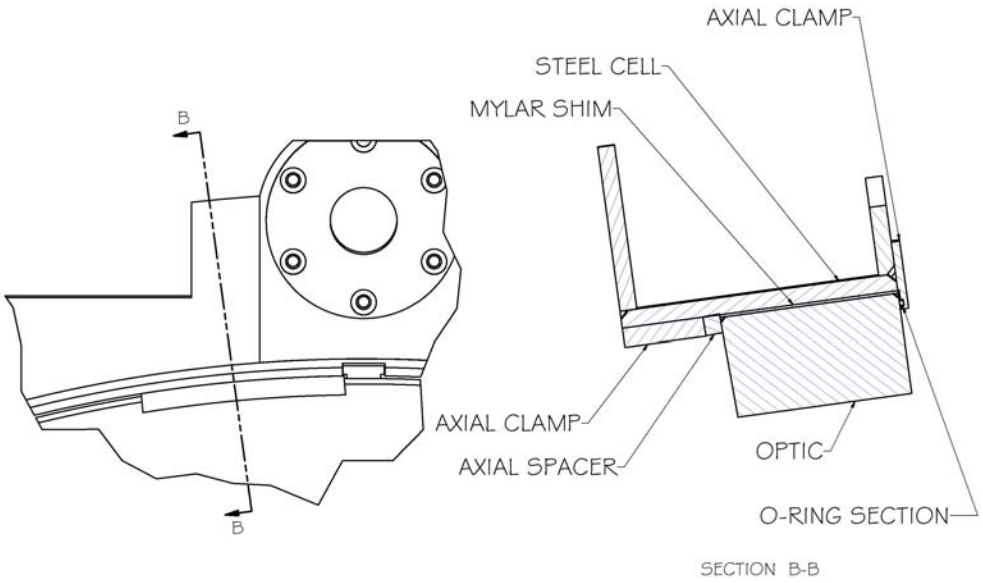
LRIS & ADC IN TERTIARY TOWER

The instrument will be stored in and installed through the Cassegrain Transfer Module. The locations of the defining points have been chosen so that they do not interfere with the transfer module. The defining points are back (+Z) of the center of gravity of the instrument to clear the baffle deployment assemblies in the tertiary tower. When the transfer module is in use for other instruments the ADC will be stored on a Jack Stand permanently mounted on the nasmyth deck.



Cell Design

The prisms are mounted in steel cells with three radial and three axial constraints at 120 degrees. These constraints have adequate clearance to accommodate the temperature variation specified in the ICD.



Cutaway View of Optic Mount

The section of o-ring just provides some spring loading to hold the optic against the axial clamp. It is on the upper surface of each optic when pointed at the zenith.

The inner surfaces of the prisms are parallel to each other and tilted 0.83 degrees to the optical axis. The tilt is accomplished by mounting the ball slides at a 0.83-degree angle from axis of the cell. The ball slide mount pads are bolted onto the cell and also hold the index tab for the fiducal/limit sensors.

Structure

The stiffness requirements for the structure are met by constructing the base structure from rectangular tube. A finite element analysis of the final structure has been preformed. The stresses are all within allowable levels for the materials used. The deflections of the prisms from desired locations have been predicted. The results of this analysis are reported in the Structural Analysis Document.

Mechanisms

The moment load resulting from a single ball screw placed at the edge of the prism cell is taken by the ball slides. As a result each cell has have slide / rail assemblies with 2 slides on each one. The slides are separated by 7" centers to accept the moment. We have identified and obtained quotes on slides from 2 manufacturers that meet the requirements.

The ball screw diameter is constrained partly by the manufacturers ability to manufacture one of adequate length. The ball screw diameter is 25 mm diameter screw. There are separate screws at each end of the instrument. These are coupled at the center and constrained axially and radially by bearings near the coupling. The outer ends are constrained radially by bearings. The center coupling is also the timing belt pulley.

The motor is a Pitman servomotor controlled by a Galil controller. A Bayside 10:1 gearbox provides speed reduction and a timing belt connects to the ball screw.

Mechanical Performance

The maximum travel rate for an individual prism is 20 mm/sec. This allows the correction adjustment of the ADC to keep up with the telescope slew rate at 60 degrees zenith distance.

The positional accuracy is limited by flexure of the instrument. The positional deflections due to gravity are TBD

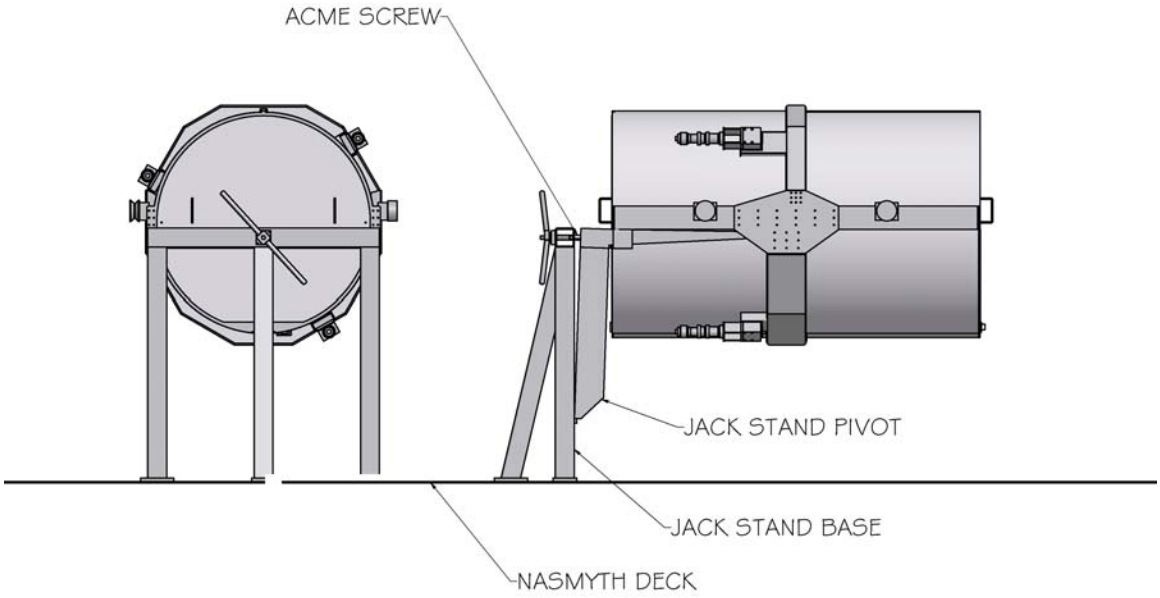
Encoder, fiducal, and limit locations, mounting and logic

A rotary encoder is installed on the front of the instrument, attached to the forward ball screw. This is used by software to determine that the drive system is functioning properly. The fiducals and limits are Hall effect sensors that are mounted along the ball slide support tube between the ball slides on one side of the instrument.

The fiducal will be closer to the end of travel, in the maximum correction direction, than the length of the index tab. When the instrument powers up, if the fiducal is blocked by the tab the cell will move toward the center of the instrument, otherwise it will move outward. A complete description of the logic and wiring is provided in drawing EL-3610.

1) Jack Stand Design

The jack stand mounts permanently on the nasmyth deck behind the module handler for the transfer module. It has 2 long forks that extend under the ball slide support tubes for the aft optic and have dowels that key into the support tubes. These lift the ADC free of the rails in the transfer module by pivoting upward. The pivot is actuated manually with an acme screw.



ADC On Jack Stand