

GLAST Calorimeter

CDE MRR
31 Oct 2003



Gamma-ray Large
Area Space
Telescope



Crystal Detector Element (CDE) Manufacturing Readiness Review 31 Oct 2003

Program Overview and Status

W. Neil Johnson
NRL

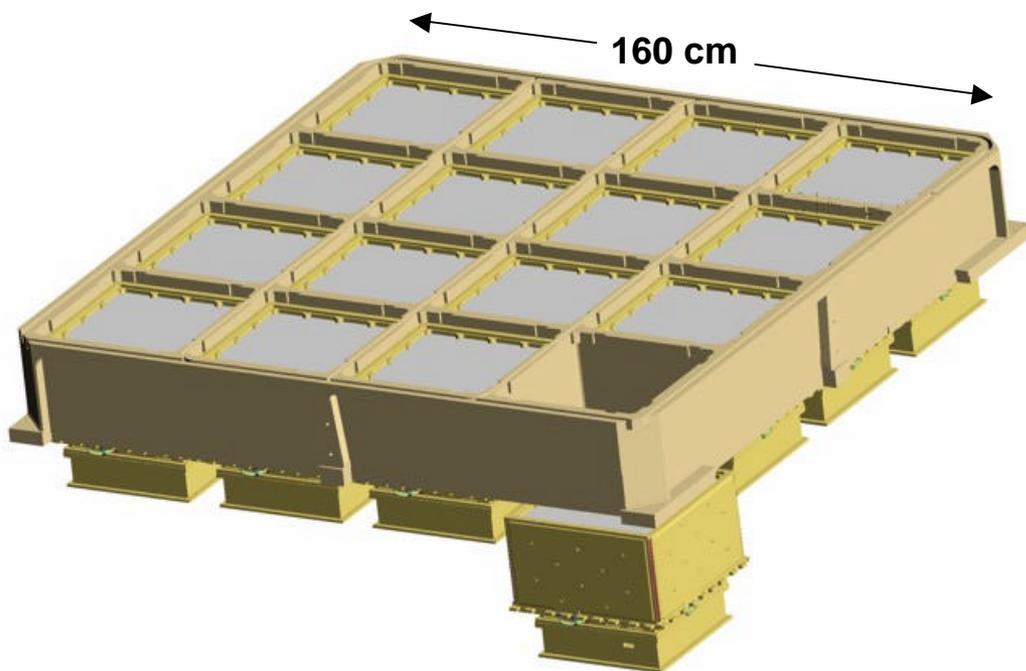


Naval Research Lab
Washington DC

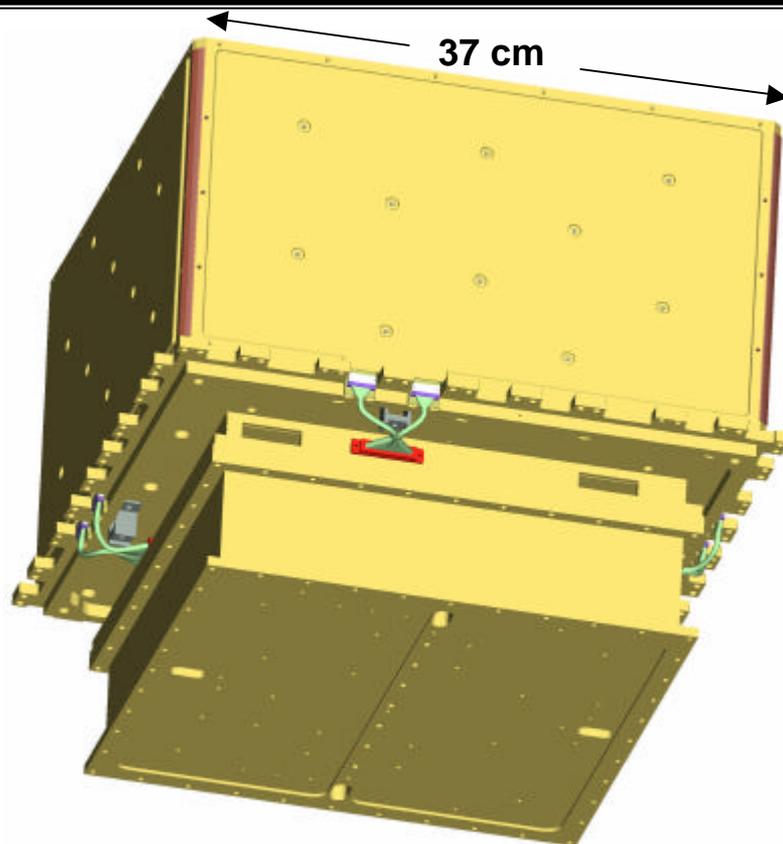


LAT CAL - Modular Design

4 x 4 Array of Calorimeter Modules

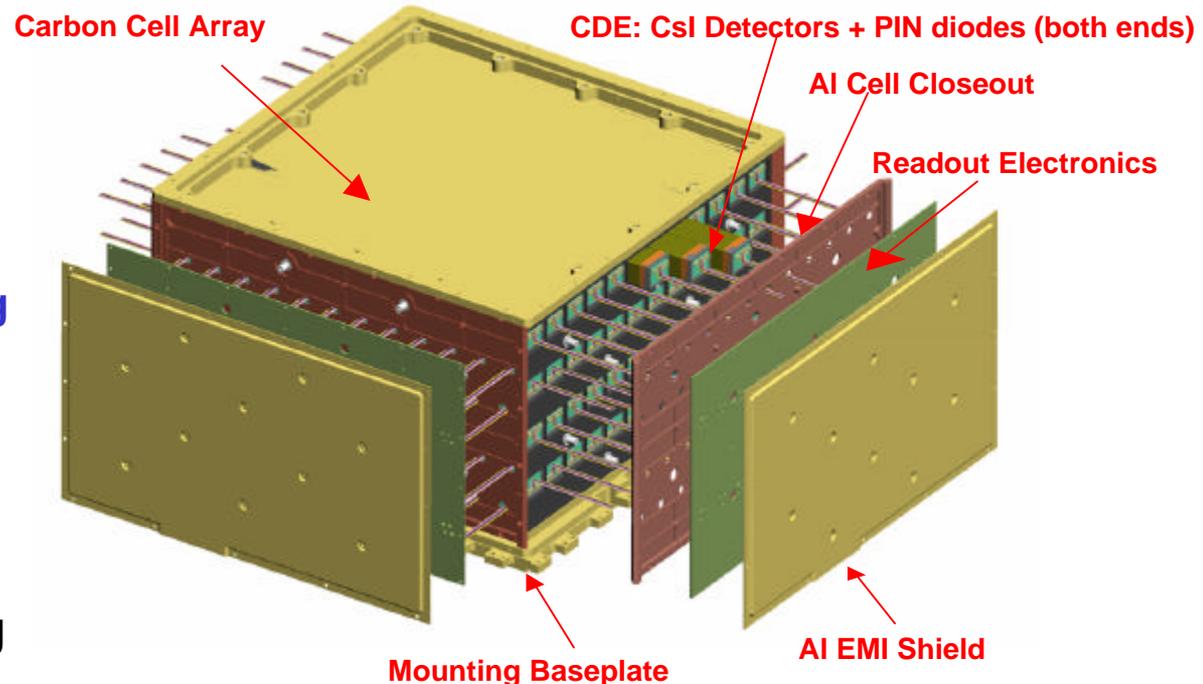


LAT GRID with 16 CAL Modules

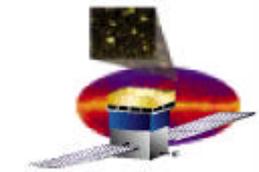


CAL Module with TEM and Power Supply mounted to base plate

- ❑ **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**
- ❑ **Outer wall is EMI shield and provides structural stiffness as well**



Calorimeter Assembly Flow

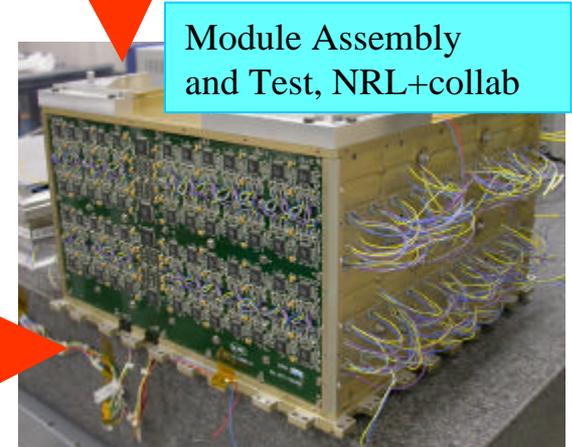
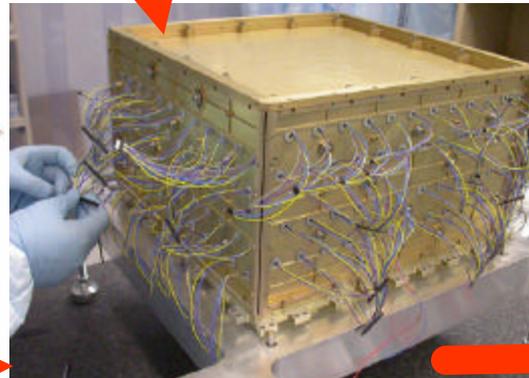
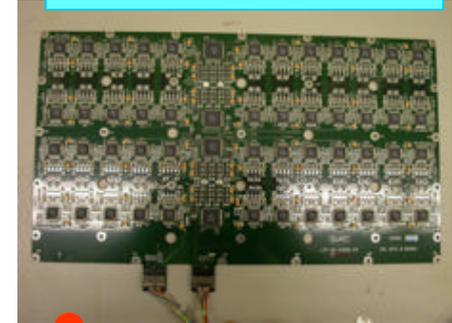
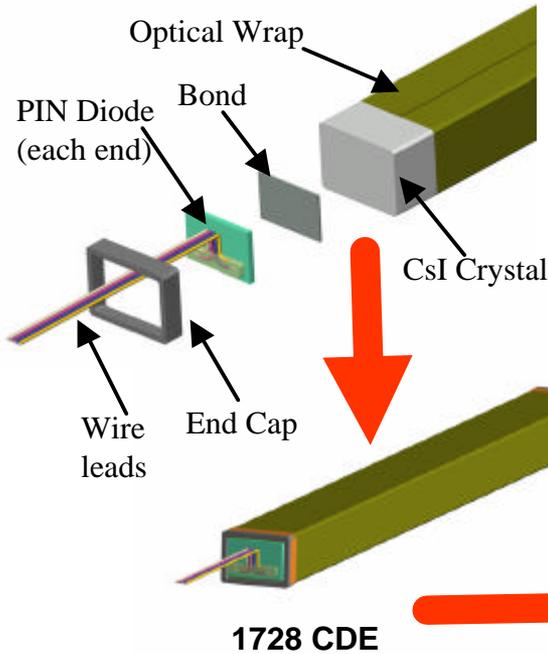
Dual PIN Diodes (DPD) NRL

CsI Crystals Sweden

Crystal Detector Element (CDE) Assembly
NRL / Swales

Mechanical Structure
France (LLR Ecole Polytechnique)

Front-End Electronics
NRL, SLAC



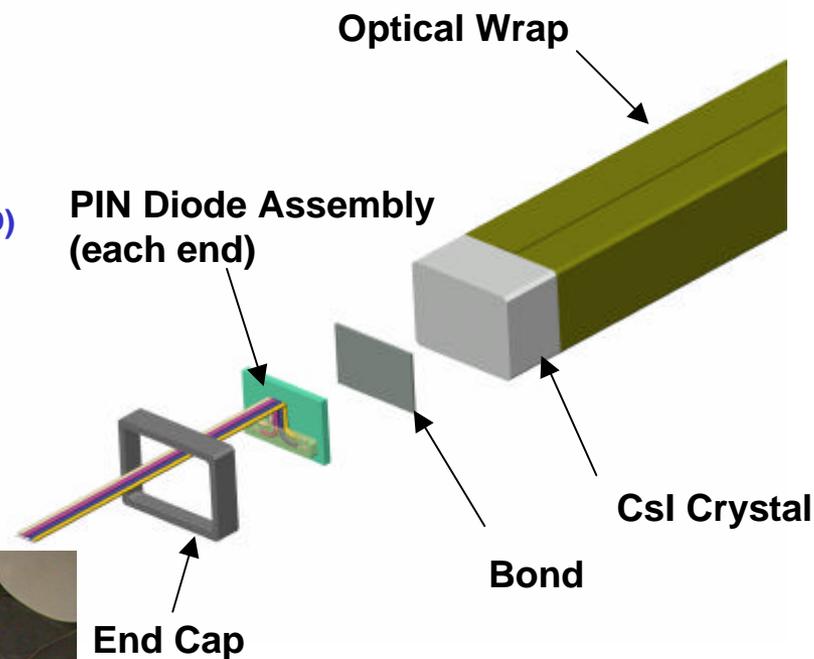
PreElectronics Module (PEM)
Assembly
NRL

Module Assembly
and Test, NRL+collab

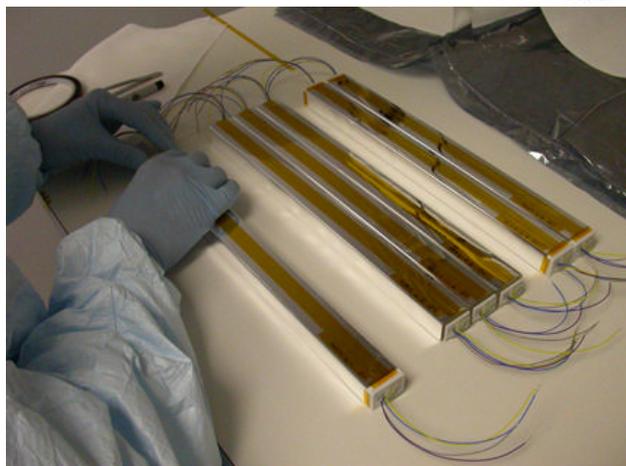
18 Modules
Naval Research Lab
Washington DC

CDE has five components

- ❑ Csl(Tl) crystal
- ❑ Two PhotoDiode Assemblies (PDAs)
 - Hamamatsu S8576-01 Dual PhotoDiode (DPD)
 - Wire leads, soldered and staked
- ❑ Optical Bond
 - Dow Corning 93 - 500
- ❑ Wrapper
 - 3M Visual Mirror VM2000 film
- ❑ Two end caps



EM CDEs during
wrapping and
attachment of end caps

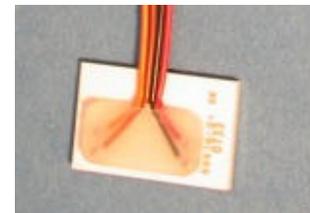


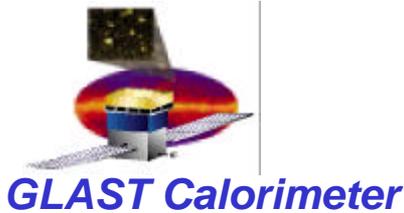
PIN Diode Assembly

PDA has four components

- ❑ Dual PIN Photodiode, Hamamatsu S8576-01
LAT Spec: LAT-DS-00209-12
- ❑ Four electrical interconnect wires,
MIL-W-22759, AWG 28 – 7 strand
- ❑ Staking (Uralane) to protect and strain relieve
electrical interconnects
- ❑ Non-flight test connectors used in acceptance
testing and screening.

Photodiode Assembly w/
test connector and
shorting plug





CDE Components – Status

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- ❑ **Csl Crystal - Spec: LAT-DS-00820-03**
 - Production readiness review: Feb 2003.
 - Readiness summary: LAT-TD-01583-01
 - Procure 1950 crystals, 493 + 48 have been accepted and delivered to NRL.
 - Delivery rate 200/month
- ❑ **PIN Diode Assembly: LAT-SS-01534-03**
 - MRR here and now...
- ❑ **Dual PIN Photodiode – Spec: LAT-DS-00209-13**
 - Production readiness review: 13 Feb 2003
 - Readiness summary: LAT-TD-01484-03
 - Procure 4800 diodes
 - Delivery rate 300 per week.
- ❑ **Optical Wrap – 3M Visual Mirror VM2000 film**
 - LAT-DS-02151-01
 - Approved LAT Material
 - Flight lot in hand
- ❑ **Optical Bond – Dow Corning 93 – 500**
 - Approved LAT Material
- ❑ **End Cap**
 - LAT-DS-01160-02
 - Approved LAT Material



PIN Diode Update

- ❑ Pre-production lot of diodes successfully completed qualification testing at GSFC.
- ❑ However, during production screening Hamamatsu discovered broken wire bonds. Subsequent visual inspection of completed parts (~1000) suggested as many as 7% of parts had suspect wire bonds.
- ❑ HPK recommended rejection of all flight diodes previously received by NRL (~600).
- ❑ Investigations into process problems identified two components
 - Contamination of bond pads caused by de-golding of empty ceramic carriers and inadequate cleaning.
 - High stresses placed on bonds during 175C bake out and re-tinning process of completed units.

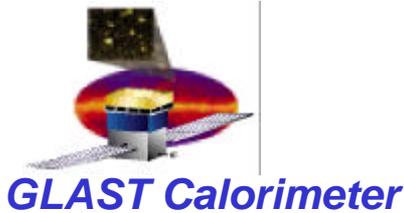
PIN Diode Update (2)

❑ Corrective action

- Do not de-gold empty carriers – no contamination.
- Use double bond (wedge and ball) to give stronger bonds.
- Reduce bake out to 125C.
- Modify tinning process of completed units to use heat shield.

❑ Status

- 100 parts have been fabricated w/ various combinations of the corrective action. 90 parts have completed accelerated thermal cycling - 100 cycles. 10 parts have been examined by NRL/GSFC and used to manufacture PDAs. No problems found.
- Flight production has been authorized, first flight deliveries expected late November

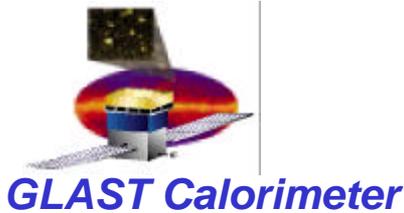


Risk Reduction Activities

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- CDE design and manufacturing processes have been demonstrated in a flight-like CAL engineering model (EM) that successfully completed qual level environmental testing in July.
 - EM CDEs meet or exceed all CAL subsystem requirements.
 - Swales / NRL team developed tooling and processes for the EM CDE.
 - Flight CDE tooling and processes have been improved based on lessons learned in EM fabrication.
- Swales team for flight production builds on experience of EM fab.
 - Required (larger) team includes key members of EM fab team.
 - EM tooling and excess materials were used in process demonstration and training of the staff.
 - To date, flight team has produced >50 test CDE including 12 pre-qualification CDEs with flight tooling and process.
 - 12 pre-qual CDEs are currently in qualification testing. All results to date exceed requirements.





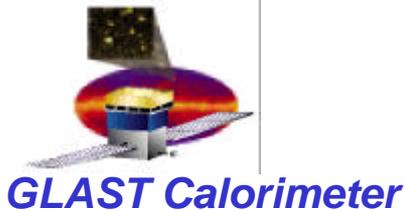
Component Delivery Schedule

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Production schedule produces 60 CDE per week.

- All material is in hand to start production except the PIN photodiodes.
- Availability of diodes will delay start of production until Dec 8th.
- ❑ **CsI crystal deliveries (GFE to Swales)**
 - NRL has 493 accepted crystals in flight stores.
 - Sweden is delivering ~200 crystals per month. Last crystals arrive 4 months before need.
- ❑ **PDA deliveries (GFE to Swales)**
 - Contract for manufacture in place. Prototypes have been manufactured.
 - Final tooling is being replicated to support production rate.
 - Start of manufacturing delayed by PIN diode availability.
 - Delivery rate is 150 – 200 PDA per week.
- ❑ **Optical Wrap – VM2000 (GFE to Swales)**
 - Entire flight lot has been delivered to Swales.
- ❑ **Optical Bond – Dow Corning 93 – 500**
 - Swales procures as needed due to limited shelf life.
- ❑ **End Caps - Ertalyte PETP**
 - Vendor under contract to LLR. 50 samples received. 1000 / 4000 on order.
- ❑ **Acceptance test bench - optical performance (GFE to Swales)**
 - In test at NRL, used for pre-qual CDE testing. Delivery to Swales before flight production.





Calorimeter Organization

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