CAL Team Meeting
Progress, Status, Schedules
Engineering Model Program

Oct 21, 2002

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Naval Research Lab
Washington DC

Agenda

9:00	LAT and CAL Status	Status, schedule, milestones	Johnson
9:30	CsI Crystals	Status and flight delivery /procurement status	Carlson, Nilsson
10:00	CsI Crystals	Radiation testing and results	Bergenius
10:15	Break		
10:30	Dual PIN Diode	Studies, problems, solutions	Johnson, Bédérède, Virmani
11:00	CDE Bonding – France	Status, Plans, Results	Bédérède
11:30	EM CDE Bonding	NRL/Swales process development, status and results	Grove
12:00	Lunch		
13:00	Mechanical Structure	Status and Issues	Dizon, Bogaert, Ferreira
13:30	EM2	Concept, objectives, plans	All
14:00	Electronics	Status and issues	Ampe
14:30	Beam Tests	Cern ’02 results and GSI ’03 plans	Lott
15:00	Break		
15:15	CAL Software	Simulations, reconstruction, EGSE	Chekhtman, Strickman
15:45	Open Discussion		All

LAT Status

- **LAT Instrument PDR/Baseline Review** — **01/07/02**
  - Four subsystems failed to be baselined (CAL, ACD, Mech, I&T)
  - All but Mech passed PDR
- **LAT Internal Review (SLAC)** — **04/16/02**
  - Preparation for delta Baseline
- **LAT DOE Delta Baseline Review** — **07/30/02**
  - Success
  - Schedule extension approved – 6 months added to fabrication phase.
  - Commissioning phase defined – delivery of LAT to NASA (10/05) (Financial meaning – DOE costs from operational funds)
- **LAT Instrument Project Office Reorganization** — **09/03/02**
  - Phase out of Instrument Design Team
  - Establish Design Engineering Team under new Chief Engineer, Lowell Klaisner
  - New Systems Engineer, Dick Horn

Delta DOE/NASA Baseline/PDR Review
CAL Recommendations Status

- **Baseline the cost, schedule and technical design of the calorimeter system.**
  - **Costs have been revised to cover overrun in CDE manufacturing**
  - **Costs need to be increased to cover additional scope of electronics efforts and directed changes in EM and QUAL environmental testing.**
- **Continue to work with Saclay to finalize the MoA and optimize the schedule in coordination with the French partners.**
  - **MoA is waiting on signing of the Letter of Agreement between NASA and CNES.**
  - **LoA is not signed because CNES and CEA are still negotiating financial arrangements.**
- **NRL and Saclay should continue to work closely on procedures for CDE assembly allowing Saclay to contribute completed CDEs to the engineering model.**
  - **NRL/Swales bonding procedure and tooling has been given to Saclay.**
  - **Tooling concepts and processes are similar.**
  - **Current Saclay schedule does not meet the needs of EM assembly without significant schedule slip.**

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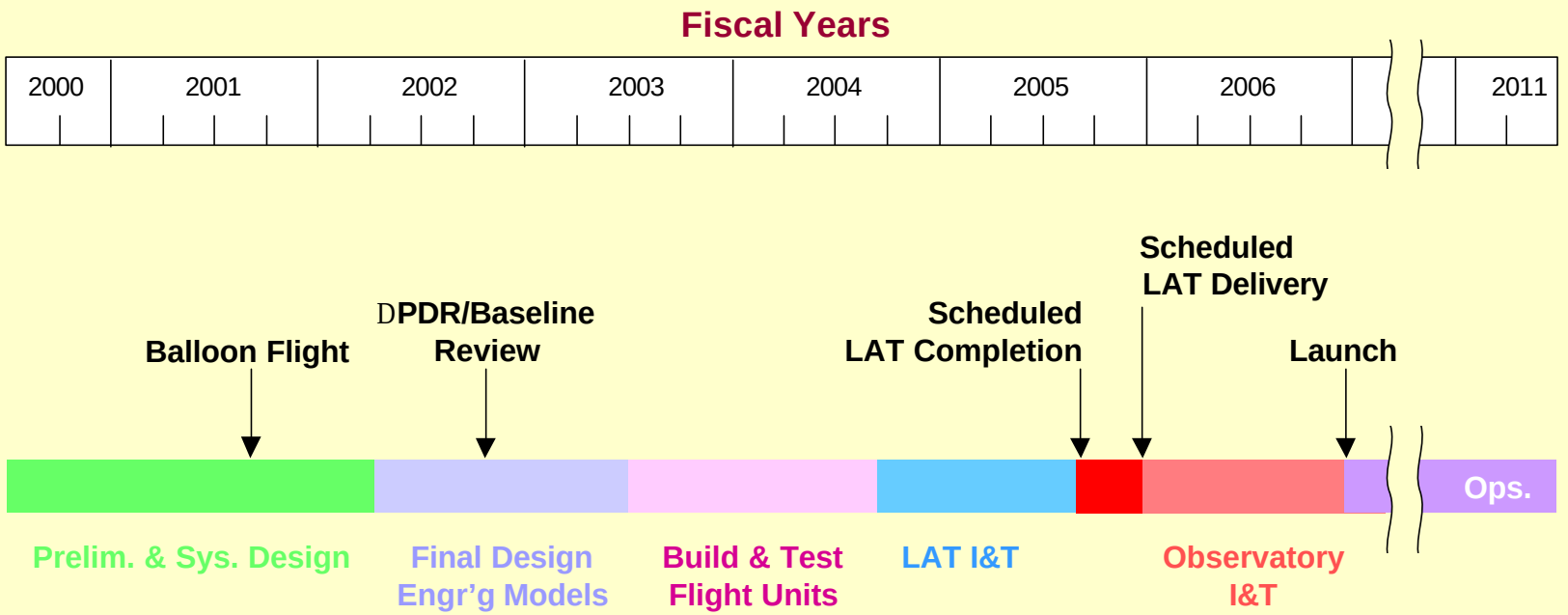
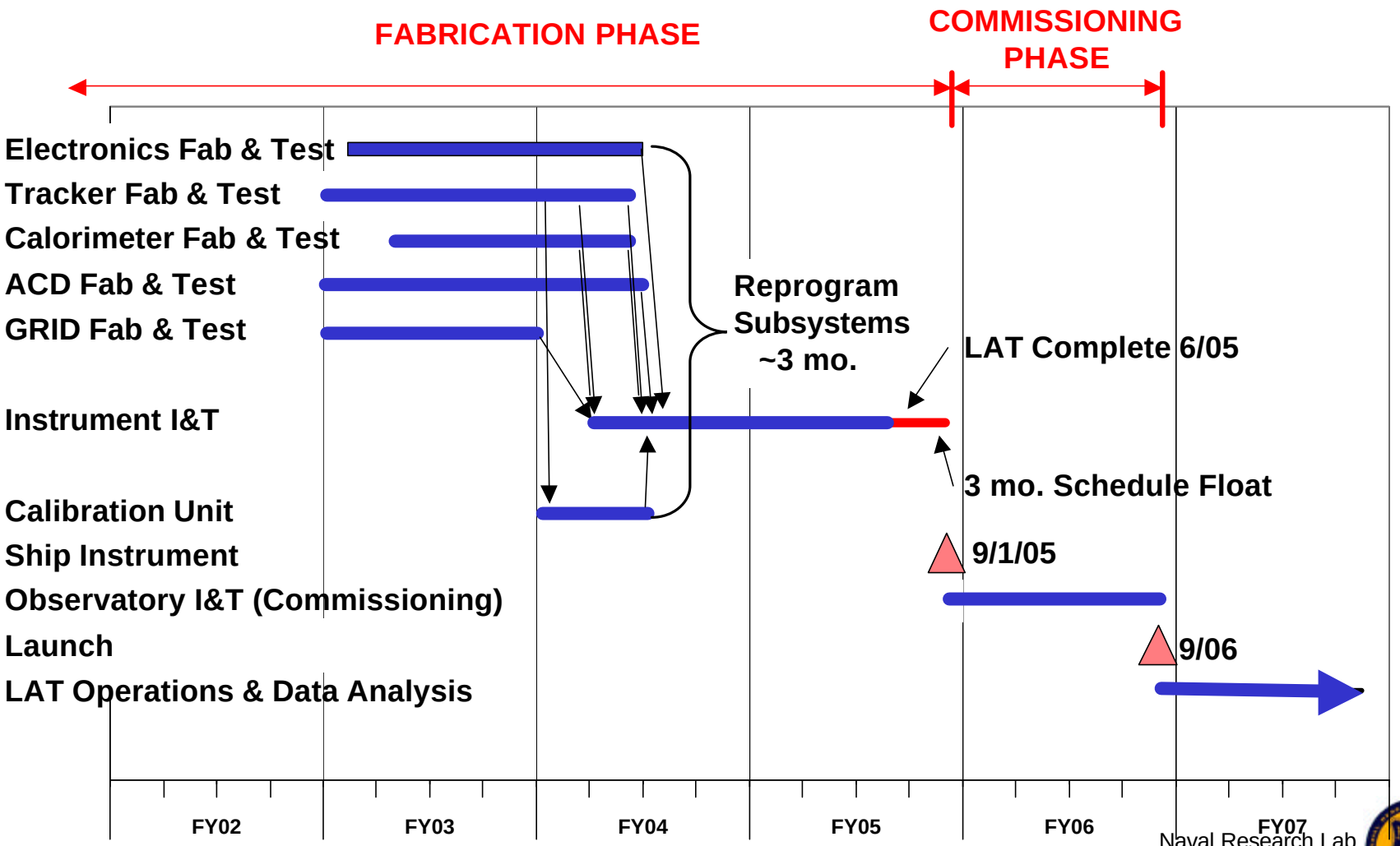
LAT Schedule Highlights



GLAST scheduled for launch in September 2006

Schedule Changes

- 6 month extension of LAT Fabrication Phase



Schedule Milestones

❑ 1st CDEs from NRL	08/12/02
❑ 1st CDE deliveries for EM from France	02/13/03
❑ Engineering Model (EM) assembly complete	01/16/03
❑ EM Test complete	04/10/03
❑ LAT Instrument CDR	04/30/03
❑ Qual Modules A & B Ready for Integration (calibration unit)	02/15/04
❑ Flight Modules 1 & 2 Ready for Integration (calibration unit)	04/01/04
❑ Flight Modules 3 – 16 Ready for Integration	05/04 – 09/04

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Summary of LAT Funding

	Funding ($M)			
	DOE	NASA	contributed*	Total
Fabrication Phase	37	83	39	160
Commissioning Phase	6	7	2	15
Operations and Data Analysis Phase (5 yrs)	35	33	n/a	68

*includes foreign contributed costs using European accounting conventions (excludes most in-house labor costs), domestic non-federal contributions, and SLAC science staff

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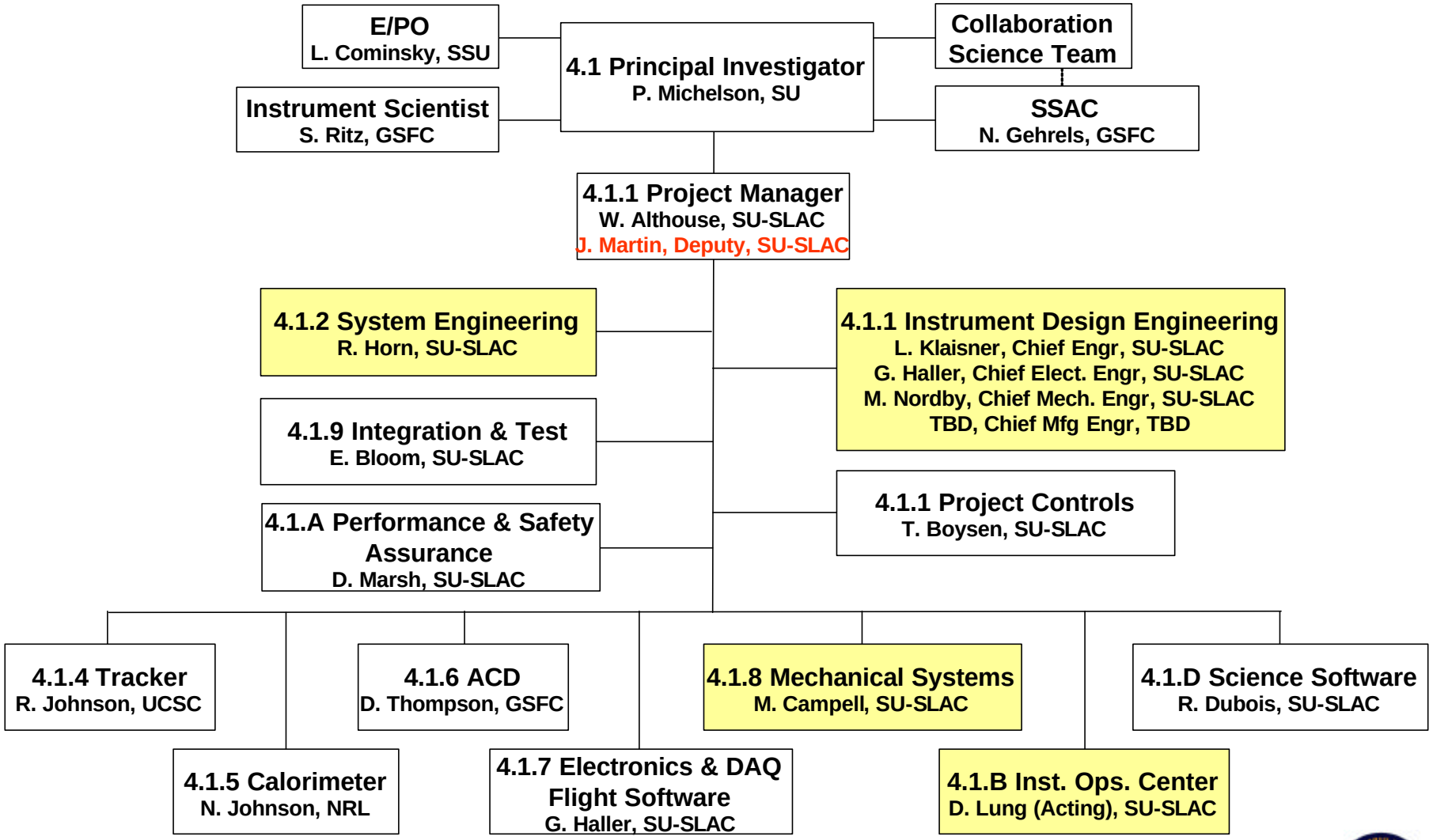
GLAST LAT Organization



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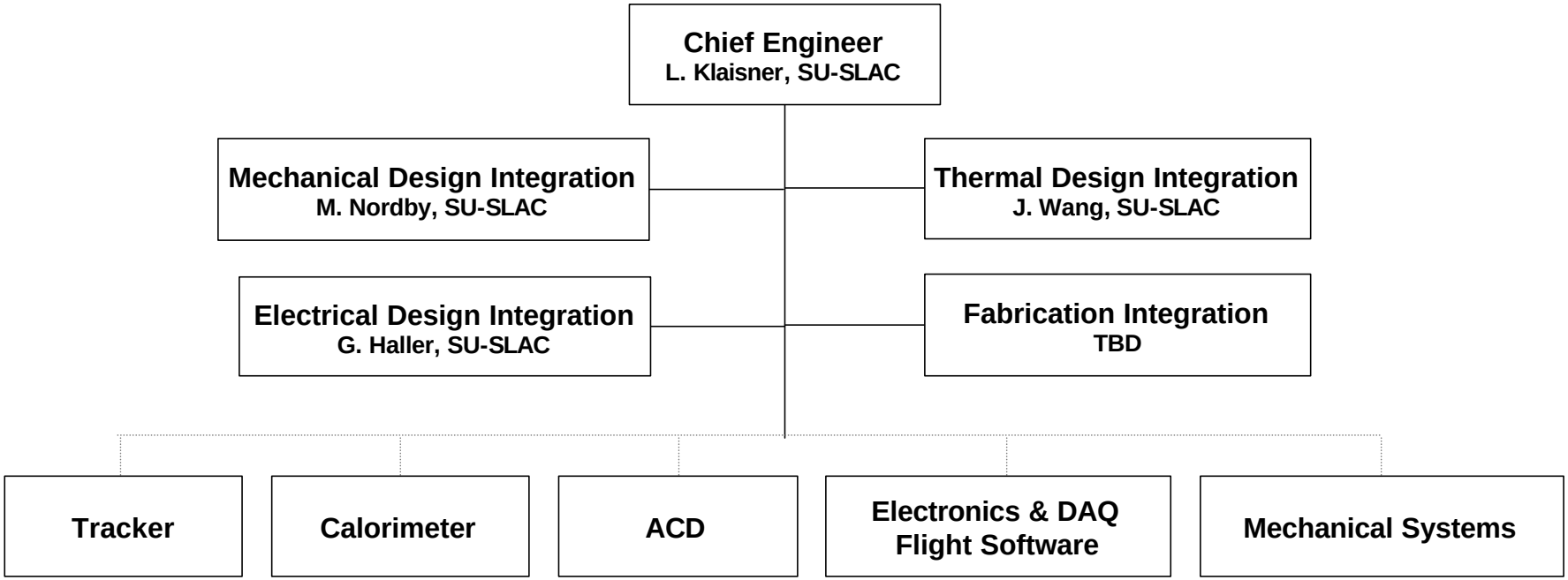
LAT Instrument Design Engineering



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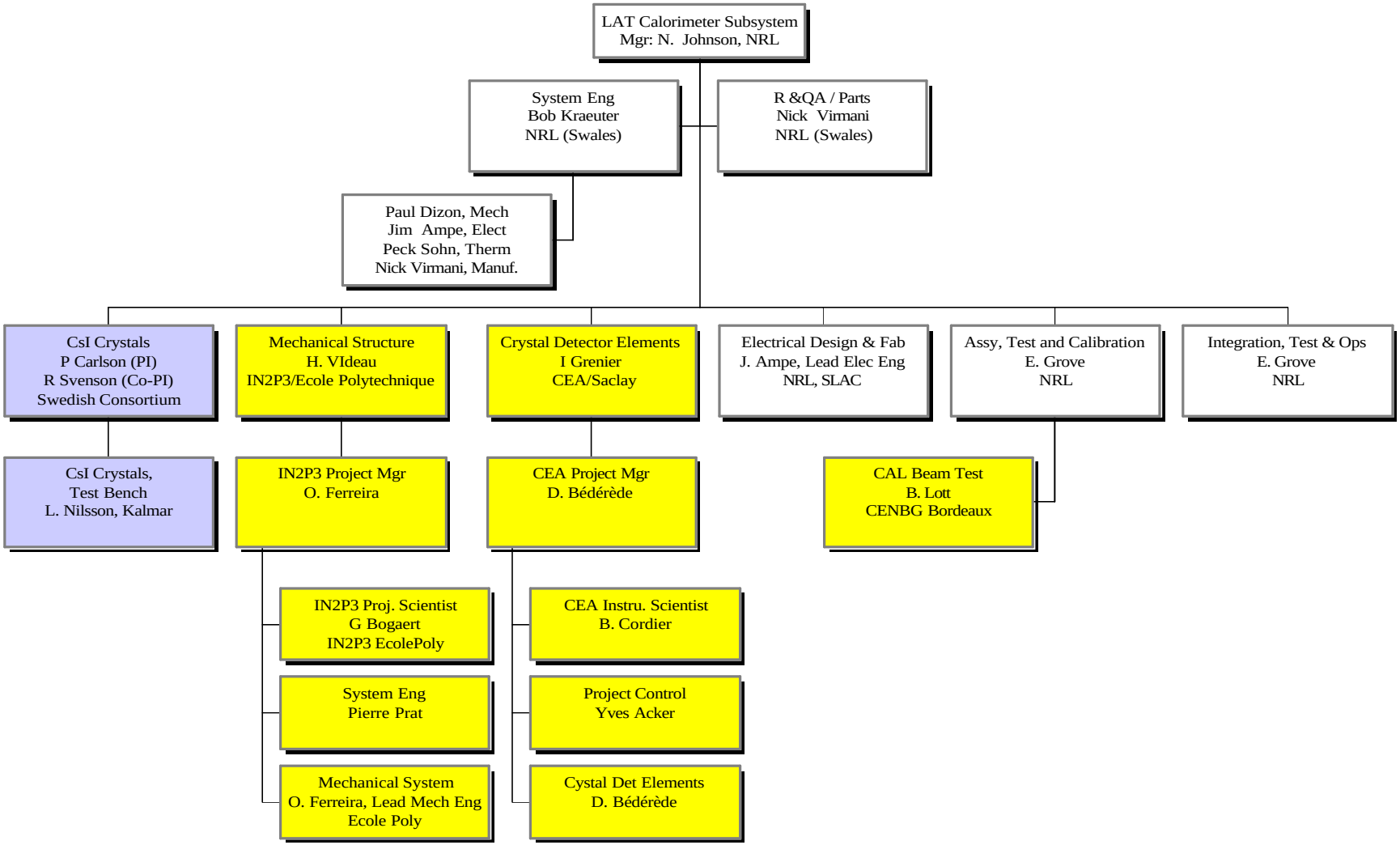
Calorimeter – Institutional Organization



CAL Engineering Model Issues and Planning

CAL EM Description

- **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.**

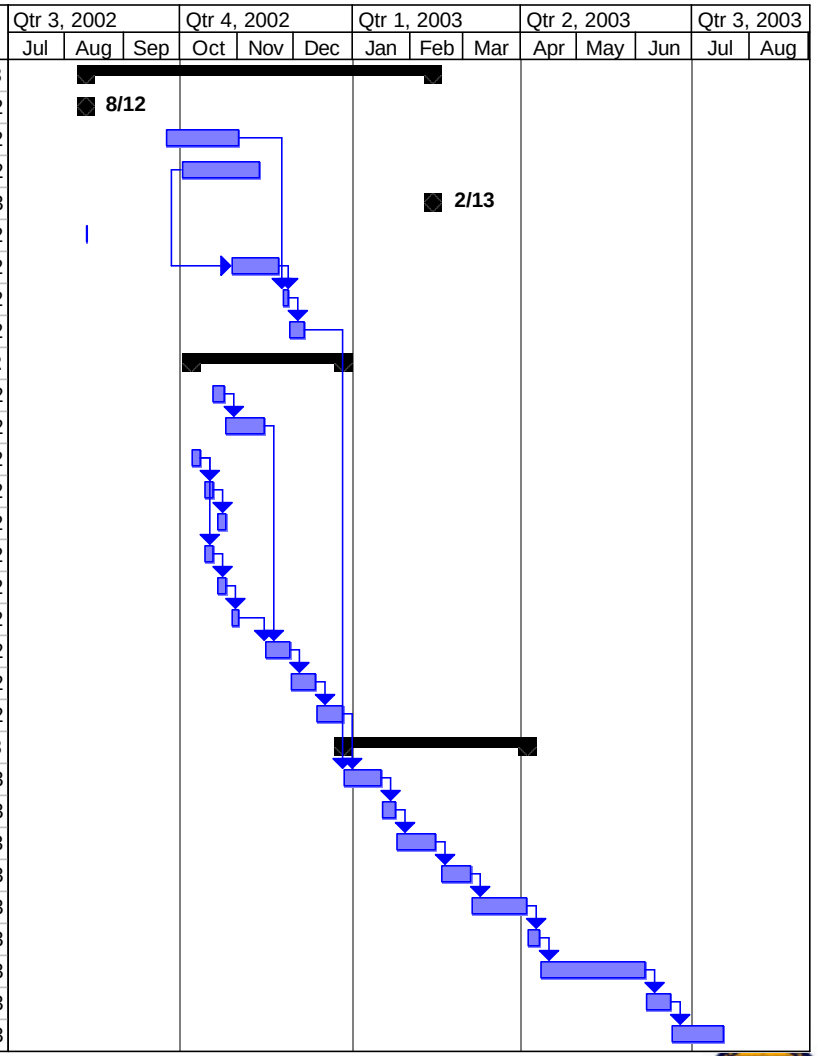
Objectives of the EM Program

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.

- **EM will 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.**

CAL EM Assembly & Test

ID	Task Name	Duration	Start	Finish
1	**Pre Electronics Module**	**133 days?**	**Mon 8/12/02**	**Thu 2/13/03**
2	Carbon Composite Structure and frame	0 days	Mon 8/12/02	Mon 8/12/02
3	Closeout Plates & Bumpers	6 wks	Mon 9/23/02	Fri 11/1/02
4	USA Bonding CDEs	6 wks	Wed 10/2/02	Tue 11/12/02
5	French CDEs Avail	0 days	Thu 2/13/03	Thu 2/13/03
6	PEM Assembly	1 day?	Mon 8/12/02	Mon 8/12/02
7	CDE Insertions	20 days	Mon 10/28/02	Fri 11/22/02
8	Closeout	3 days	Mon 11/25/02	Wed 11/27/02
9	Muon Calibration	7 days	Thu 11/28/02	Fri 12/6/02
10	**Analog Front End Electronics**	**59 days**	**Mon 10/7/02**	**Thu 12/26/02**
11	Package GCFE8 & GCRC4	5 days	Fri 10/18/02	Thu 10/24/02
12	Screen GCFE8 & GCRC4	3 wks	Fri 10/25/02	Thu 11/14/02
13	Layout preEM Y-Board	1 wk	Mon 10/7/02	Fri 10/11/02
14	Fab preEM Y-Board	5 days	Mon 10/14/02	Fri 10/18/02
15	Test preEM Y-Board	5 days	Mon 10/21/02	Fri 10/25/02
16	Layout EM X-Board	5 days	Mon 10/14/02	Fri 10/18/02
17	Layout EM Y- Board	5 days	Mon 10/21/02	Fri 10/25/02
18	Fab EM Circuit Boards	5 days	Mon 10/28/02	Fri 11/1/02
19	Assemble EM AFEE	10 days	Fri 11/15/02	Thu 11/28/02
20	PCB Functional tests	10 days	Fri 11/29/02	Thu 12/12/02
21	PCB Environmental tests	10 days	Fri 12/13/02	Thu 12/26/02
22	**Assembly and Test**	**70 days**	**Fri 12/27/02**	**Thu 4/3/03**
23	PEM - AFEE Integration	15 days	Fri 12/27/02	Thu 1/16/03
24	TEM Integration	5 days	Fri 1/17/03	Thu 1/23/03
25	Comprehensive Functional & Calib	16 days	Fri 1/24/03	Fri 2/14/03
26	EMI/EMC & Vibration Testing	12 days	Mon 2/17/03	Tue 3/4/03
27	Thermal Vacuum Testing	30 days	Wed 3/5/03	Thu 4/3/03
28	Ship to SLAC	5 days	Fri 4/4/03	Thu 4/10/03
29	At SLAC for I&T	40 days	Fri 4/11/03	Thu 6/5/03
30	Ship to GSI	10 days	Fri 6/6/03	Thu 6/19/03
31	GSI (Heavy Ion) Beam Test	20 days	Fri 6/20/03	Thu 7/17/03



EM Test Program – Identical to Flight Qual Unit

- 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)

Issues and Concerns

- **Dual PIN photodiode qualification problems**
  - Current DPD design w/ hard epoxy optical window fails to survive qualification thermal cycling.
  - Investigating alternate optical window materials
  - Procurement for flight diodes needs to be initiated in November
- **CEA/Saclay contribution of CDE to EM Assembly**
  - EM should validate CDE manufactured by CEA, the flight CDE provider
- **SLAC mechanical systems engineers have proposed significant changes in the stiffness of the CAL base plate and its attachment to the LAT GRID.**
  - Concern for stress buildup near S/C attach points to the GRID.
  - These changes may invalidate all the analyses of the CAL structure and any test results of the EM. EM can not be changed to reflect these changes without significant schedule slip.
- **Preparation for CDR**
  - A large number of plans, specifications, drawings, and procedures must be completed and approved before CDR. CDR is scheduled for 30 Apr 2003 – about 6 months from now.