
USA SCT Barrel Module Assembly

SCT Week Uppsala

June 2003

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UC Santa Cruz - SCIPP

Scope and Deliverables

- USA Barrel Cluster is LBNL and UC Santa Cruz
- Basic deliverable were 670 working modules. This has been revised to 483 by agreement in order to meet the schedule.
- USA schedule determined by construction rate locally and by component delivery rate from other institutes.
- Hybrids
 - Assemble and test hybrids for original US module count (~670) from components (ABCD3T chips, bare hybrid substrates) received from other institutions. Deliver 190 to Japan.
- Modules
 - Assemble and test 483 SCT barrel modules from components (silicon detectors, baseboard assemblies, test boxes) received from other institutions or assembled locally (hybrids).

Institutional Responsibilities and Resources

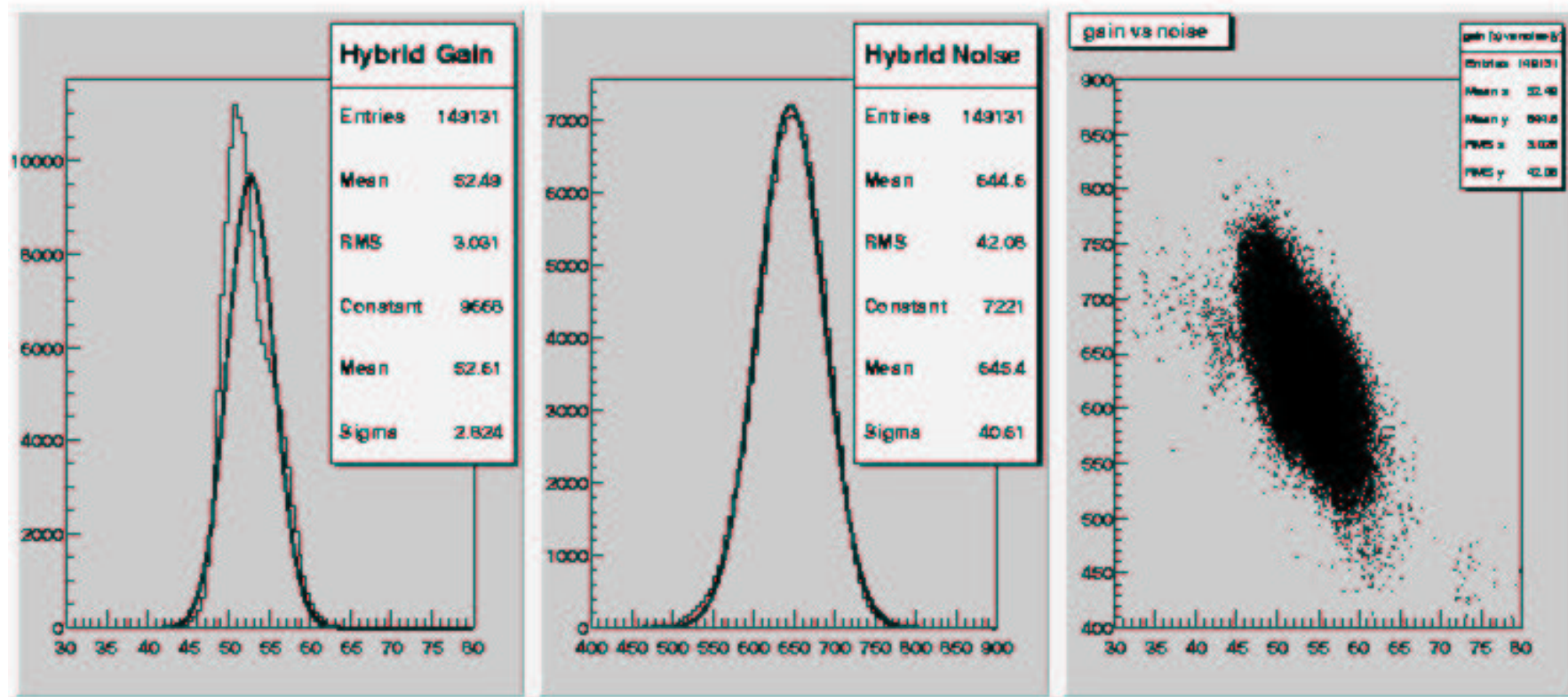
- Task assignments
 - Hybrid assembly and bond: UC Santa Cruz, LBL (ending)
 - Hybrid bonding and rework: UC Santa Cruz
 - Hybrid test: UC Santa Cruz, LBL (ending)
 - Module assembly and bond: LBL
 - Module test: LBL
 - Module rework and test: UC Santa Cruz

TASK	PHYSICISTS	TECHNICIANS	STUDENTS
HYBRIDS			
ASSEMBLY	0.5	2	0
TEST	1	1	0
MODULES			
ASSEMBLY	2.5	5	1.5
TEST	1.5		2.5

Technical Status

- Production started 9/02
- Qualification milestone passed 4/03
- Technical staff trained for production are in place, some cross training to spread expertise still underway
- Second metrology system and wire-bonder recently installed (overlap with pixels)
- Regularly building modules inside all specs
- Still experiencing occasional problems which require halts and modifications to tools or procedures (learning curve)
- Goal is to reach 2 completed modules/day by 8/03
- Current average 1.5/ starts day but have done 2
- Full 483 deliverable complete by 6/04

Hybrids Performance



Hybrids Production

- Required rate is 15 hybrid/week. Technically has gone well however receipt of hybrids has been slow due to production problems. Rate has been ~15 month but recent acceleration evident.
- 84 completed since 1/03 – determined by deliveries.

Hybrid Starts per Week

- Strongly coupled to deliveries
- Note improvement since March 03

week	starts
6-Jan	2
13-Jan	3
20-Jan	5
27-Jan	1
3-Feb	12
10-Feb	0
17-Feb	0
24-Feb	2
3-Mar	0
10-Mar	0
17-Mar	0
24-Mar	5
31-Mar	7
7-Apr	5
14-Apr	4
21-Apr	6
28-Apr	11
5-May	12
12-May	3
19-May	25
26-May	2
2-Jun	8

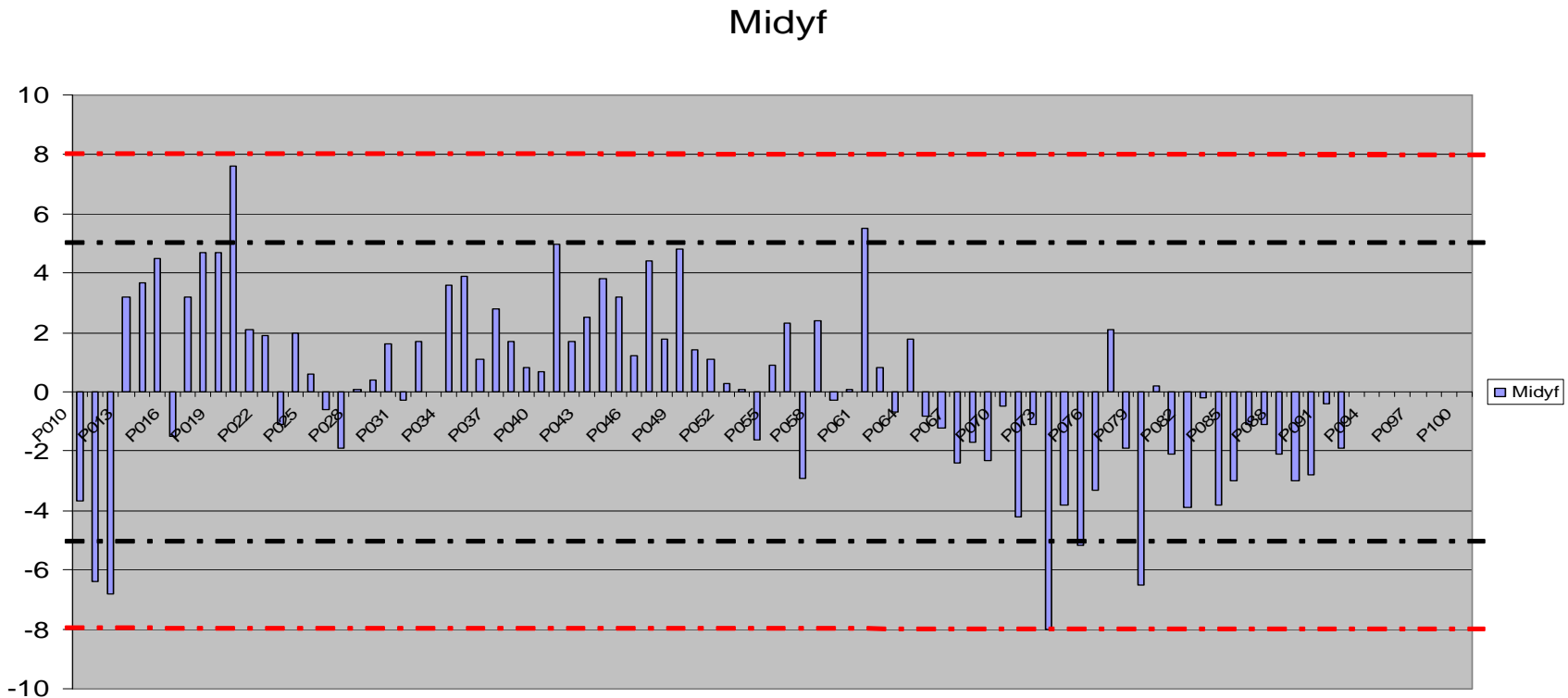
Hybrid Production at UCSC

- 40** **Made.**
- 26** **Passed Burn-in.**
- 12** **Shipped to LBL for module mounting.**
- 14** **Waiting to be shipped.**

Module Assembly and Test

- What have been the key technical issues?
 - Metrology: meeting tightest specs on front to back alignment (“midyf”) and stereo angle
 - Wire-bonding: lost channels and re-bonding
 - Glue pattern: had to adapt to provide sufficient support during bonding, alignment became a critical issue
 - Leakage currents: with strict re-bonding protocols always achieve ~“sum of the 4 crystals”
 - Bad channel counts: spec 15/module, result approaches 0
 - Hybrid attachment: height parameter, facing b angle, fixture evolution

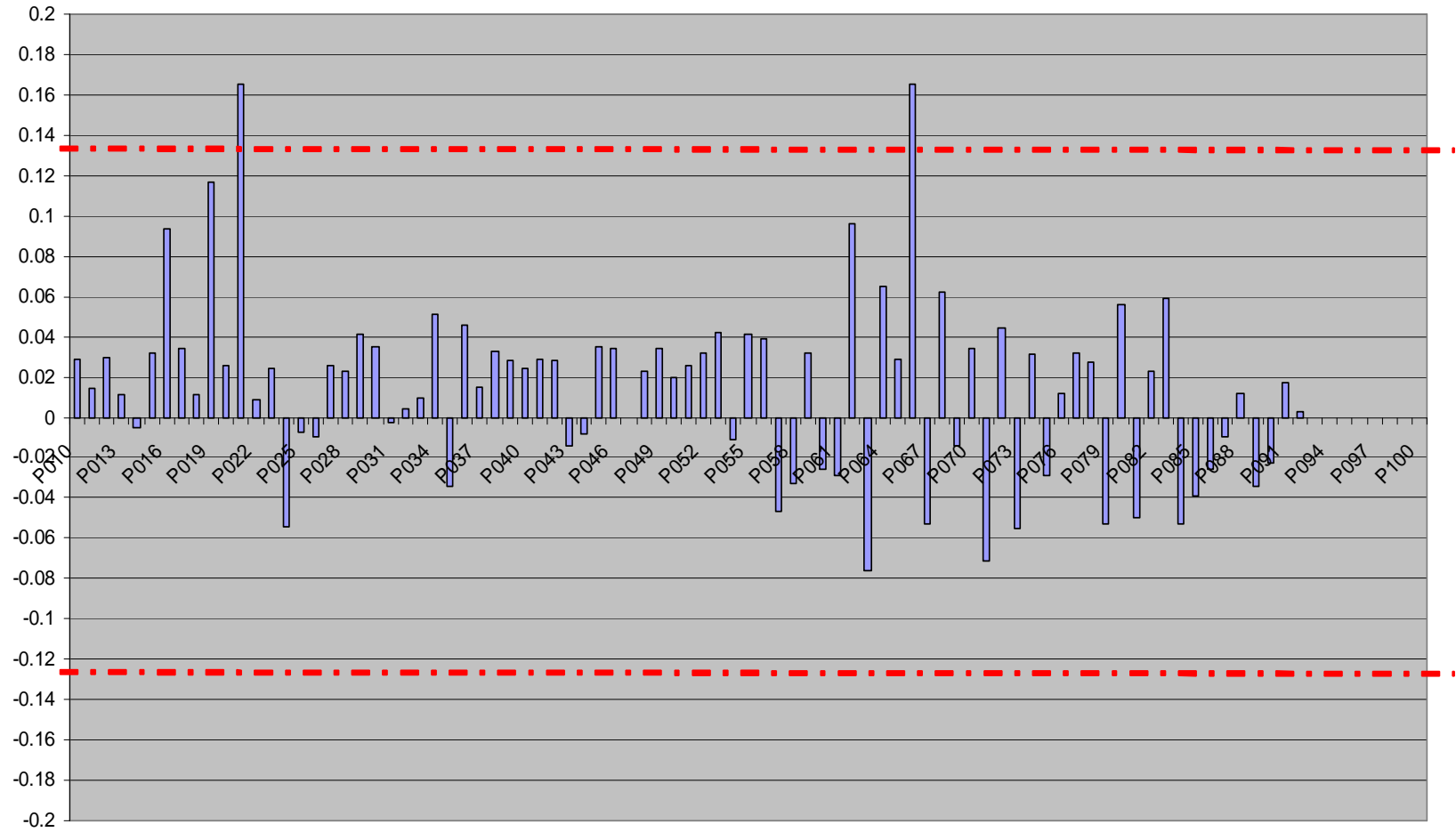
Metrology: Midyf history



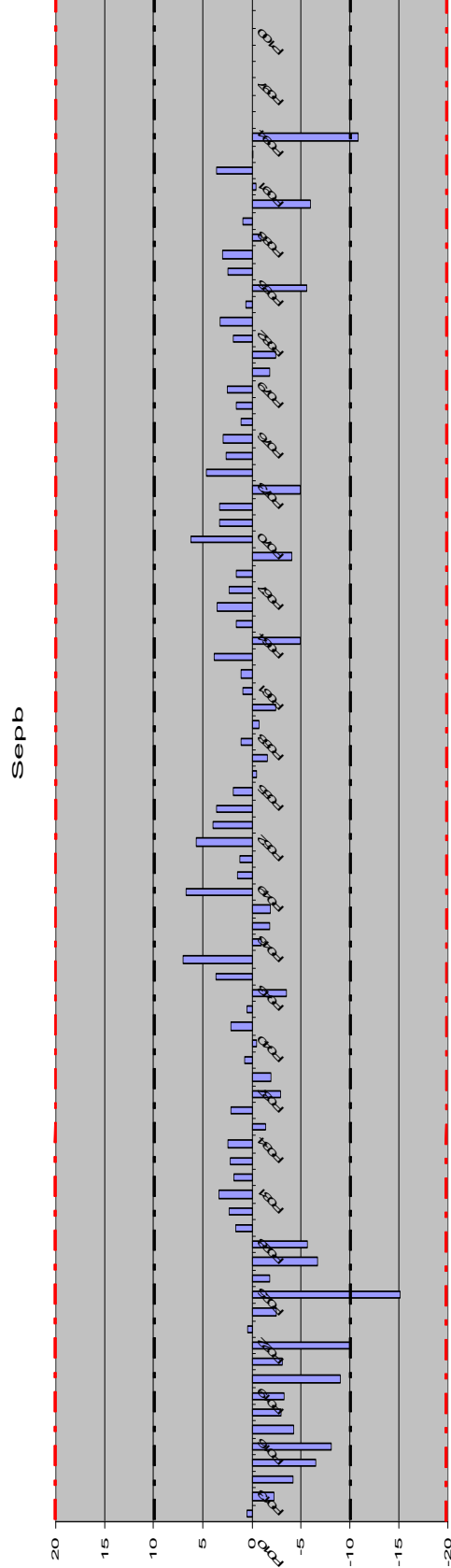
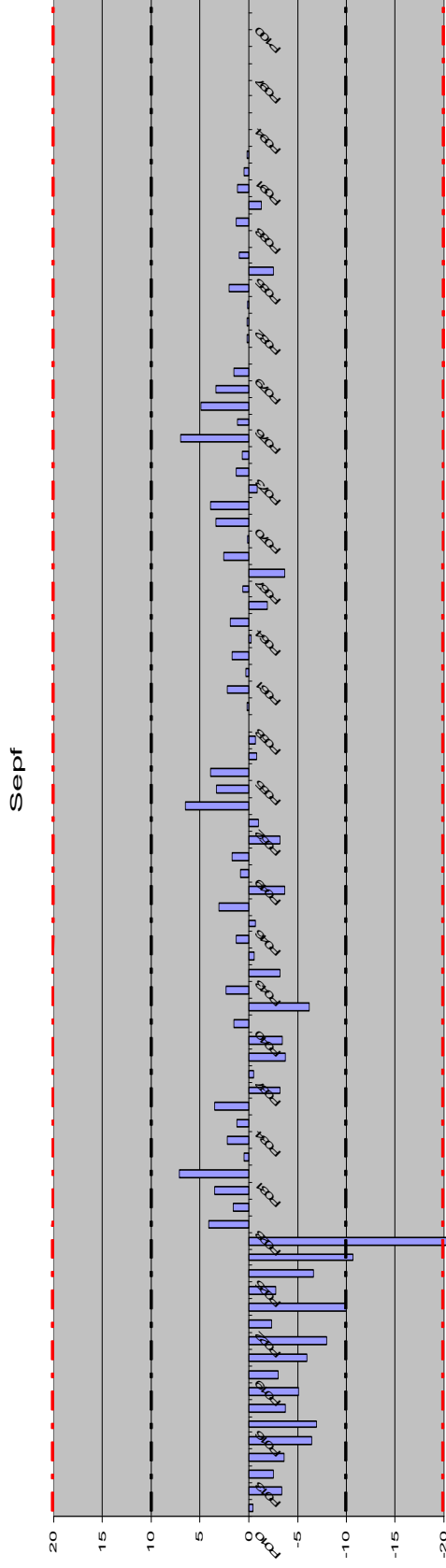
- Spec on midyf is 5 μm
- Secondary category for use on outer barrel 7.5 μm
- Plot shows history since 11/02

Stereo Angle (130 mrad)

Stereo

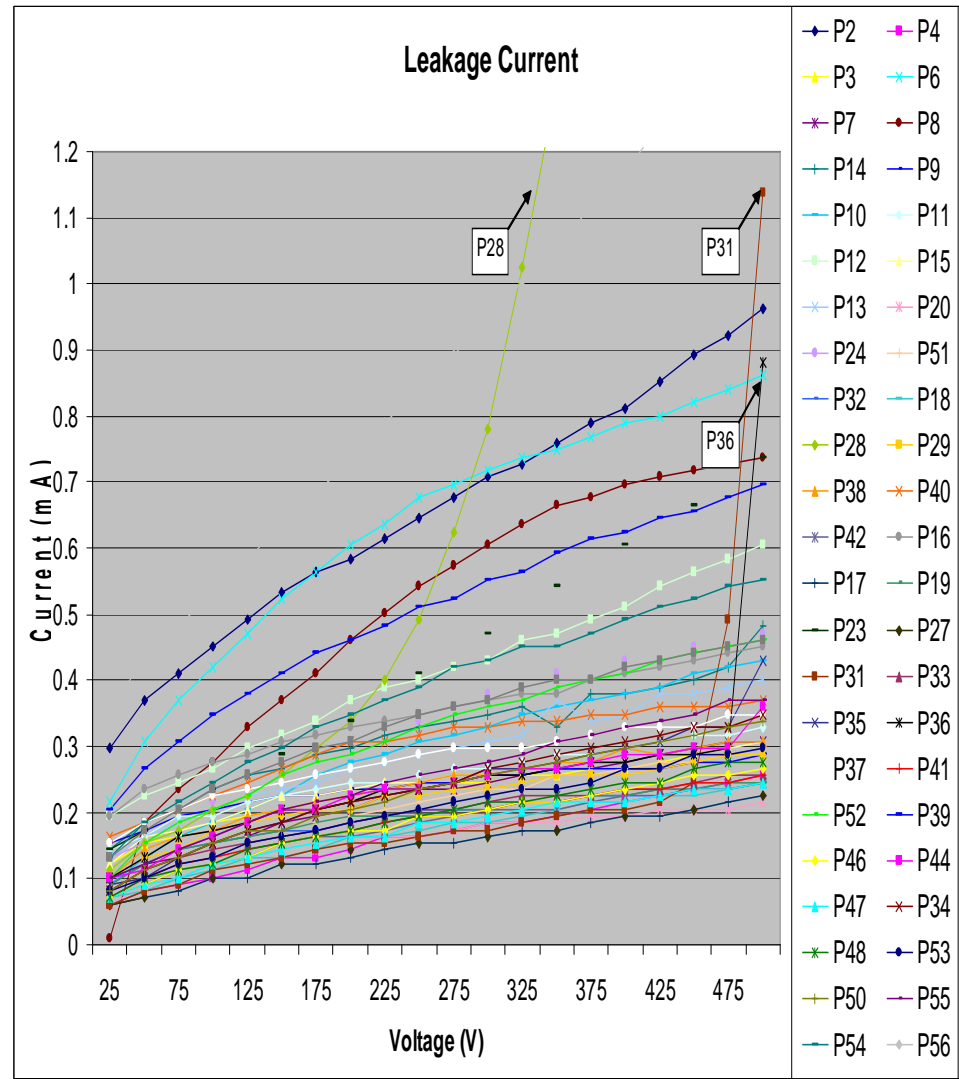


Sepf and Sepb (10 μm)

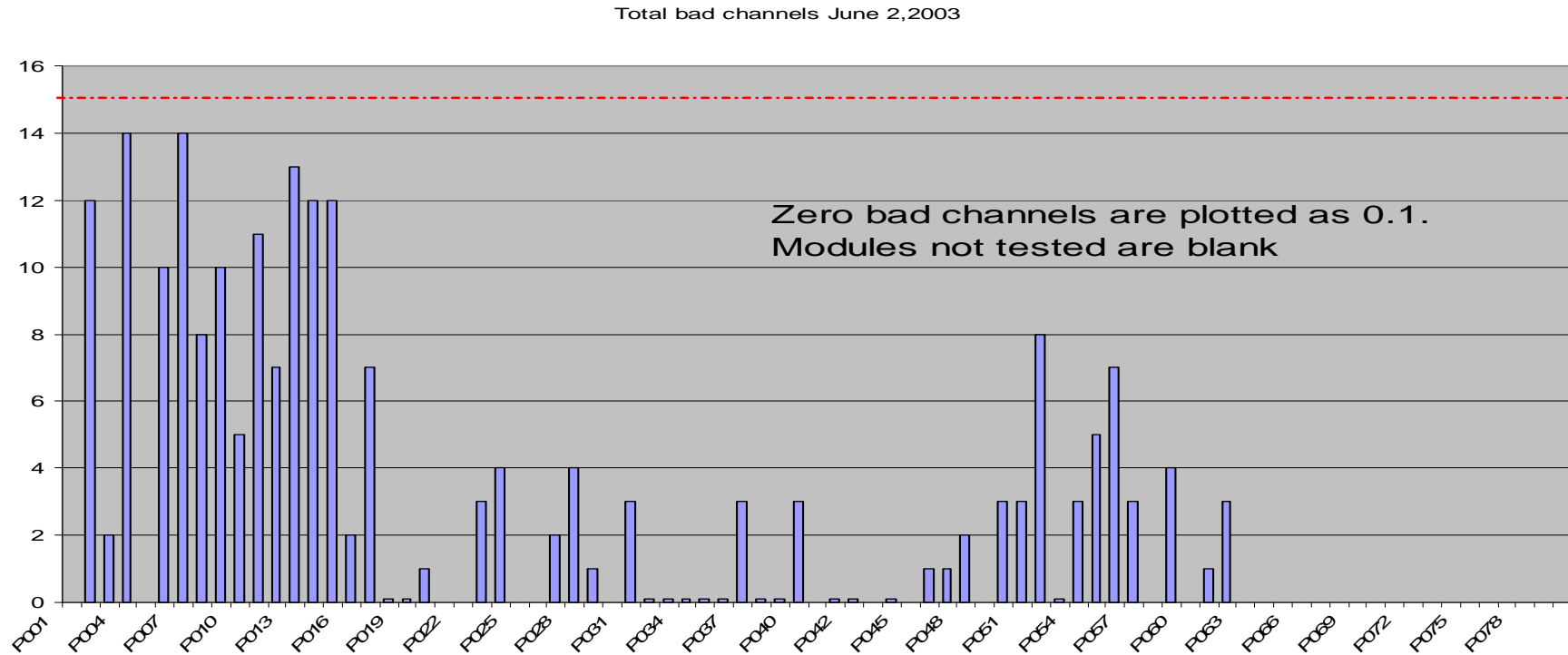


Leakage Currents

- Results shown are after bonding @ 15C
- Sum of 4 individual crystals ~250-550 nA normalized to 15C

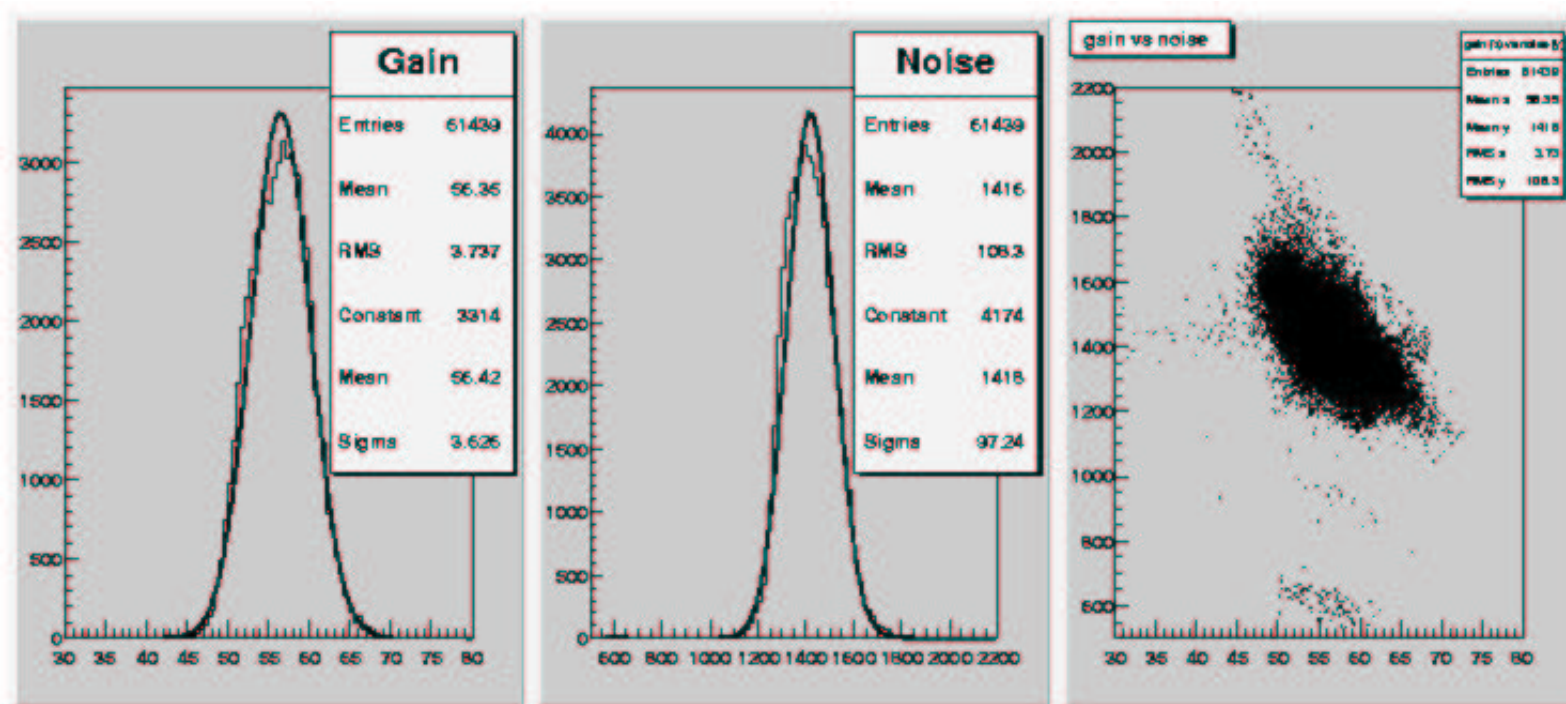


Bad Channels per Module



- Regularly achieve <4 bad channels per module
- Dramatic improvement due to new protocols for re-bonding channels for which the wire did not stick
- Previously wanted to separate leakage current issue from bonding

Modules Electrical Performance

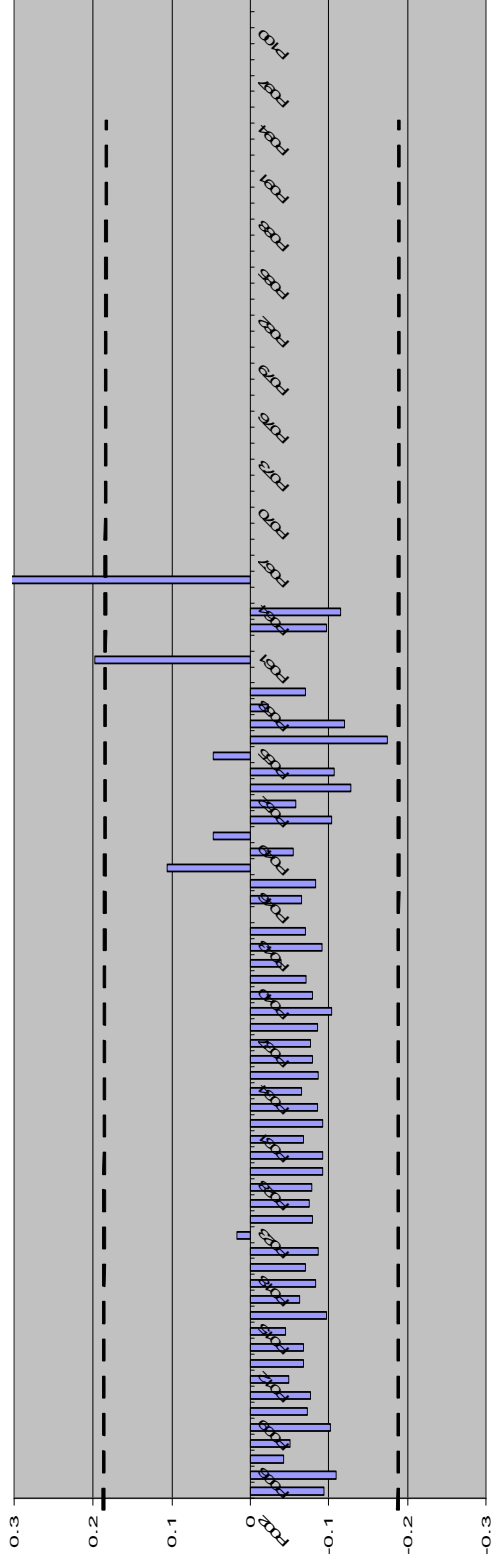


Hybrid Folding

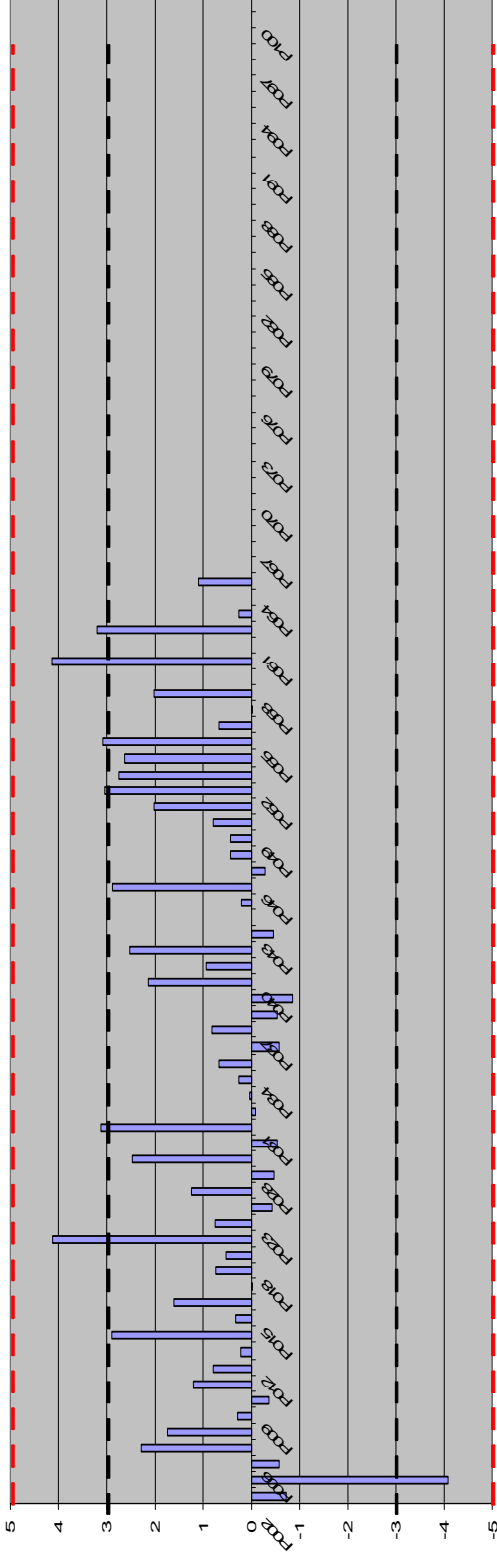
- As of a few weeks ago hybrid folding has stopped, due to a few modules with hybrid2 height or facing “b” angle out of spec
- Caused by weakness in fixture design seen as additional fixtures were commissioned
- Since addressed by modifications which are currently under test
- Expect to resume presently

Effects of Hybrid Mounting

hyb2LeftFarH



b



Module Categories

• Started	96
• Classified (Complete)	96 (45)
• Good	49
• Pass (slightly out on 1 parameter)	23
• Hold	15
• Fail	4
• Rework (expect repairable)	5
• Yields:	
– Good	51%
– Good+Pass	75%
– Good+Pass+Hold	91%
– Good+Pass+Hold+Rework	96%

Module Starts per Week

- Required production rate is 10 starts/week
- Shown are only production starts, there were ~25 test and commissioning modules started in this period as well.

week	starts
6-Jan	2
13-Jan	2
20-Jan	2
27-Jan	4
3-Feb	4
10-Feb	4
17-Feb	1
24-Feb	1
3-Mar	3
10-Mar	4
17-Mar	6
24-Mar	2
31-Mar	5
7-Apr	3
14-Apr	0
21-Apr	7
28-Apr	4
5-May	10
12-May	6
19-May	5
26-May	3
2-Jun	9

Concluding Remarks

- Technical capability to produce modules in place and demonstrated in USA.
- Production ramp well underway
- Still experiencing small glitches due to fixture commissioning
- Hybrid folding has caused gap between mechanical and electrical completion
- Vulnerable to component deliveries from outside US.
- Reduced deliverables by agreement.