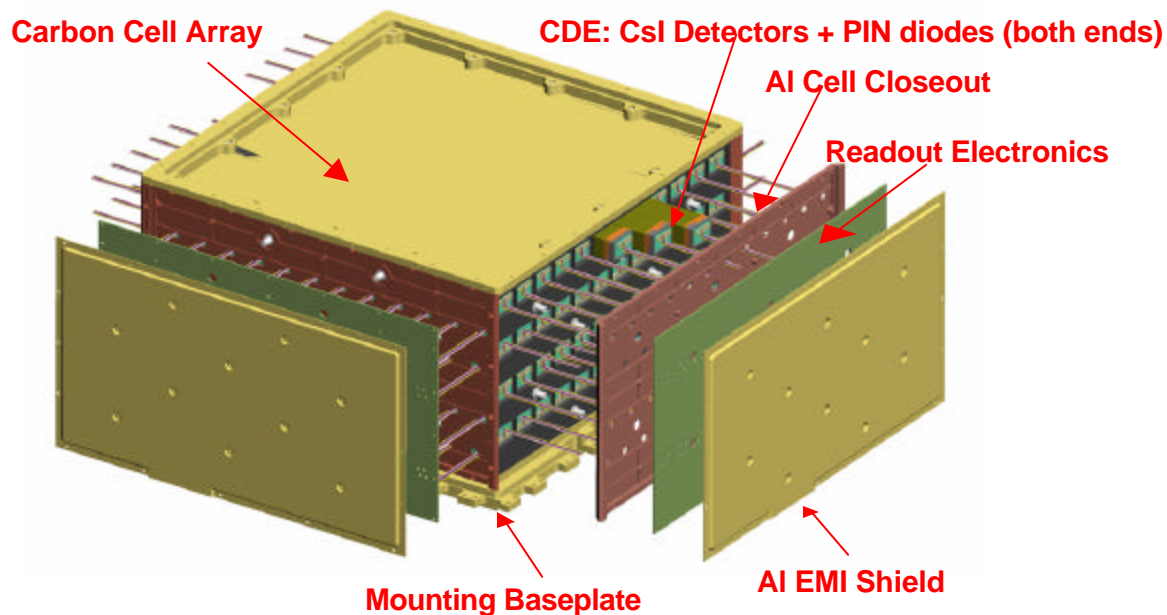


Calorimeter Subsystem Flight Fabrication Fotos

**12 May 2003
W. Neil Johnson
Naval Research Lab**



- **8 layers of 12 CsI(Tl) crystals**
 - **Crystal dimensions**
 - 27 x 20 x 326 mm
 - **Hodoscopic stacking**
 - alternating orthogonal layers
 - **Dual PIN photodiode on each end of crystals**
- **Mechanical packaging**
 - **Carbon Composite cell structure**
 - **Al base plate and side cell closeouts**

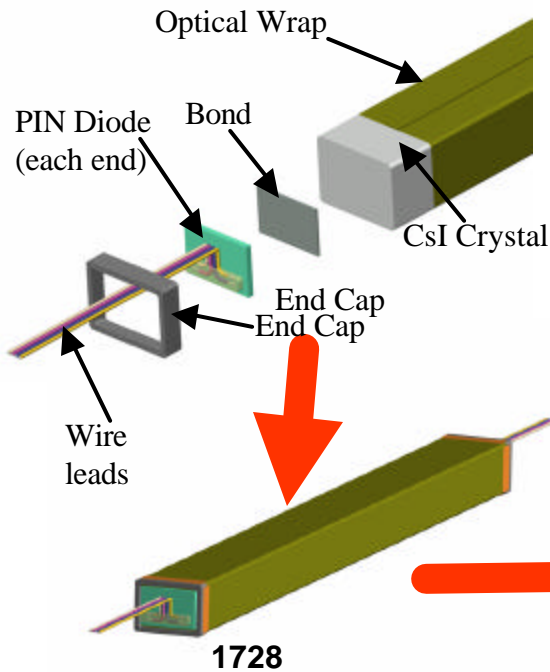


- **Electronics boards attached to each side**
 - **Interface connectors to TEM at base of calorimeter**

Calorimeter Assembly Flow

Dual PIN Diodes (DPD) NRL
CsI Crystals Sweden

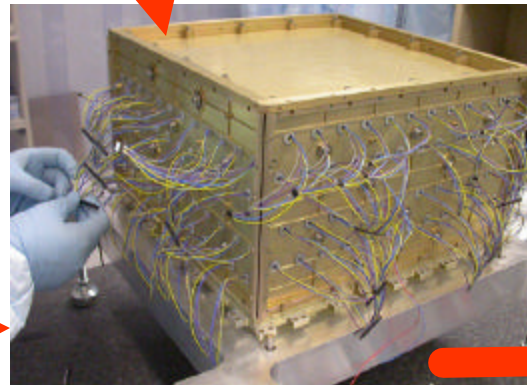
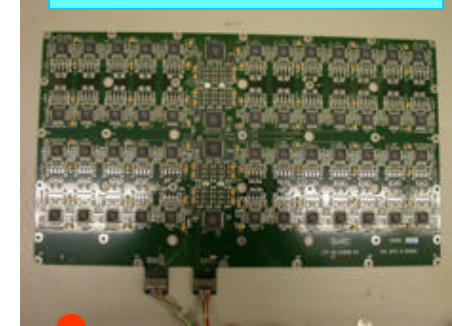
Crystal Detector Element (CDE) Assembly
NRL



Mechanical Structure
France / NRL

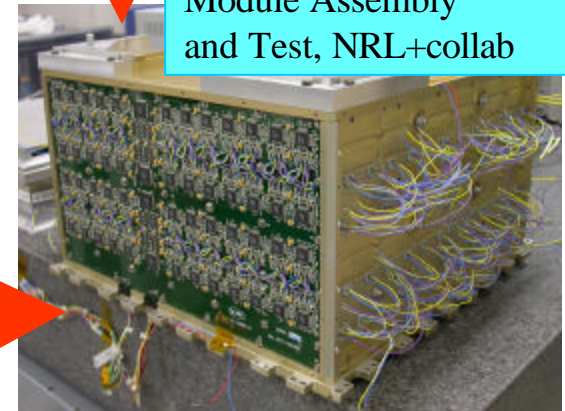


Front-End Electronics
NRL, SLAC



PreElectronics Module (PEM)
Assembly
NRL

Module Assembly
and Test, NRL+collab



16 Flight modules + 2 Spare

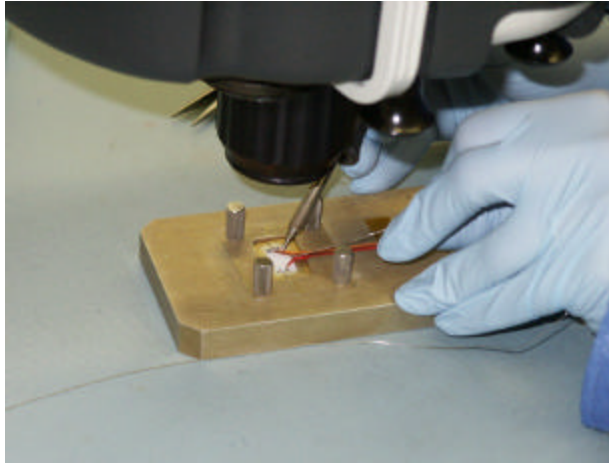


Crystal Detector Element (CDE) Manufacture

**CsI Testing – Kalmar Univ, Sweden
PIN Diode Assembly and Test – NRL
CDE Bonding and Test – Swales Aerospace**



CsI Crystals / PIN Diodes

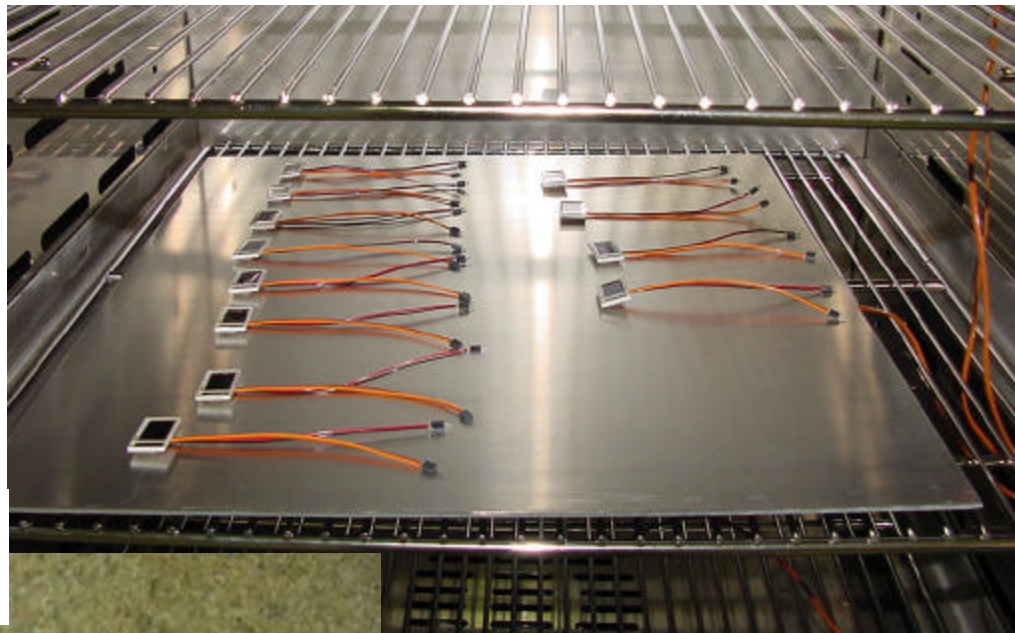


**PDA's are dried in oven
before bonding**

**>1300 of 1900 CsI Crystals
have been delivered to NRL**



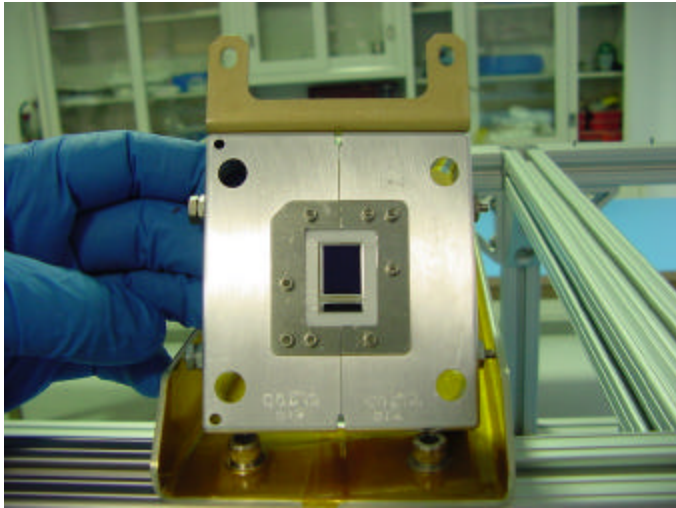
Soldering PIN diode assemblies (PDAs)
>3000 of 4800 PDA's have been manufactured



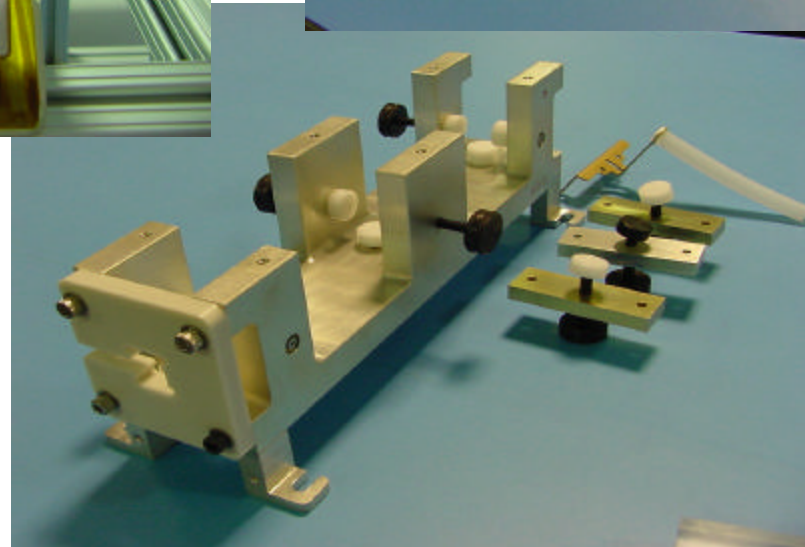
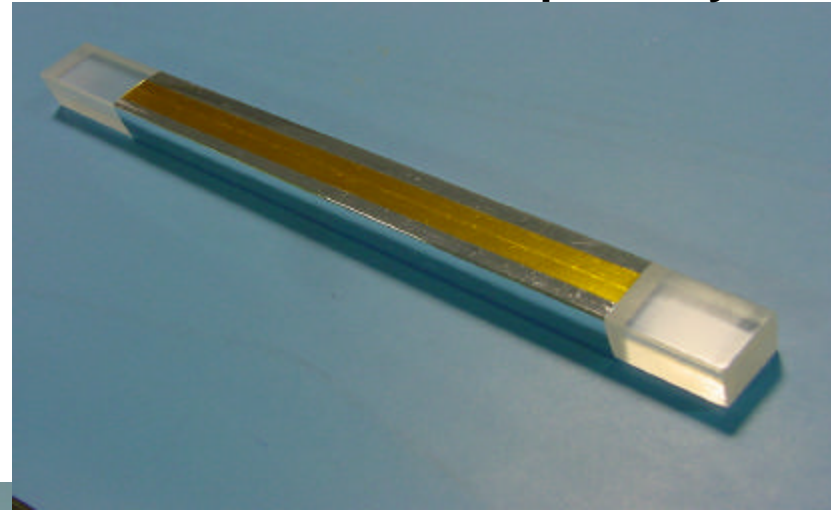
**Prior to bonding,
CsI crystal is
visually inspected**

Prepare CsI Crystal and PIN Diode for Bonding

**Mount PIN Diode
in bonding mold**



Protective Wrap on Crystal

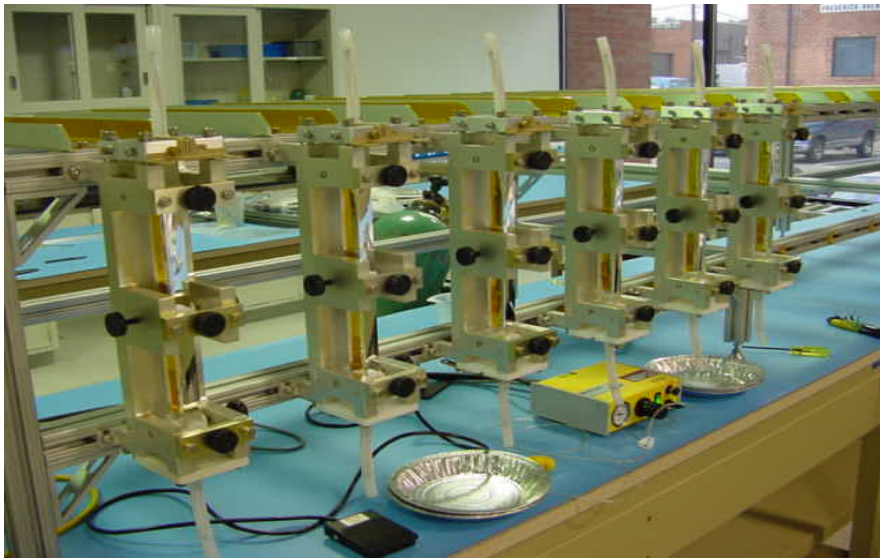


Bond Support Tool

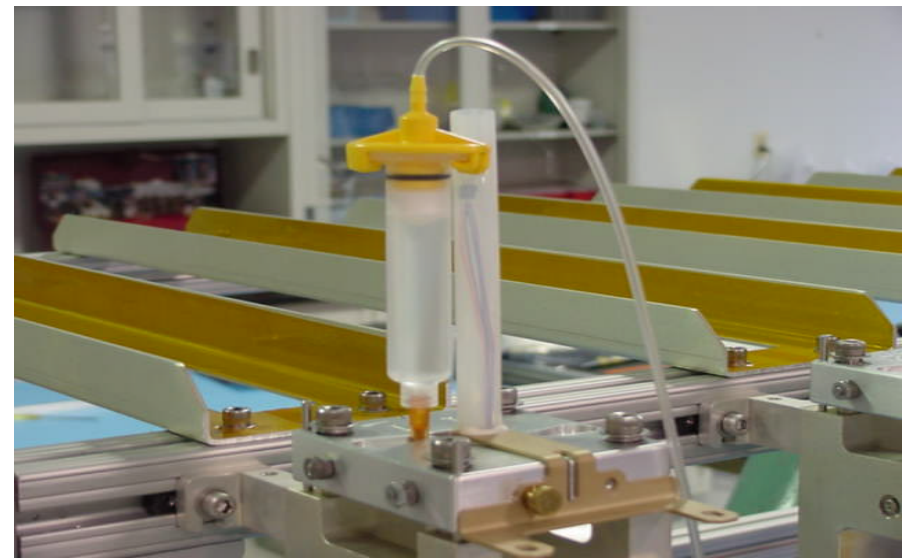
CDE Bonding

Swales Aerospace Products builds CDEs

24 CDEs are bonded at one time



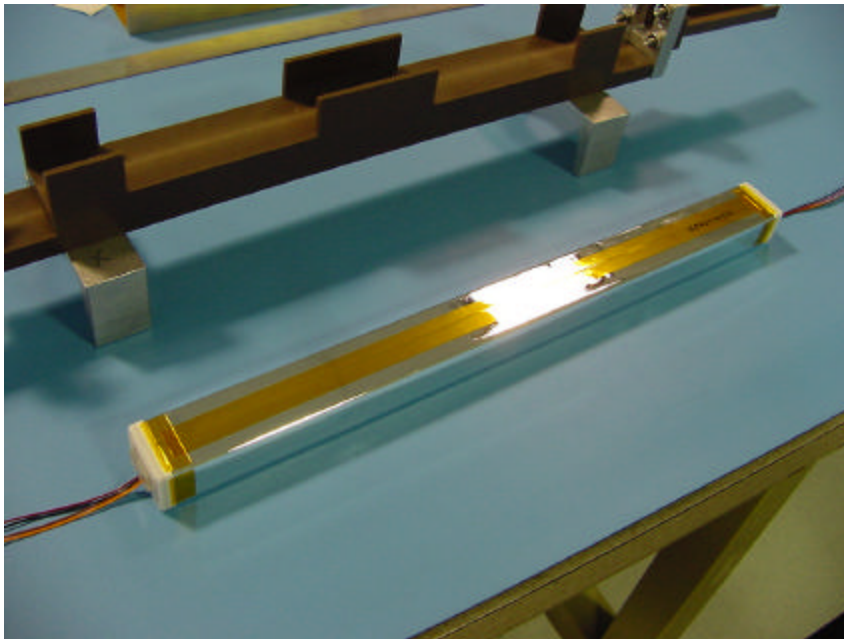
Set of Tools



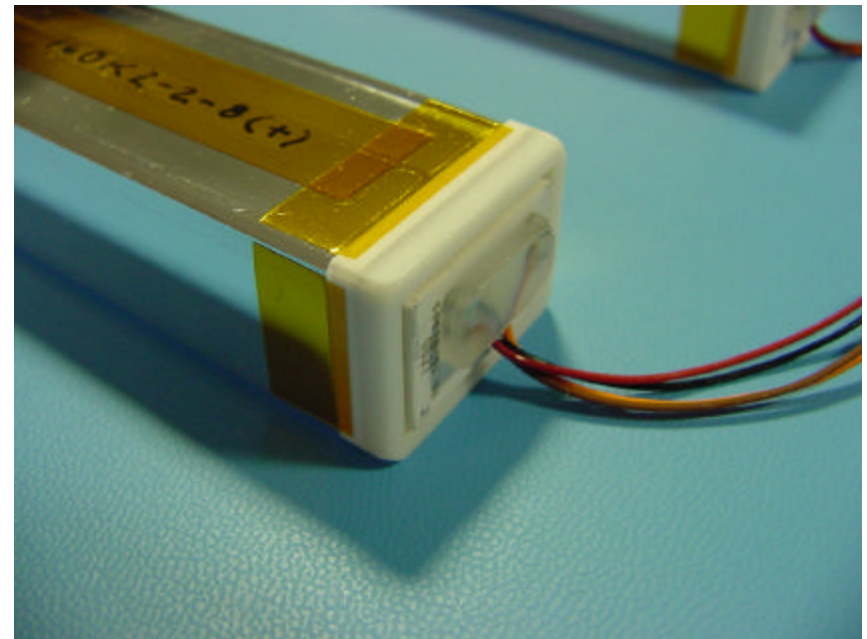
Injecting Adhesive

Complete CDE

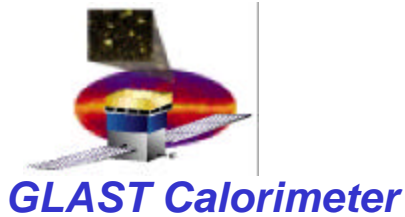
>720 of 1900 Flight CDEs have been bonded



Complete CDE



PIN Diode Detail



Pre Electronics Module (PEM)

**Carbon Composite Structure – LLR Ecole Polytechnique,
France**

Machined Parts, CDEs and Assembly – NRL



Composite Structure

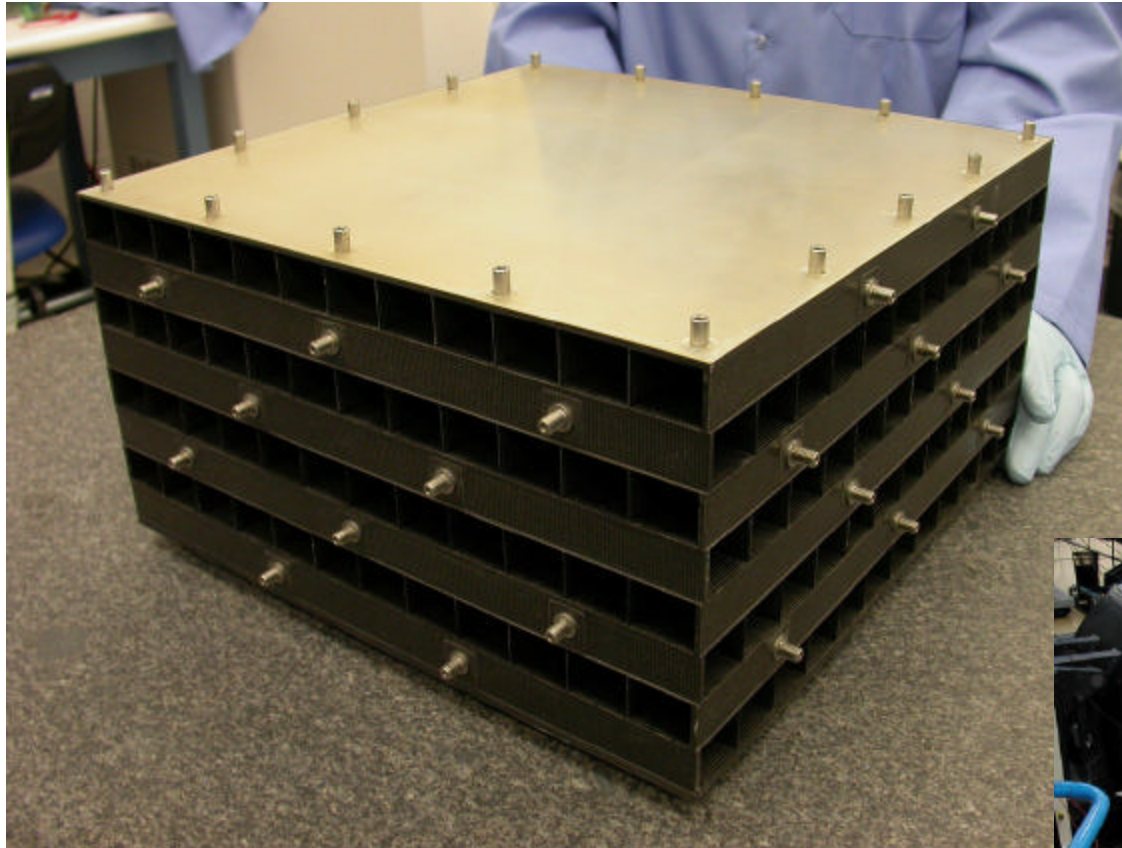


Layup of the structure – prepreg material wrapped around 96 mandrels in 8 layers

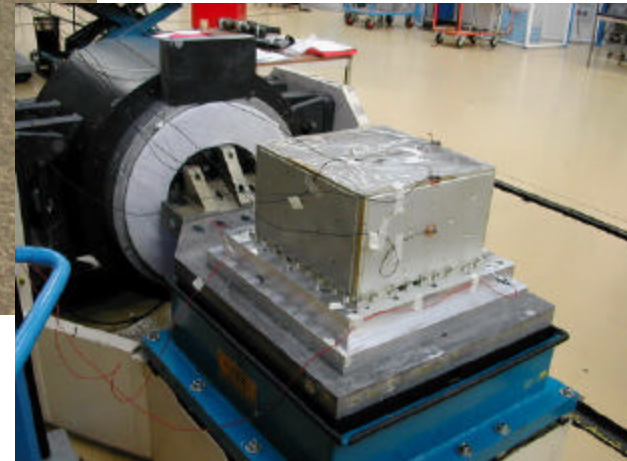
The structure is cured in an autoclave at LLR.



Carbon Composite Structure



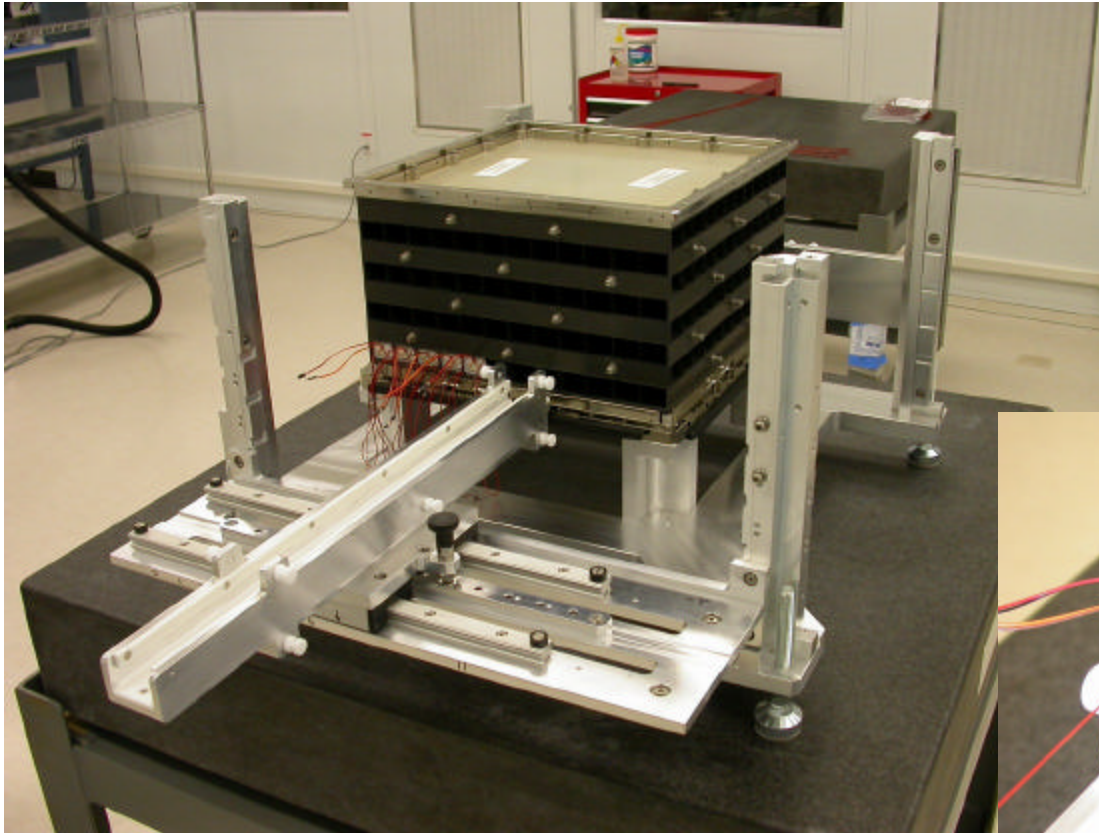
- ❑ 8 of 18 Flight Structures have been built
- ❑ 7 have been strength tested
- ❑ 4 are at NRL



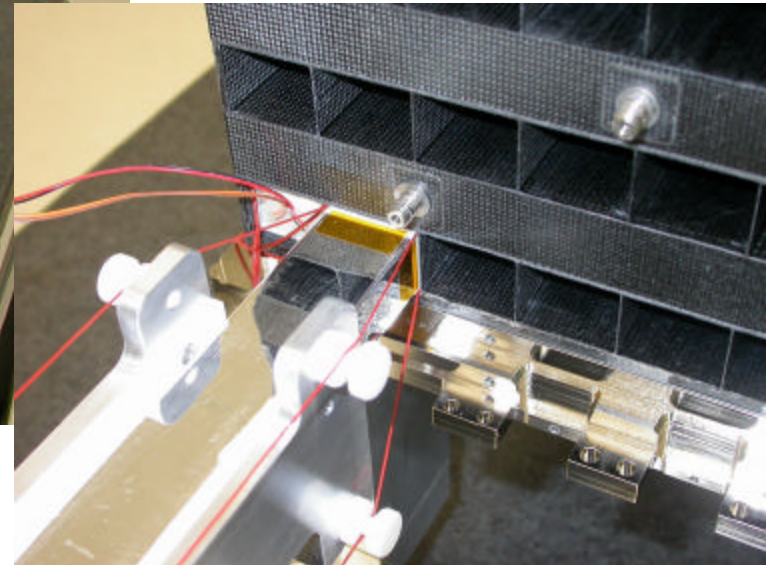
Vibration Test for Strength



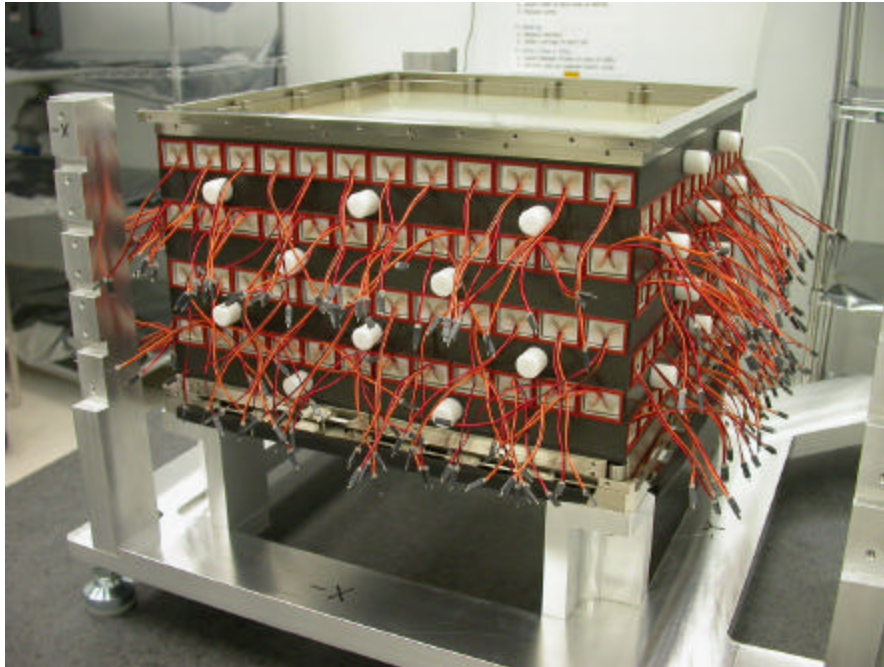
CDE Insertion into Structure



CDE insertion tooling supports and aligns CDE and stretches rubber bands.

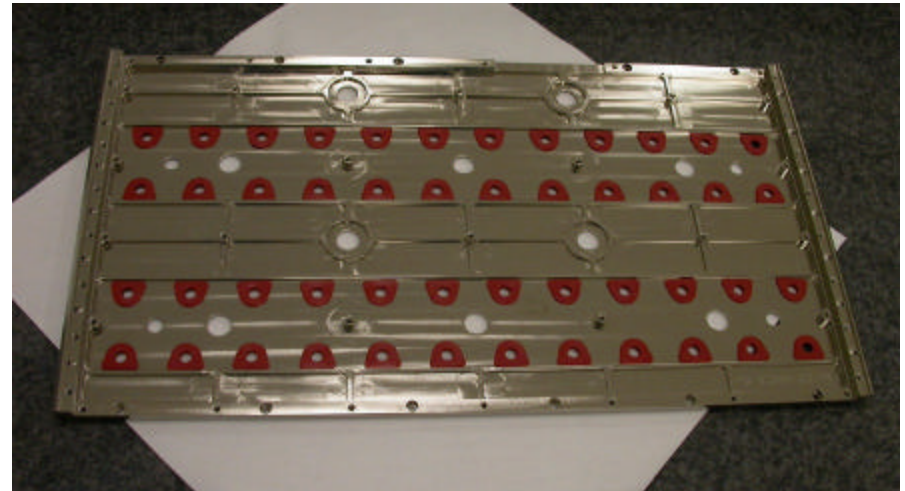


PEM Closeout



All 96 CDEs have been installed

CDEs are held in place by a closeout plate on each side



Closeout Plate. Grommets protect diode wires as they pass thru the closeout plate.



A “stadium” of test electronics is attached to the completed PEM to verify post-assembly CDE performance using cosmic muons.

First flight Pre Electronics Module has been completed

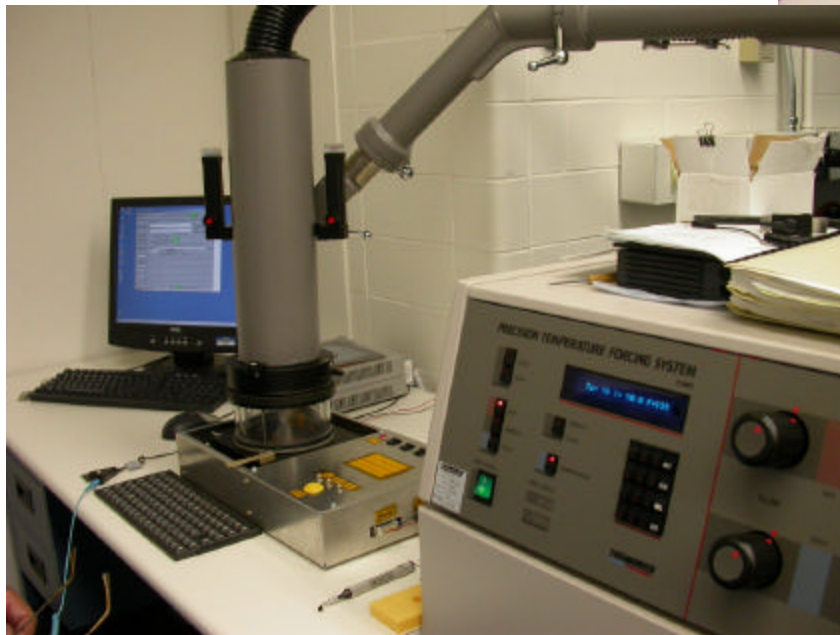
Analog Front End Electronics (AFEE)

NRL and SLAC

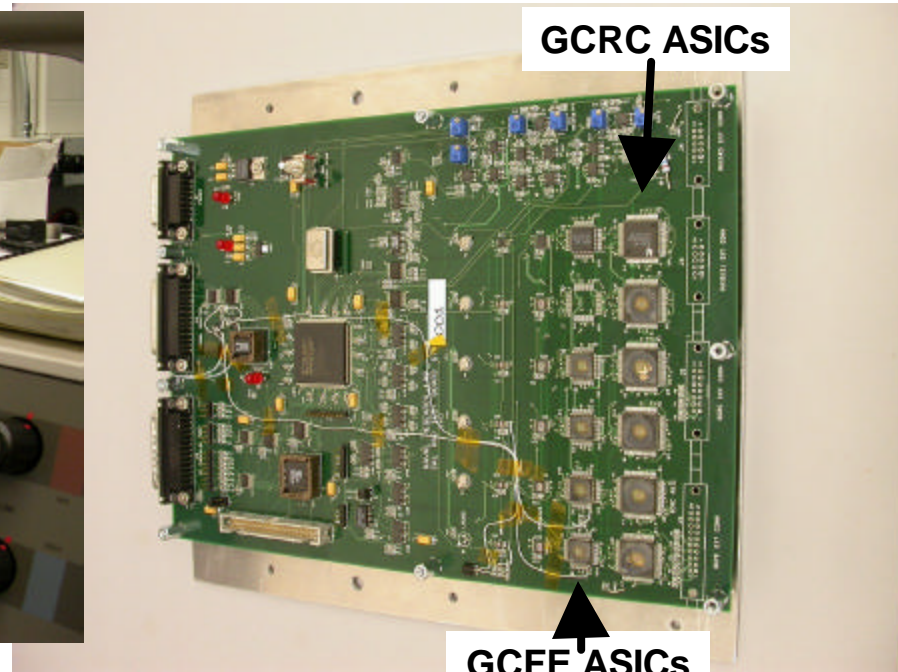


Application Specific Integrated Circuits (ASICs)

- Fab'ed and tested 7,000 plastic encapsulated front end ASICs (GCFE) and 1,000 plastic encapsulated readout controller ASICs (GCRC)

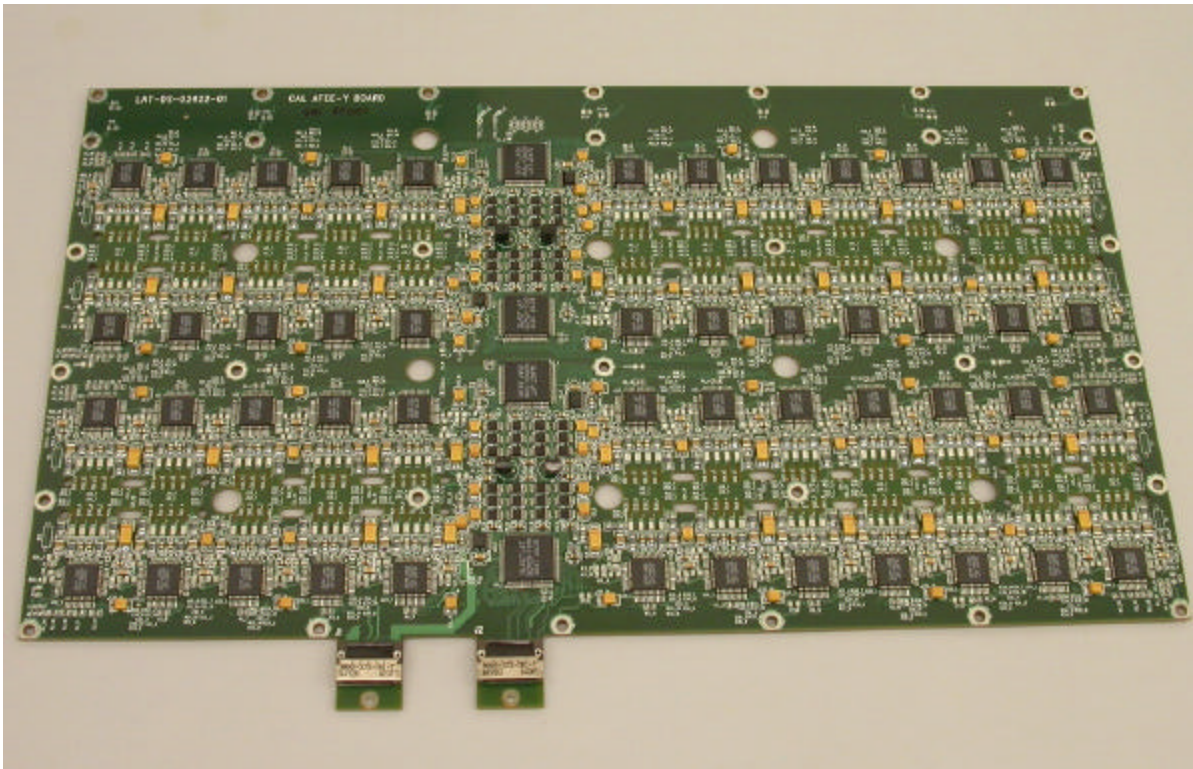


Temperature Forcing Unit. Screening of ASICs requires tests at -30 degC and +85 degC.



ASIC Radiation Test Board. Qualification of ASICs requires test in heavy ion beams for radiation damage or upsets.

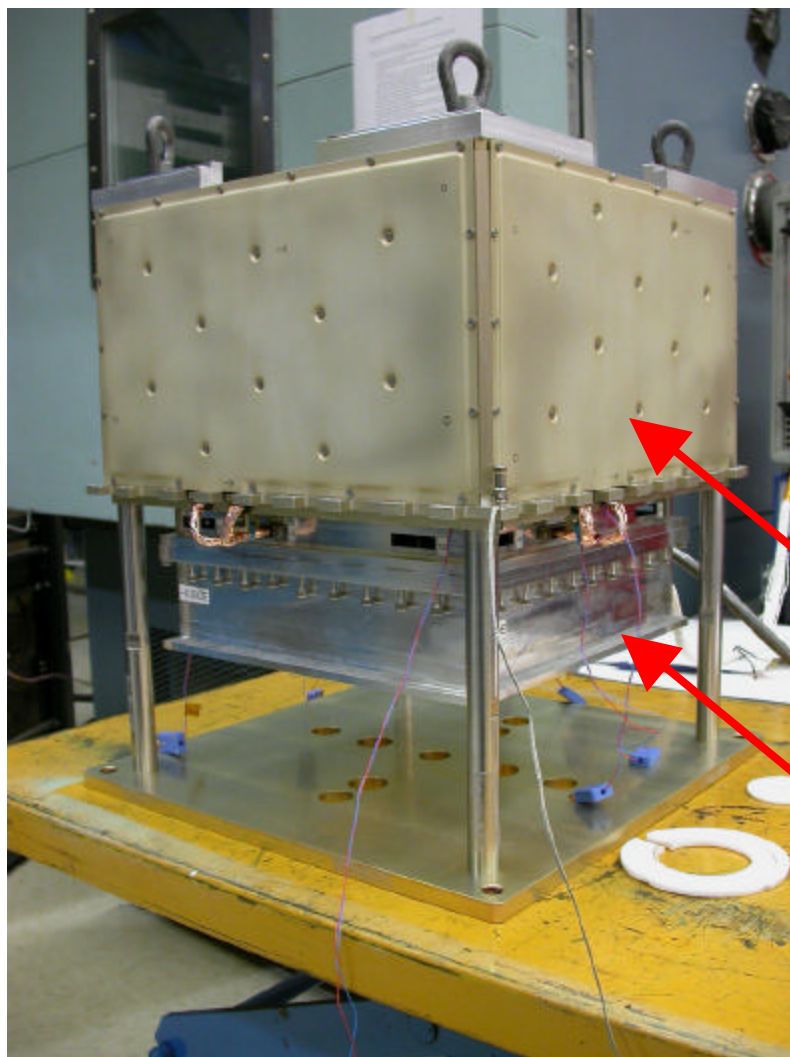




- ❑ 4 boards per CAL module
- ❑ Each board reads out 48 Crystals

Flight production boards are currently in manufacture

Summary



- ❑ Flight production is well underway.
- ❑ From manufacture of a high fidelity engineering model and its test program, the technical issues are well in hand.
- ❑ The big issue is maintaining schedule.

Engineering Model Calorimeter

Engineering Model TEM and Power Supply (SLAC)

