Dark Energy Camera

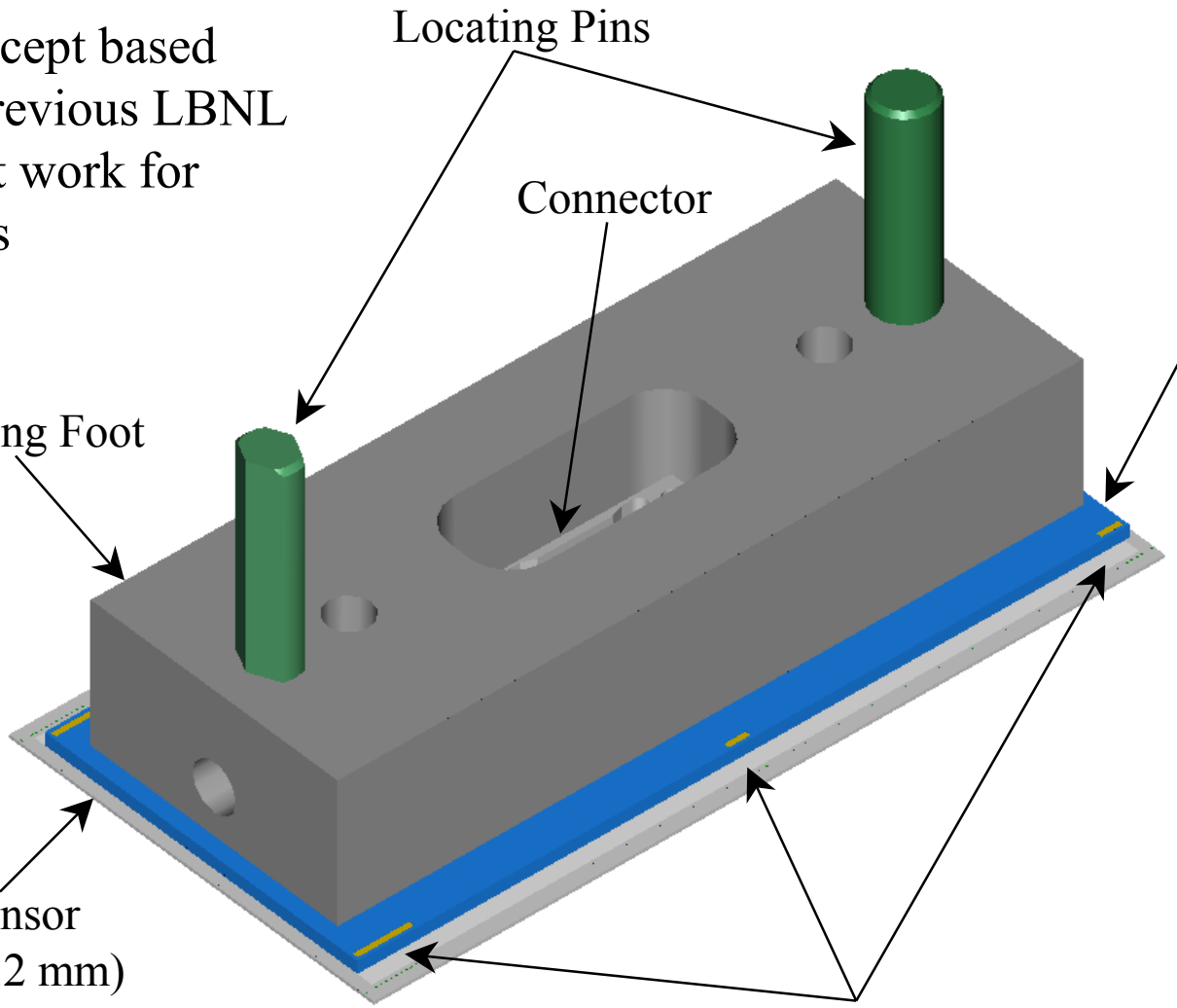
1.2.2 CCD Packaging

1.2.6 Focal Plane Support Plate

Greg Derylo
Fermilab

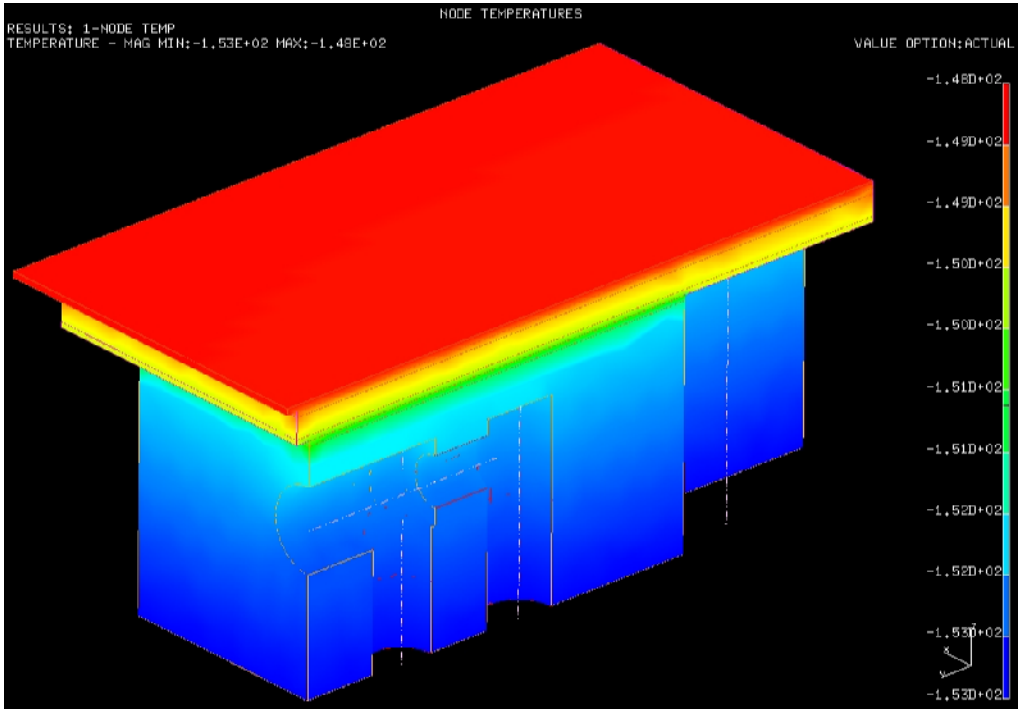
CCD Module Package Overview

Package concept based largely on previous LBNL development work for these sensors



CCD Packaging Specifications

- Operating temperature at some point between 150 – 180 K
- Uniform temperature within a CCD sensor. Initial studies indicate this is met with this design concept.
- Flatness of CCD face < 10µm
- For focal plane uniformity, average thickness module-to-module within 10µm
- Development of thermal distortion analysis model is underway

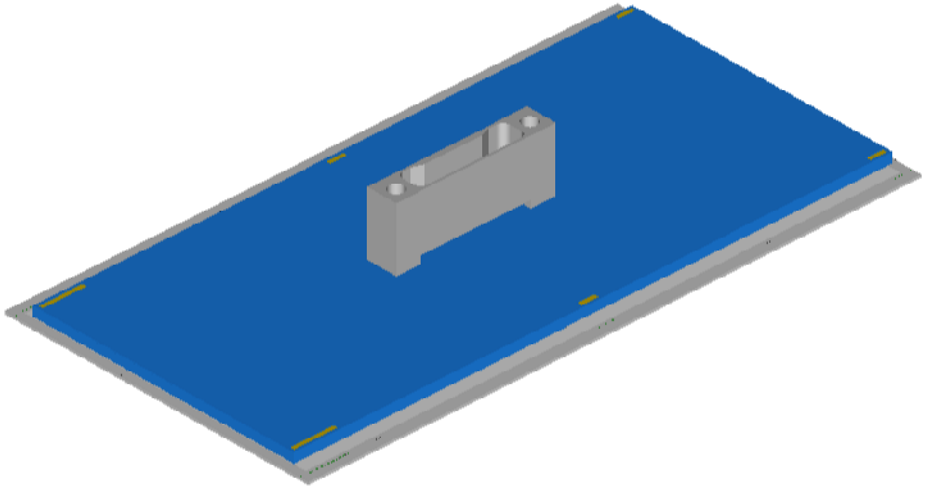


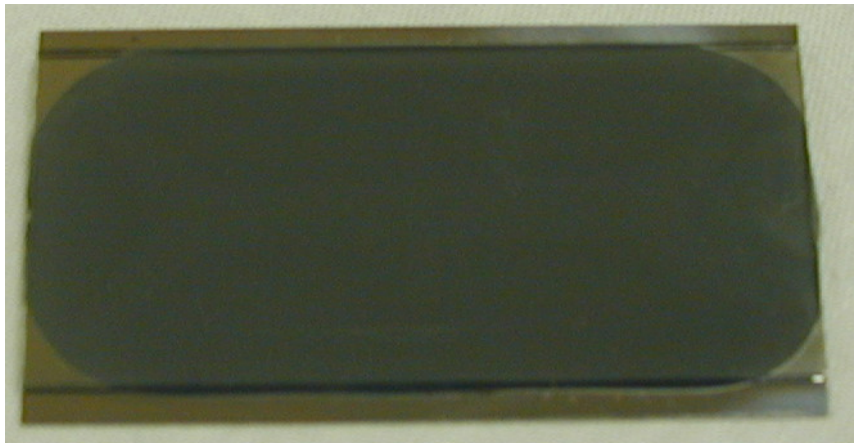
Preliminary quarter-module heat transfer study

* 0.95 W flux / module
* 5°C variation through the module thickness
* 0.1°C variation over surface of CCD

CCD Module Assembly Sequence

- Assembly techniques are similar to those used for fabricating HEP vertex detectors at SiDet
- CCD sensor held flat with vacuum and glued to the assembled AlN readout board (already equipped with connector & etc.)
- Gluing technique being developed to maximize uniformity of epoxy coverage, but glue lines in active area must still exist due to close proximity of bondpads to pixels
- Wirebond AlN to CCD
- Functional test

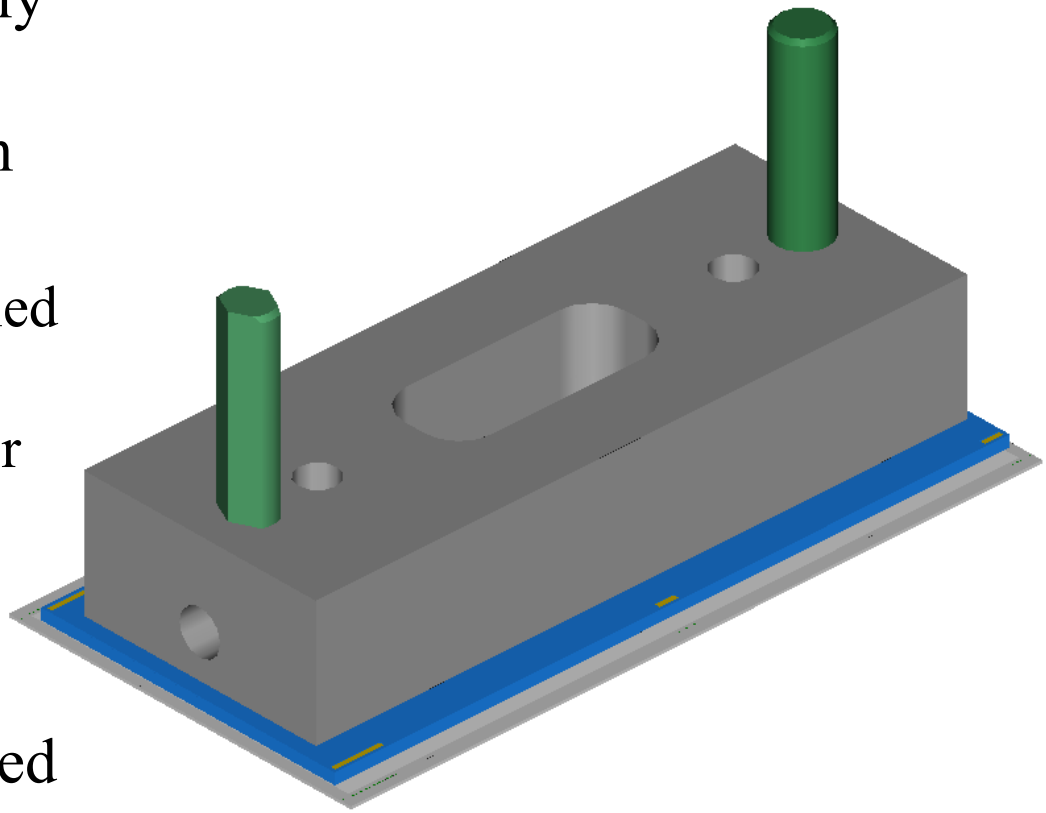




Epoxy test photo of glass readout board mockup glued onto blank Si (corners still need work)

CCD Module Assembly Sequence

- Glue mounting foot assembly to the AlN board
- Fixturing design to maintain
  - Flatness
  - Uniform thickness controlled with precision shims
  - Relative positions of sensor edges to mounting pins
- Inspect geometry
- Test
- Good ESD practices observed throughout process



CCD Module Prototyping

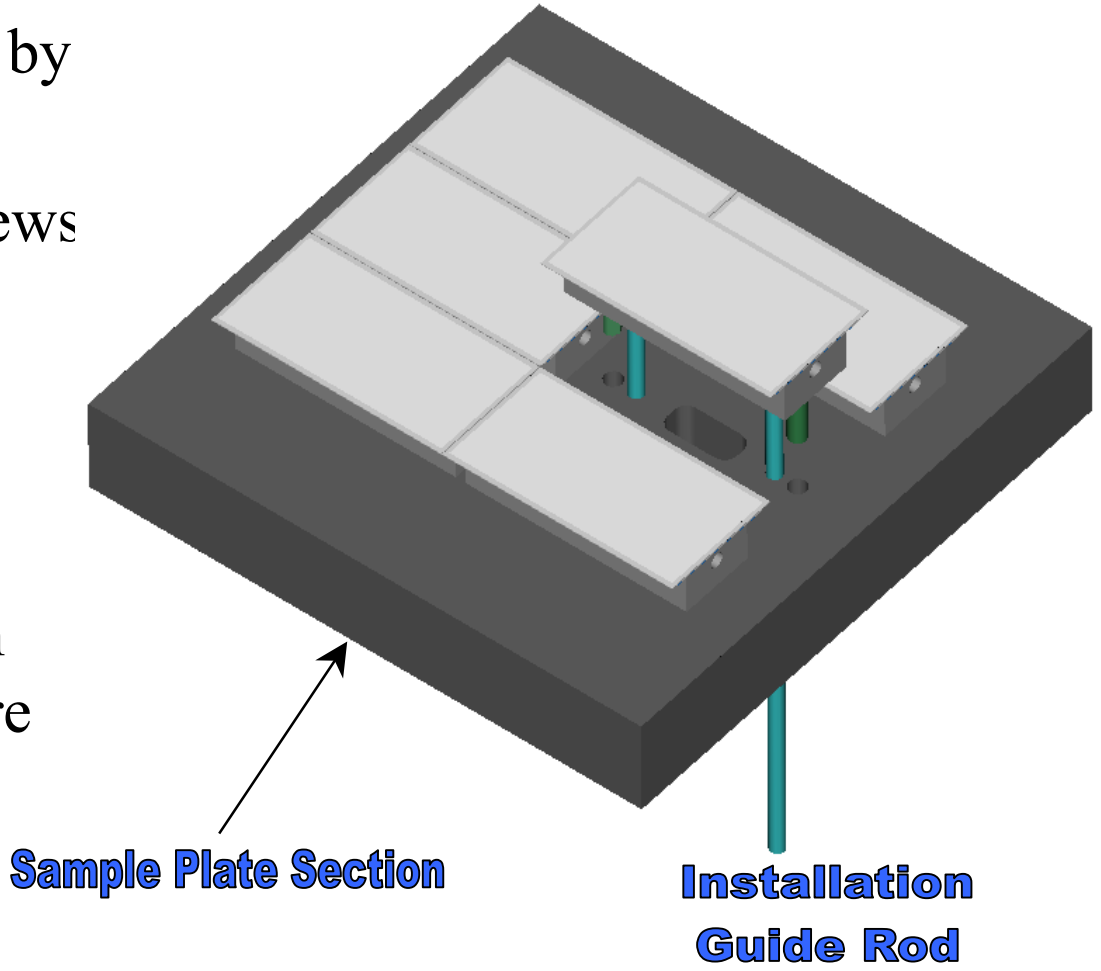
- Design integrated package and focal plane support plate to satisfy thermal and mechanical design requirements
- Investigate epoxy options and application techniques
- Design & develop assembly tooling
- Fabricate and test mechanical prototypes
- Work with Lick Observatory to assemble first electrical prototype December 2004. First electrical module packaged at FNAL in April 2005 (“Phase A” device).
- Prototype packaging review / go-ahead for electrical-grade preproduction in September 2005

CCD Module Production

- Module pre-production assembly scheduled from August 2005 to November 2005 (several “Phase B” devices used to evaluate the CCDs prior to placing the production order)
- Readiness review December 2005 prior to packaging the “Phase C” and the rest of the “Phase B” devices
- Module production assembly from May 2006 to May 2007
- LBNL to provide sensors at a rate of 20 per month
- Minimum required packaging through-put is therefore one module per day
- Two sets of fixture trains needed in order to ensure margin for this assembly rate. A technician can process multiple gluing setups in a day (a lot of time during assembly is spent waiting for epoxy to cure).

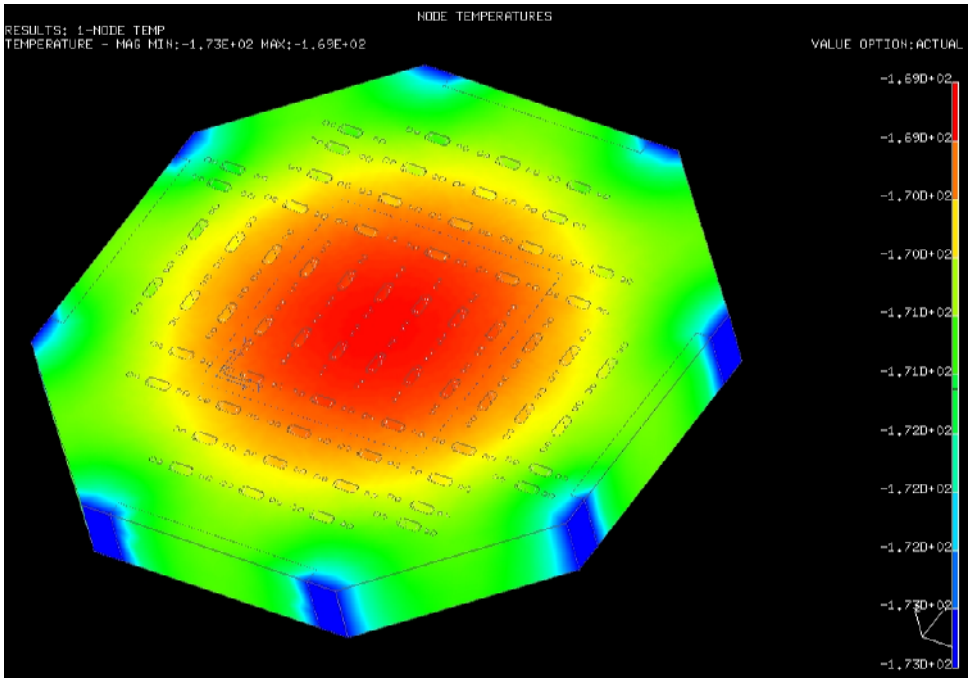
Focal Plane Layout Overview

- CCD module locations set by pin/hole engagements
- Fastened in place with screws from rear
- Access through plate for electrical readout
- Heaters actively shim the plate temperature based on measured CCD temperature data



Focal Plane Specifications

- Plate stiffness must keep the CCDs coplanar. Plate flatness over the range of motion to be less than ~15μm.
- Temperature to be kept uniform across the focal array to within 4°C in order to maintain sensor QE levels
- Plate material selection to be made to satisfy the mechanical and thermal requirements



Preliminary Temperature FEA Model
* 100 W / 2" aluminum
* ~3°C variation over module mount area

Estimated Hardware Costs

- Module Preproduction
  - 20 k$ CCD module mounting hardware
  - 25 k$ Assembly fixtures & module storage
- Module Production
  - 100 k$ CCD module mounting hardware
  - 50 k$ Assembly fixtures & module storage

- Focal Plane Support Plate
  - 10 k$ Sample section / mockup
  - 30 k$ Production plate

Summary

- CCD module development work is underway. The module design takes advantage of previous work done by LBNL for these sensors.
- Design of the focal plane support plate is proceeding to satisfy the mechanical and thermal performance requirements
- We look forward to working with Richard Stover at the UCO/Lick Observatory to gain from their packaging experience