



# Instrument Design Engineering CAL Engineering Model Program

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# CAL EM Description

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- ❑ **Designed and fabricated to be as accurate a representation of the flight CAL module as possible.**
  - **Full flight form, fit and function.**
  - **Flight quality parts where available**
  - **GCFE ver 7, GCRC ver 4 ASICs**
  
- ❑ **Known deviations from flight modules:**
  - **PIN photodiodes must be modified for flight**
    - **Size reduced by 1 mm in 2 dimensions, electrical connections moved**
    - **Diode optical window epoxy likely will be changed**
  - **EM CDEs manufactured in USA (possibility of as many as 16 from France but current schedule problems for French deliveries)**
  - **Carbon composite structure will use an improved curing process for flight.**
  - **New discussion on major design changes to CAL baseplate.**





# Objectives of the EM Program

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**EM functions as a verification of design decisions and assembly processes as well as a science model used to verify scientific performance, calibration processes and ass'y and test software.**

- Demonstrate feasibility of fabrication, assembly and test processes and identify assembly problems and potentials for improvement.**
- EM provides the first full integration of the AFEE electronics with a PEM. This demonstrates assembly issues and measures performance.**
- EM will verify functional test procedures and EGSE software prior to flight usage**
- EM will test the muon calibration procedures to establish the baseline calibration database. This tests processes and software.**
- EM will undergo full qual level environmental testing at NRL which might uncover design flaws or issues that need to be incorporated in the flight units as well as verify the environmental test procedures and activities before the flight "production line" begins.**
- EM will be taken to electron and heavy ion accelerators for calibration and characterization at energies and with accuracies that will not be possible with the flight units.**
- EM will be delivered to SLAC for software testing and development.**
- EM will be returned to the CAL team for extended calibrations and investigations in other accelerator beams.**





# EM Test Program – Identical to Flt Qual Unit

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- Comprehensive Functional**
- Cosmic Muon Calibration**
- Mass Properties**
- EMI/EMC**
- Vibration**
  - **Shock**
  - **Random**
- Thermal Vacuum (12 Cycles)**
- Comprehensive Functional**
- SLAC I&T, FSW Tests**
- Heavy Ion Beam Test (GSI)**



# EM Schedule

Task	Duration	Start	Finish
<b>PreElectronics Module</b>			
USA CDE Manufacturing	30	10/02/02	11/18/02
French CDE Complete			2/13/03
CDE – Structure Insertion	20	10/28/02	11/22/02
PEM Closeout	3	10/25/02	11/27/02
Muon Calibrations	7	11/28/02	12/06/02
<b>AFEE</b>			
GCFE8 & GCRC4 Packaging			10/24/02
ASIC Screening	15	10/25/02	11/14/02
Fab and Test preEM Y-AFEE Board	10	10/14/02	11/01/02
Layout EM X-AFEE Board	5	10/14/02	10/18/02
Layout EM Y-AFEE Board	5	10/21/02	10/25/02
Fab EM AFEE Boards	5	10/28/02	11/01/02
Assemble AFEE Boards	10	11/15/02	11/29/02
AFEE Functional Tests	10	11/29/02	12/12/02
AFEE Environmental Tests	10	12/13/02	12/26/02



# EM Schedule (2)

Task	Duration	Start	Finish
<b>Module Assembly and Test</b>			
PEM – AFEE Integration	15	12/27/02	1/16/03
TEM Integration	5	1/20/03	1/24/03
Comprehensive Func & Calib	16	1/27/03	2/14/03
EMI/EMC & Vibration	12	2/17/03	3/04/03
Thermal Vac (12 cycles)	31	3/05/03	4/03/03
<b>LAT I&amp;T</b>			
Ship to SLAC	5	4/04/03	4/10/03
LAT I&T Testing	40	4/11/03	6/05/03
Ship to GSI (Heavy Ion Beam)	10	6/06/03	6/19/03
GSI Beam Test	20	6/20/03	7/17/03
Ship to NRL – CAL Assy & Test		7/18/03	

