



Module Testing at Fermilab

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Working Groups

- Gantry and Wire Bonding
 - Bill Kahl – Kansas State University
 - Lenny Spiegel – Fermilab
- Module Testing
 - Elizaveta Chabalina – University of Illinois at Chicago
 - Len Christofek – University of Kansas
 - Slawomir Tkaczyk - Fermilab



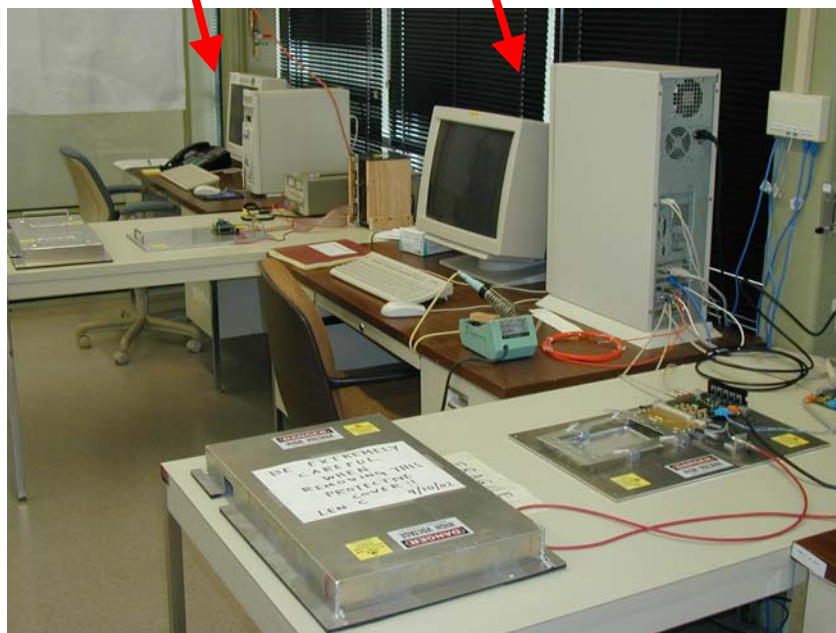
Appreciation

- We would like to express our appreciation to two groups whose assistance was invaluable in helping us get the test stands in working order.
 - Aachen
 - Markus Axer
 - Torsten Franke
 - Michael Poettgens
 - Lyon
 - Laurent Mirabito
 - Patrice Siegrist



Module Testing Facility

ARCS and DAQ test stands
in Sidet at Fermilab



We will have 7 ARCS and 4 DAQ
test stands in the room with
space allocated for rod burn-in.
2 ARCS delivered
2 DAQ delivered



ARC and DAQ Test Stands

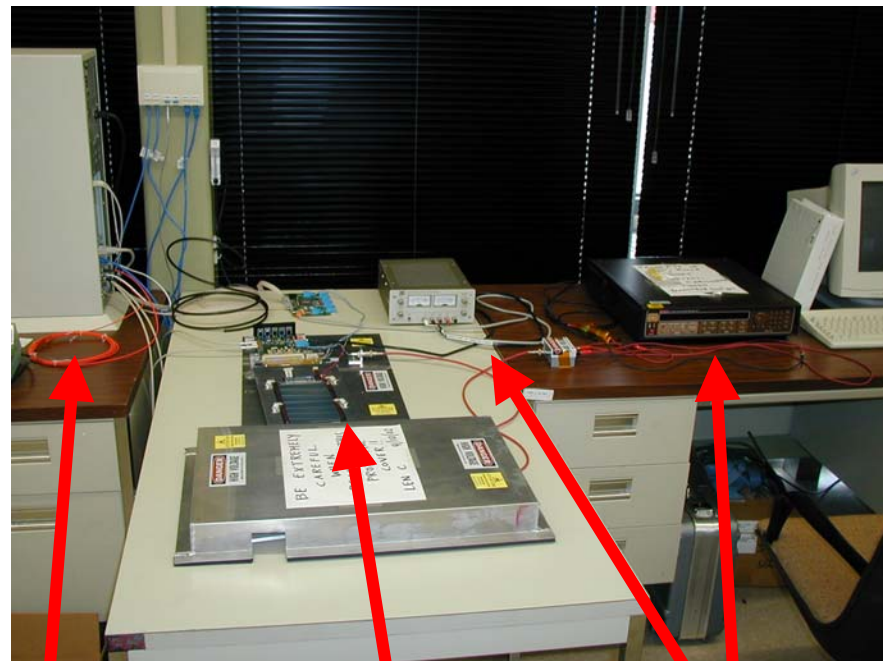
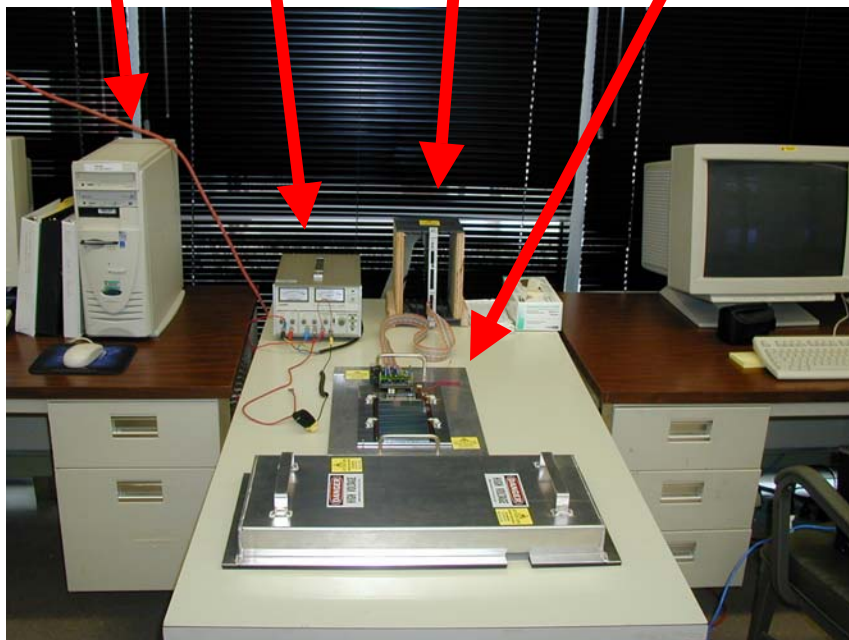
ARC Test Stand

Computer and
Memory
Expander

SRDAPV

Power
Supply

Front End Adaptor
and Hybrid/Module



FEC, FED, TSC
and Fiber Optic
Cable

CCU, UTRI
and Module
Carrier

LV and HV
Power Supplies

DAQ Test Bench

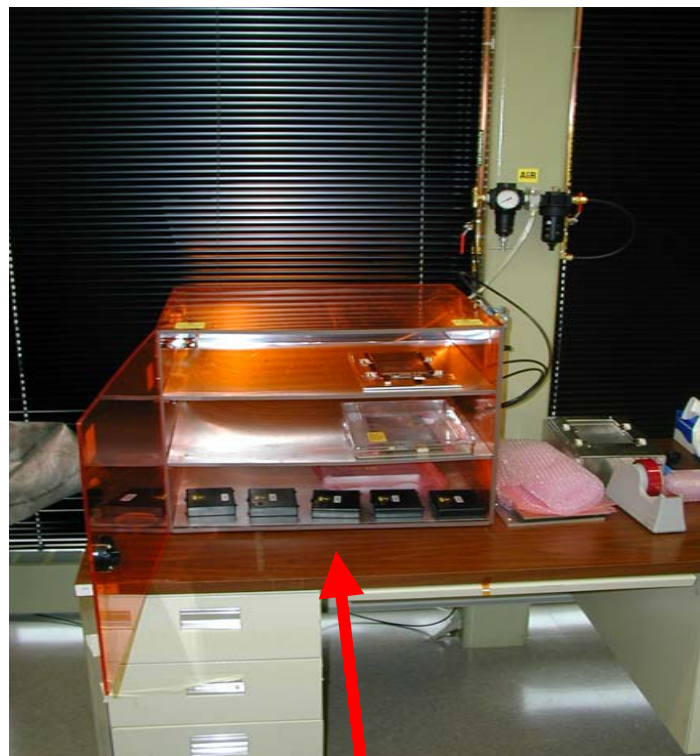


Hybrid/Module Handling and Storage



Latex Gloves

Surgical Mask



Dry Box

Always practice good handling habits !



Web Pages

We have a web page, so you can see what is going on at Fermilab.

All our results can be accessed through this web page.

You can reach this page through the link below.

The screenshot shows a web browser window titled "FNAL CMS Module Testing - Microsoft Internet Explorer". The address bar contains the URL: <http://d0server1.fnal.gov/users/leonard/WWW/CMS/index.htm>. The page content includes:

- Navigation Menu:** Home, Members, Results, Database, ARCS, DAQ, Gantry, USCMS.
- Project Abstract:** Fermi National Accelerator Laboratory (FNAL) has committed to building 6,000 high quality Tracker Outer Barrel (TOB) modules for the Compact Muon Solenoid (CMS). This web page was created to provide US and non-US CMS collaborators access to the FNAL data for module qualification. The modules will be constructed using the Gantry system and then tested using the Aachen ARC system and Lyon full DAQ test bench.
- What's New:**
 - We delivered three high quality modules to CMS using hybrids 01, 49, 57 for the CMS test beam.
 - We received four hybrids and tested them (65, 66, 67, and 94). Modules 65 and 94 have been constructed and tested.
 - We recently received four more hybrids from CERN (43, 46, 89, 90).
- Key Milestones:**
 - Of course, Milestone 200.
 - Construction of six high quality modules for the CMS test beam.
- Footer:** [Security, Privacy, Legal](#). For problems or questions regarding this web contact leonard@fnal.gov. Last updated: 05/02/02.

uscms.fnal.gov/uscms/subsystems/sitracker/sitracker.html



Database

We are learning how to use the CMS database and will be entering our results. Since we are in pre-production, we made a mini-database that we have been using to help us keep track of our test results.



Sensor 1 (S1) is the sensor closest to the hybrid and **S2** is the second sensor of the module.

S1 pinholes correspond to a skipped bond on the hybrid and **S2 pinholes** correspond to a skipped bond between sensors.

- Home
- Members
- Results
- Database
- ARCS
- DAQ
- Gantry
- USCMS

Module Inventory

Frame	Hybrid	Sensor 1	Sensor 2	S1 Pinholes	S2 Pinholes	Depletion Voltage	ARC Hybrid Test	ARC Module Test	DAQ Module Test	Quality	Comments
17		144392 W16	47721 W28	147,227,256	33,57,296,405	70	yes	yes	yes	good	shipped to CERN
		43				0	yes	no	no	-	stored at FNAL
		46				0	yes	no	no	-	stored at FNAL
36		4945482 W08	47721 W19	-	203,427	95	yes	yes	yes	good	shipped to CERN
28		5445482 W32	45482 W43	418	18,244,339,439	105	yes	yes	yes	good	shipped to CERN
		6545482 W19	45482 W17	-	332,504	140	yes	yes	yes	good	stored at FNAL
		6644392 W40	45482 W01	-	246	184	yes	yes	yes	good	stored at FNAL
		6745482 W30	45482 W36	4,497	14,252,255,410	100	yes	no	no	-	stored at FNAL
		89				0	yes	no	no	-	stored at FNAL
		90				0	yes	no	no	-	stored at FNAL
04		9445482 W04	44392 W31	179,236,276,504	3,134,226,227,280	125	yes	yes	yes	good	stored at FNAL



Quality Assurance

- All components will be delivered from Europe to Fermilab.
- We will use the official testing procedures to test the hybrids and modules.
- Fermilab and UCSB are production sites and we will both use the CMS database to track components.



Production Testing Procedure

1. Test hybrid on ARC test stand.
2. Create a module using the hybrid and then test the module on the ARC test stand (make possible repairs, if necessary).
3. Turn modules into rods and burn them in.
4. Test rod with CMS DAQ test bench.



Our Experience with the ARC Test Stand

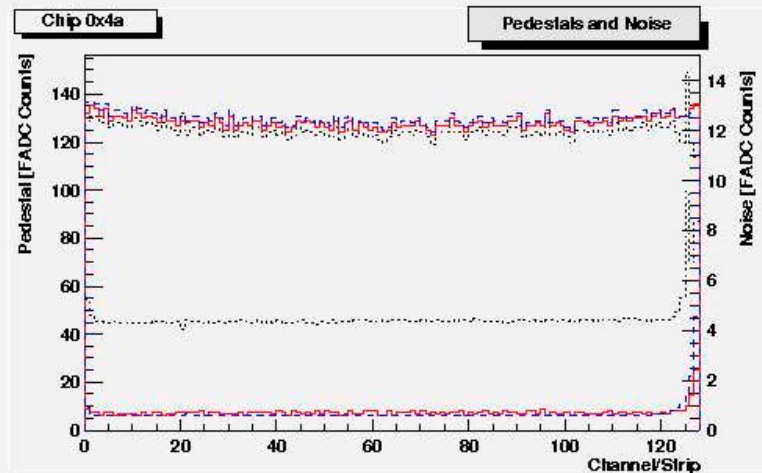
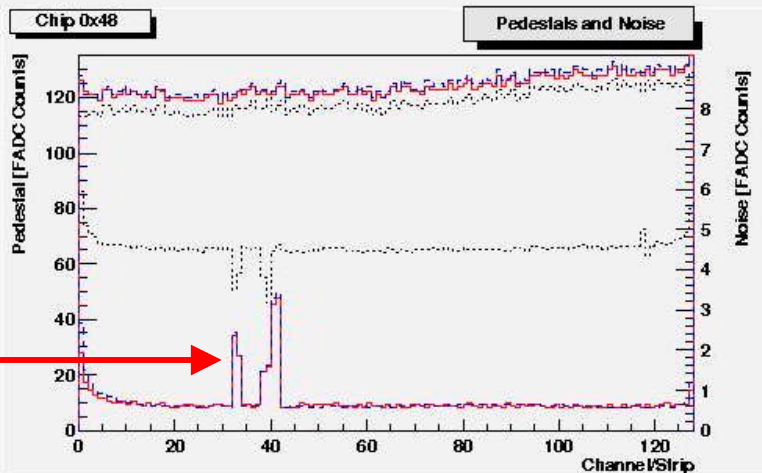
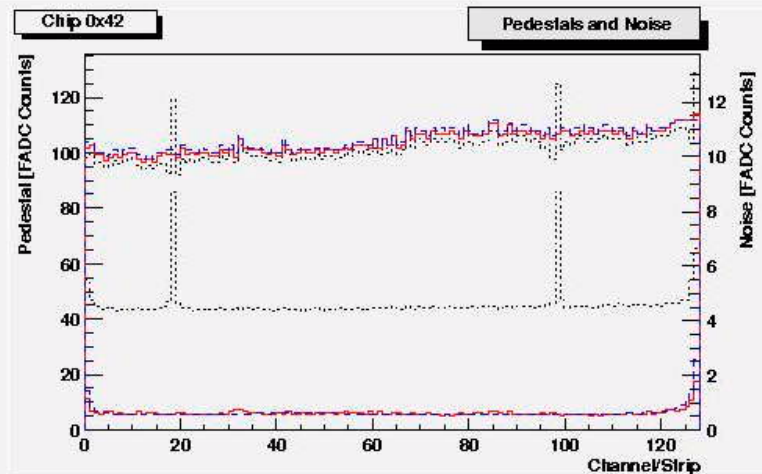
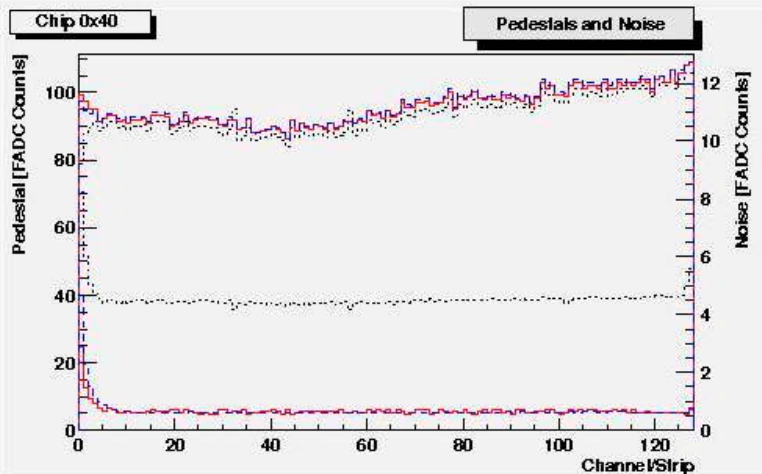
- In order to commission our ARC test stand, all seven milestone hybrids were tested at CERN with their ARC test stand.
- After the hybrids were shipped to Fermilab, we tested the same hybrids to confirm our ARC test stand was working properly.
- Modules were then constructed using these hybrids and we tested them again using the ARC test stand.
- We found excellent agreement between all tests.



Milestone ARC Calibration

History of Hybrid/Module 01

— CERN hybrid data
- - - FNAL hybrid data
... FNAL module data





Our Experience with the DAQ Test Stand

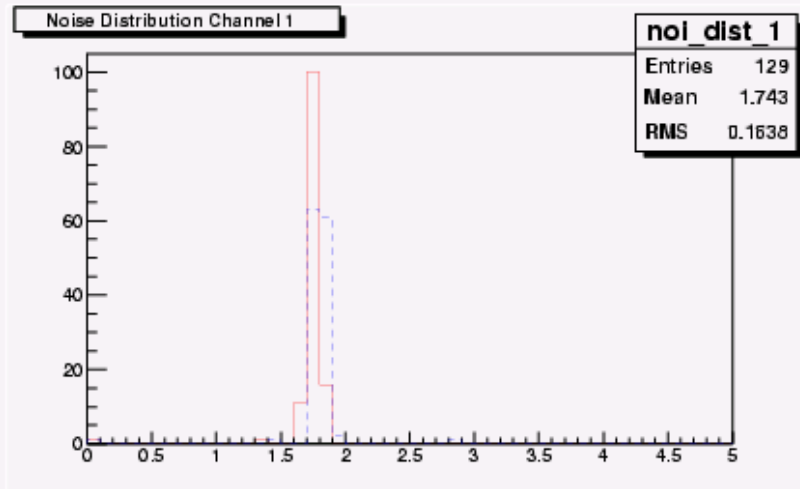
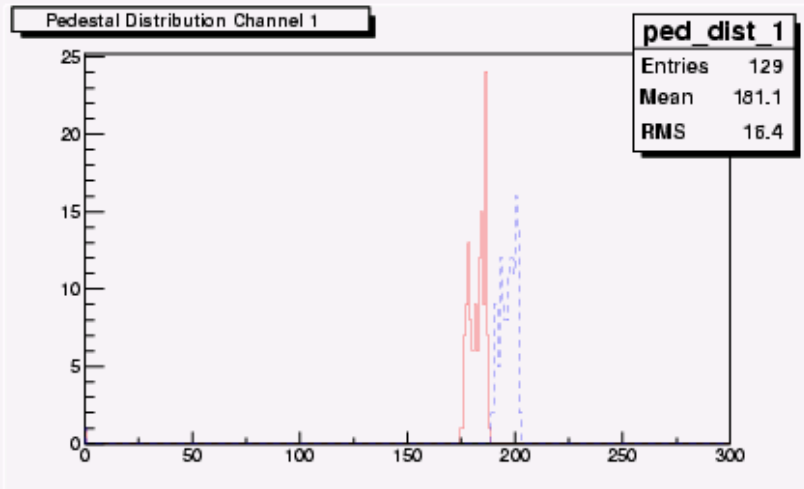
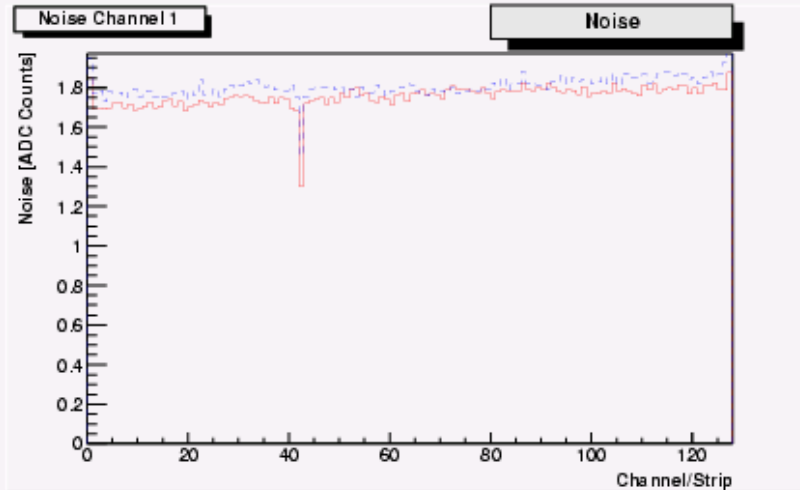
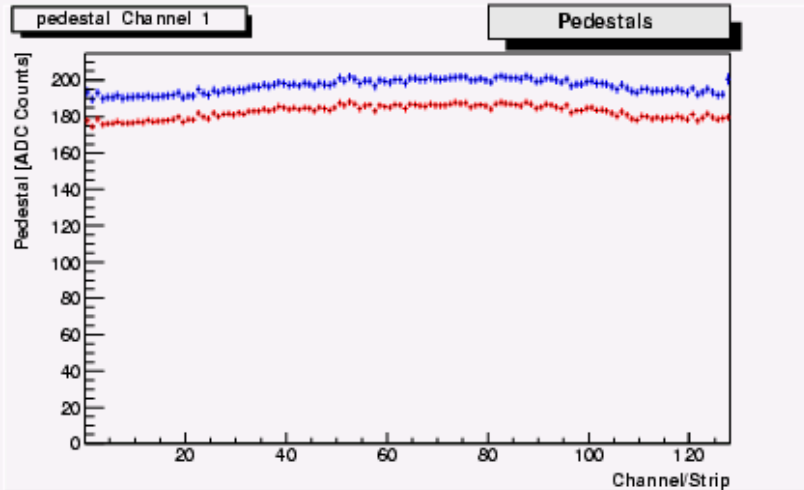
- In order to commission our DAQ test stand, all seven milestone modules were tested at FNAL with our DAQ test stand.
- After the modules were shipped to CERN, we tested the same modules to confirm our DAQ test stand was working properly.
- We found excellent agreement between all tests and found an average noise per chip of 2 ADC counts and CMN ~ 0.5 ADC.



Milestone DAQ Calibration

DAQ History of Module 49

— **FNAL module data**
- - **CFBN module data**





Summary & Conclusions

- We have constructed 7 Milestone 200 TOB modules.
- Six modules were shipped to CERN for test beam studies (all modules survived the journey back to CERN).
- We have all the software for running the test stands and for data analysis. (We ported ARCS to Windows NT).
- We are now preparing our facility for production testing.
- Presently, we have 4 additional hybrids, 22 sensors and 12 frames.