



Заседание Ученого Совета ОФВЭ 29 декабря 2004

Проект CMS

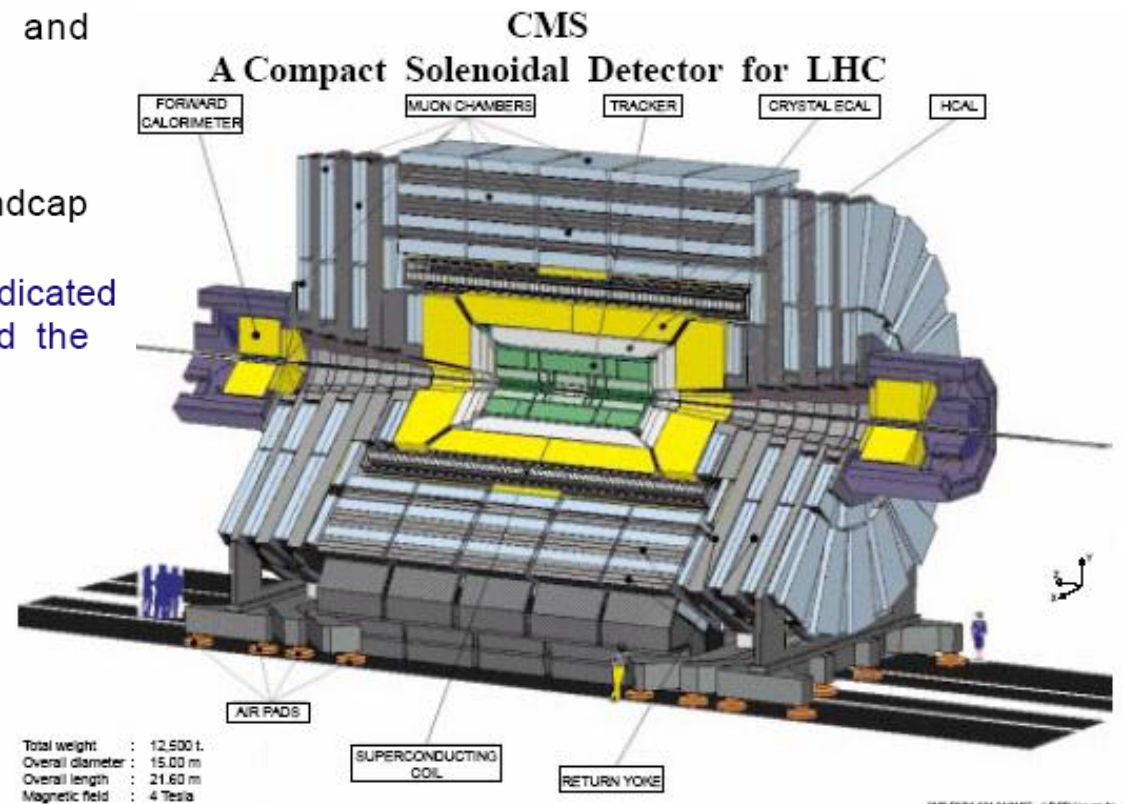
Ю.М.Иванов



Мюонный детектор CMS

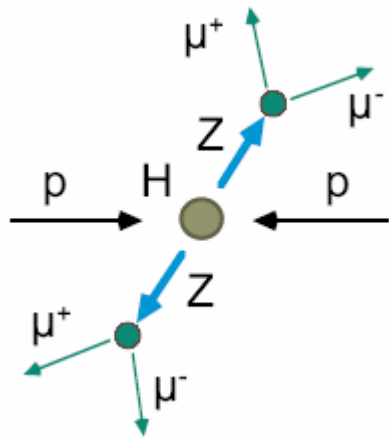
The CMS Muon detector is made of 3 different sub-detectors to ensure redundancy and robustness:

- Drift Tubes (DT) in the barrel region
- Cathod Strip Chambers (CSC) in the endcap region and
- Resistive Plate Chambers (RPC) as dedicated trigger detectors in both the barrel and the endcap

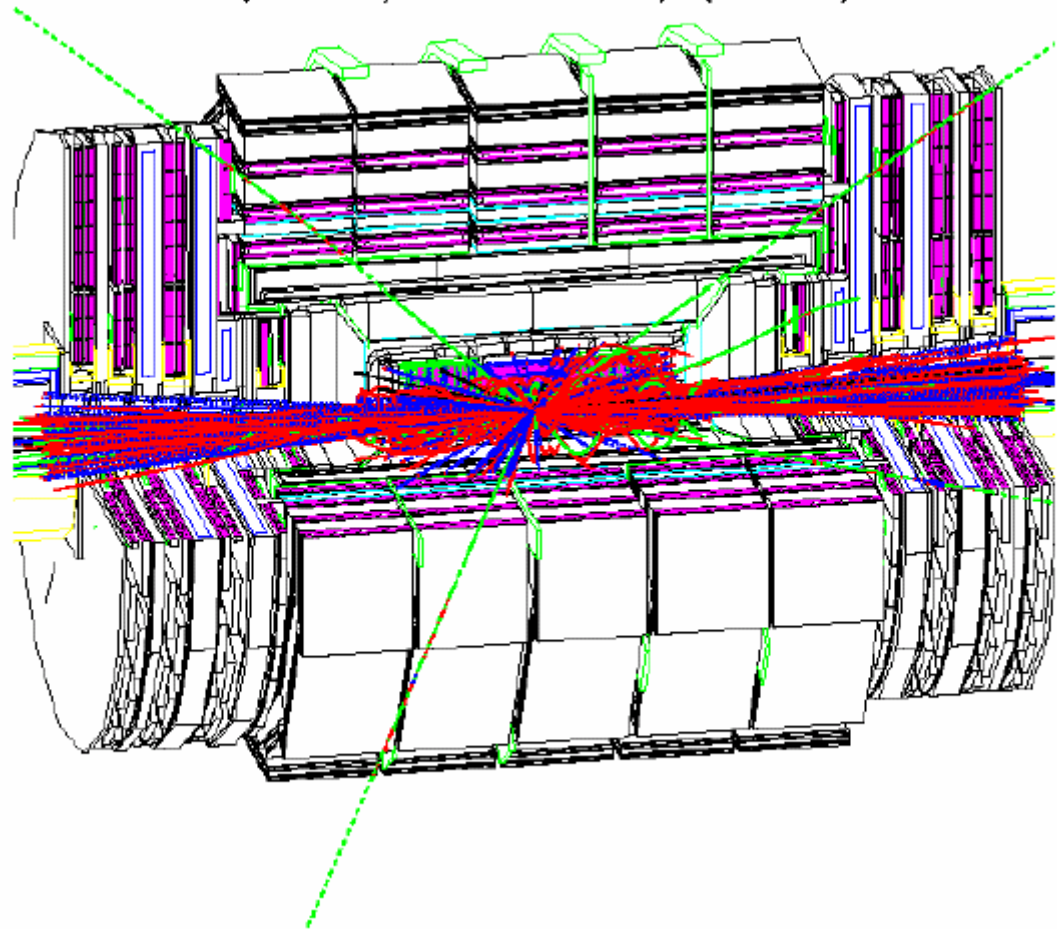




Событие с распадом хиггса на 4 мюона



$H(150\text{GeV}) \rightarrow Z^0 Z^{0*} \rightarrow 4\mu$ (event 8)





Расположение мюонных камер Торцевого детектора

396 CSCs, not counting ME4/2

- 144 Large CSCs (3.4x1.5 m²):
 - 72 ME2/2 chambers
 - 72 ME3/2 chambers
- Small CSCs (1.8x1.1 m²):
 - 72 ME1/2 chambers
 - 72 ME1/3 chambers
- 20° CSCs (1.9x1.5 m²):
 - 36 ME2/1 chambers
 - 36 ME3/1 chambers
 - 36 ME4/1 chambers



Each CSC: 6 planes

Each plane: 2d-readout

~2,000,000 wires

~6,000 m² sensitive area

Precision (trigger):

drj ~ 1 mm

dr ~ 1 cm

dt ~ 4 ns

Precision (offline):

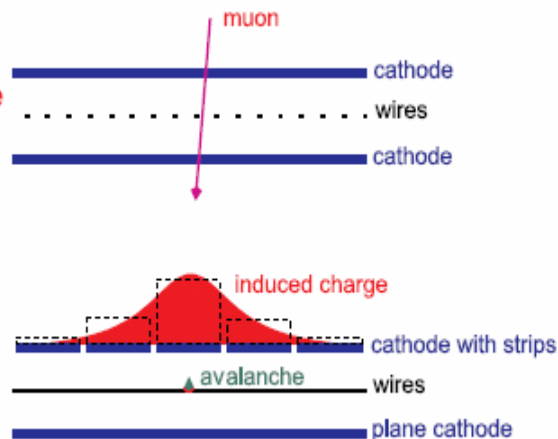
drj ~ 100 mm



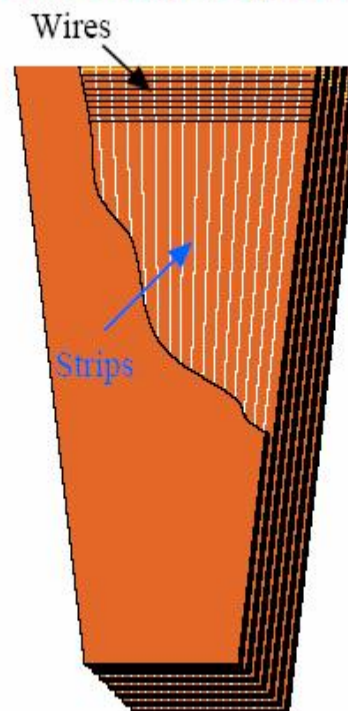
Мюонная камера Торцевого детектора

CSCs will

- satisfy the performance requirements,
- while operating in the CMS/LHC environment



Conceptual design of a CMS EMU CSC



trapezoidal chambers
length up to 3.4 m
width up to 1.5 m
6 planes per chamber
9.5 mm gas gap (per plane)

6.7 to 16.0 mm strip width
strips run radially to measure
 ϕ -coordinate with $\sim 100 \mu\text{m}$ precision

50 μm wires spaced by 3.2 mm
5 to 16 wires ganged in groups
wires measure r-coordinate

gas Ar(40%)+CO₂(50%)+CF₄(10%)
HV \sim 3.6 kV ($Q_{\text{cathode}} \sim 110 \text{ fC}$, $Q_{\text{anode}} \sim 140 \text{ fC}$)



Основные этапы проекта создания мюонных камер в ПИЯФ

...-1999 - разработка дизайна и технологии, подготовка помещений
2000, весна - сборка прототипов камер ME2/1 и ME3/1 в Фермилабе
2000, осень – отправка оборудования из Фермилаба в ПИЯФ
2000, декабрь – начало предпроизводства камер ME2/1 и ME3/1
2001, июнь – Production Readiness Review

2001, ноябрь – начало работы PNPI CSC Factory и производства ME2/1 камер
2002, март – начало работы PNPI FAST Site и тестирования камер
2002, июль – завершение производства ME2/1 камер

2002, октябрь – начало производства ME3/1 камер
2003, июль – завершение производства ME3/1 камер

2003, октябрь – начало производства ME4/1 камер
2004, август – завершение производства ME4/1 камер и работы PNPI CSC Factory
2004, ноябрь – завершение тестирования камер и работы PNPI FAST Site

Всего изготовлено и отправлено в CERN 120 мюонных камер, из которых 114 собрано с электроникой и протестировано

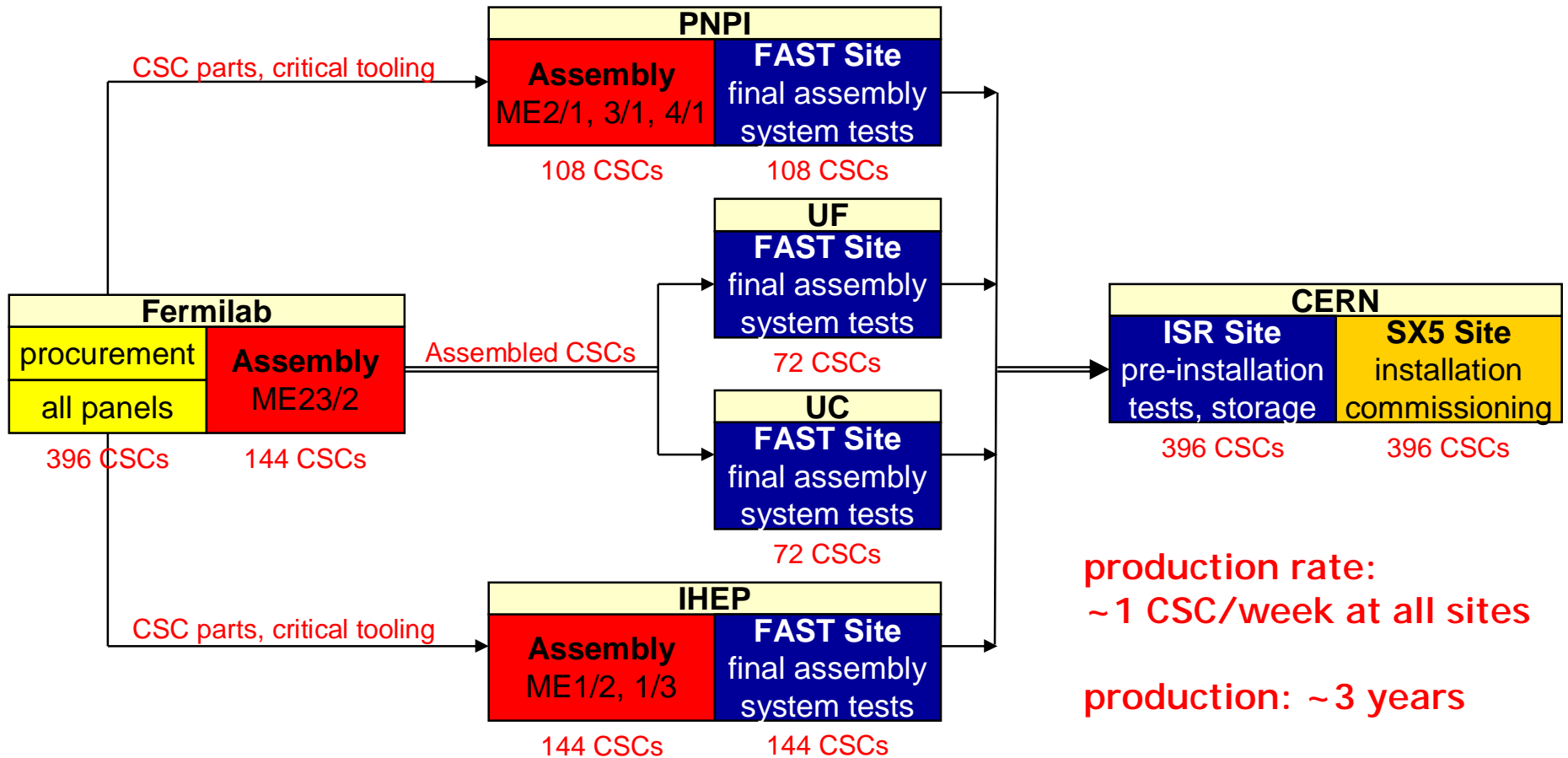


Production Readiness Review at PNPI CSC Factory in June, 2001





Организация производства мюонных камер Торцевого детектора





PNPI CSC Factory





PNPI CSC Factory





PNPI CSC Factory





PNPI CSC Factory





PNPI CSC Factory





PNPI CSC Factory





PNPI CSC Factory



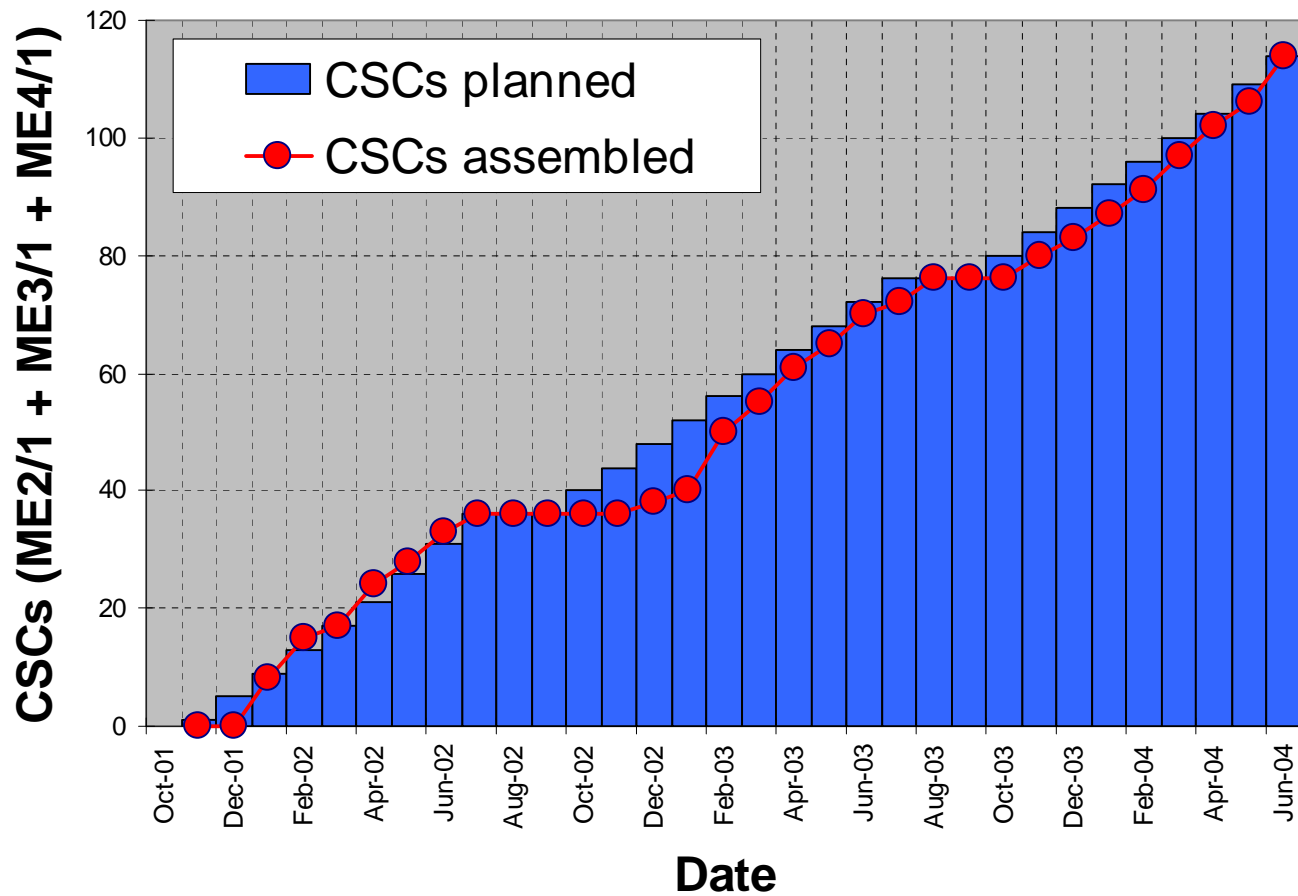


Изготовление каркаса камер





CSC Production at PNPI





FAST Site Tests/Procedures

- 1 Broken wires
- 2 HV connectivity
- 3 Gas leak (twice)
- 4 Long-Term HV Test (2+ months)
- 5 Gas gain uniformity and exposure to radioactive source
- 6 Mechanical Assembly
- 7 Water leak
- 8 LVDB check
- 9 Slow Control Test (ALCT, LVMB)
- 10 HV-on qualitative test
- 11 AFEB counting noise, after-pulsing, interconnections (3600 and 3800 V)
- 12 AFEB connectivity, cabling check, cross-talks
- 13 AFEB threshold calibration, analog noise
- 14 AFEB-ALCT time delay calibration
- 15 CFEB noise, SCA pedestal uniformity, readout cross-talks
- 16 CFEB connectivity, cabling check
- 17 CFEB pulse timing, quality, near-strip and long-range cross-talks, gain calibration
- 18 CFEB comparator counting noise (3600 and 3800 V)
- 19 CFEB comparator threshold calibration, analog noise
- 20 CFEB comparator timing
- 21 CFEB comparator logic check
- 23 CFEB comparator offsets and analog noise: (n+1)-(n) and (n+1)-(n-1)
- 24 Chamber gain map and HV offset calibration
- 25 ALCT self-trigger: k/6 rates at normal and high-rate background conditions
- 26 CLCT self-trigger: k/6 rates at normal and high-rate background conditions
- 27 High-Statistics: plane alignment, resolution
- 28 ALCT and CLCT 4/6 rate vs HV (plateau)

Black—manual test

Blue—assembly procedure

Red—FAST-DAQ test

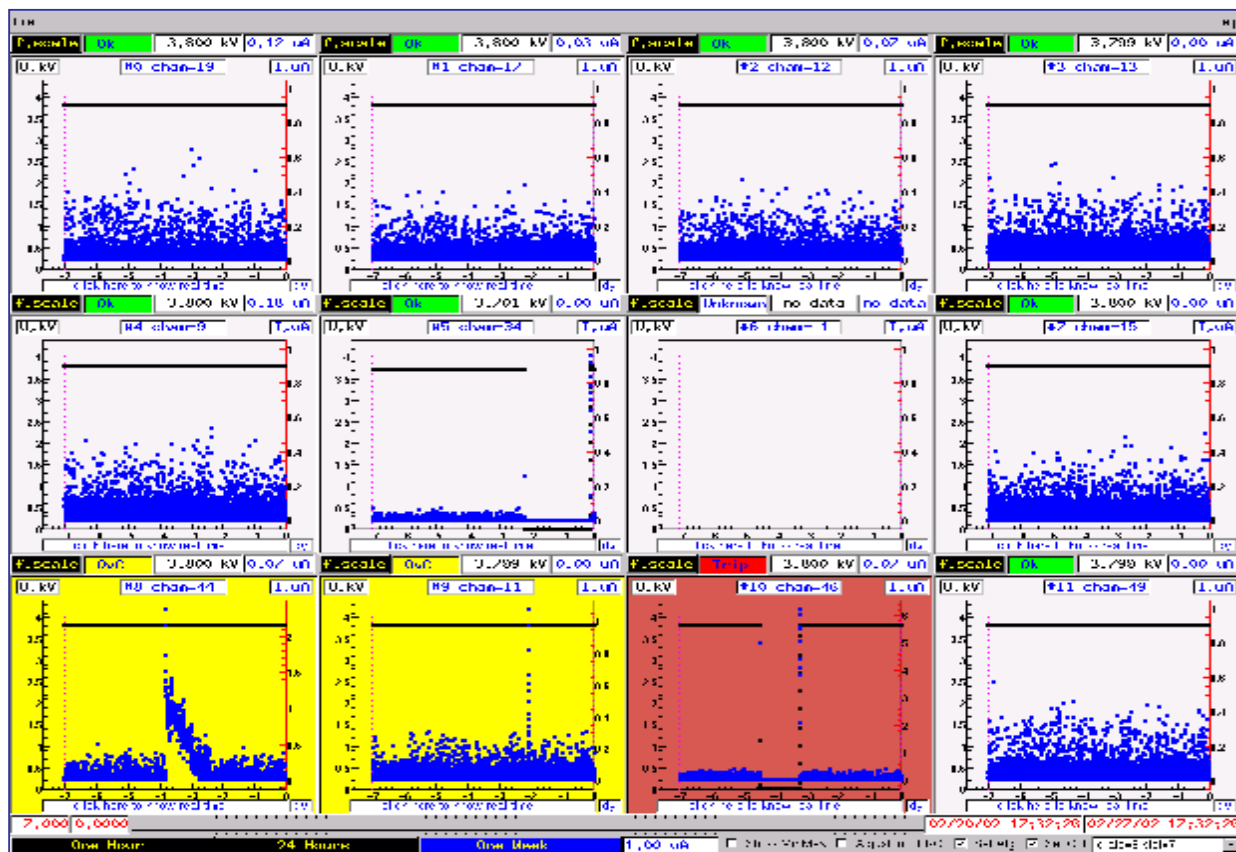


PNPI Fast Site





Test 4: HV long term test



1 month min under HV=3600 and up
1 month under HV=3800 V
look for continuous over-currents (1 uA) and trips (10 uA)



Assembling with electronics





Inventory Database

FAST SITE BOARD DATABASE

===== BOARD FLOW AT FAST SITE =====

board_type ALCT

date from 2001-09-01 date to 2003-05-26 oracle

FAST_Site PNPI report_type ALL_REPORT_TYPES **GETDATA**

boardtype	date	action	board_#
__ALCT	2003-04-09	__INSTALLED	_____422
__ALCT	2003-05-16	__INSTALLED	_____424
__ALCT	2003-05-06	__INSTALLED	_____407
__ALCT	2003-04-28	__INSTALLED	_____426
__ALCT	2003-04-21	__INSTALLED	_____412
__ALCT	2003-04-18	__INSTALLED	_____428
__ALCT	2003-04-04	__INSTALLED	_____414
__ALCT	2003-03-14	__INSTALLED	_____410
__ALCT	2003-04-04	__INSTALLED	_____419
__ALCT	2003-03-31	__INSTALLED	_____417
__ALCT	2003-04-02	__INSTALLED	_____411

===== SUMMARY =====

SUMMARY

2001-09-01 : 0 on hand, 0 on shelf, 0 on csc@fast

from 2001-09-01 to 2003-05-26 :
11 received, 0 sent for repair, 0 sent to CERN

2003-05-26 : 11 on hand, 0 on shelf, 11 on csc@fast

print **back to prev. menu** **exit**



PNPI Fast Site

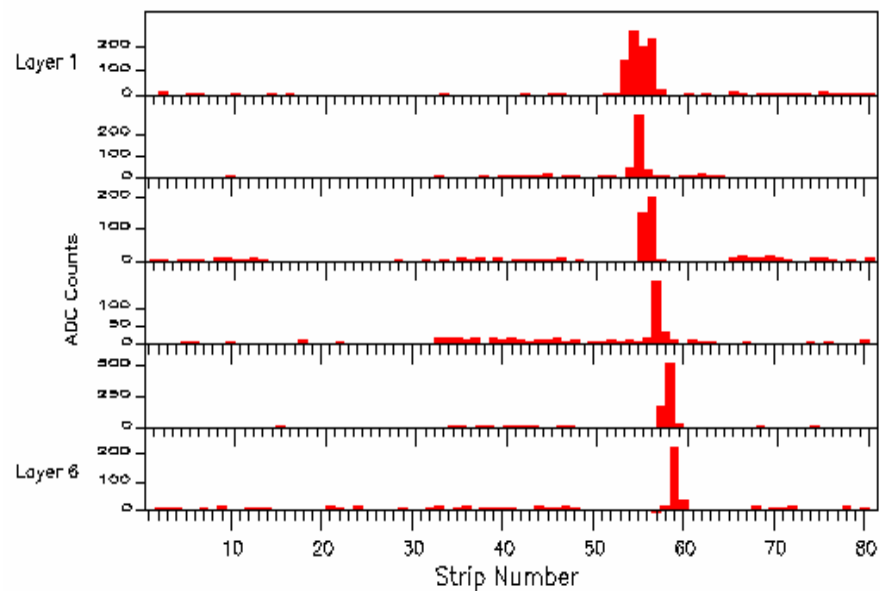




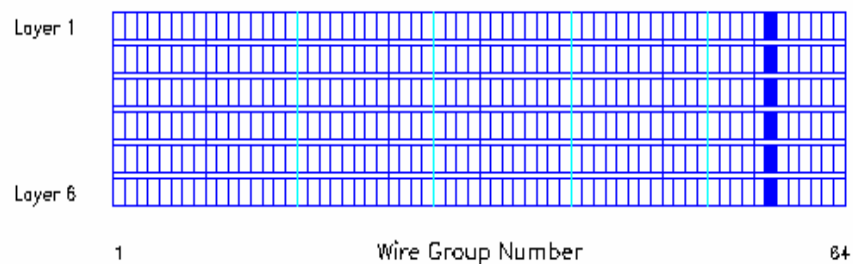
Event Display

RUN 4045 EVENT 10654

STRIPS



WIRES

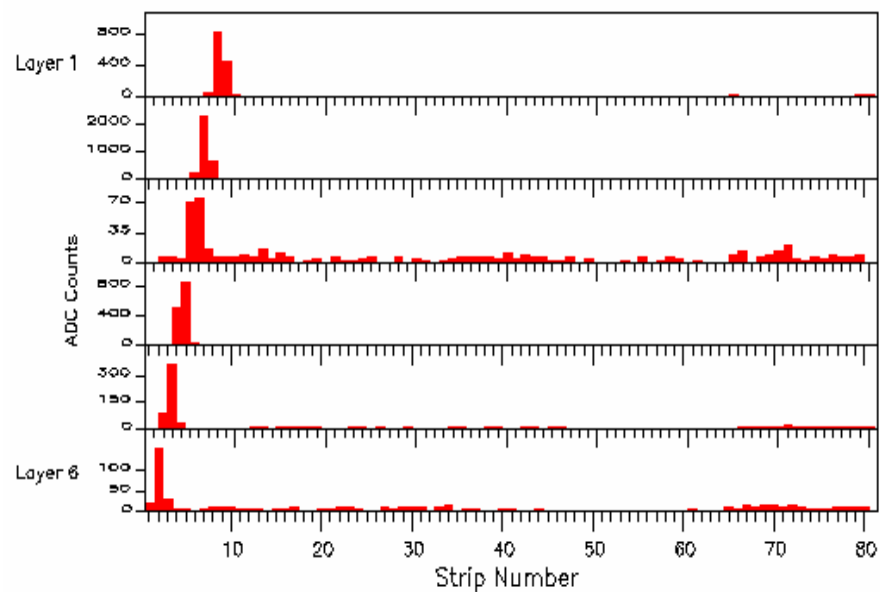




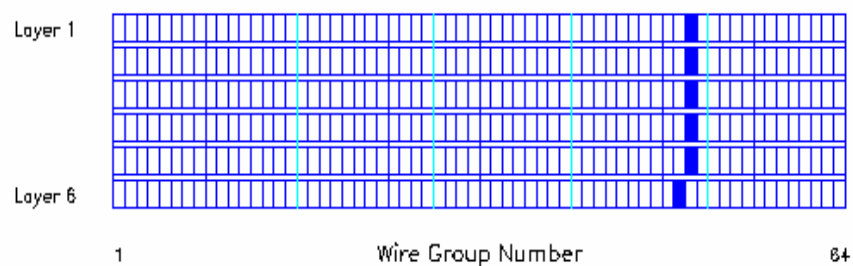
Event Display

RUN 4045 EVENT 11404

STRIPS



WIRES

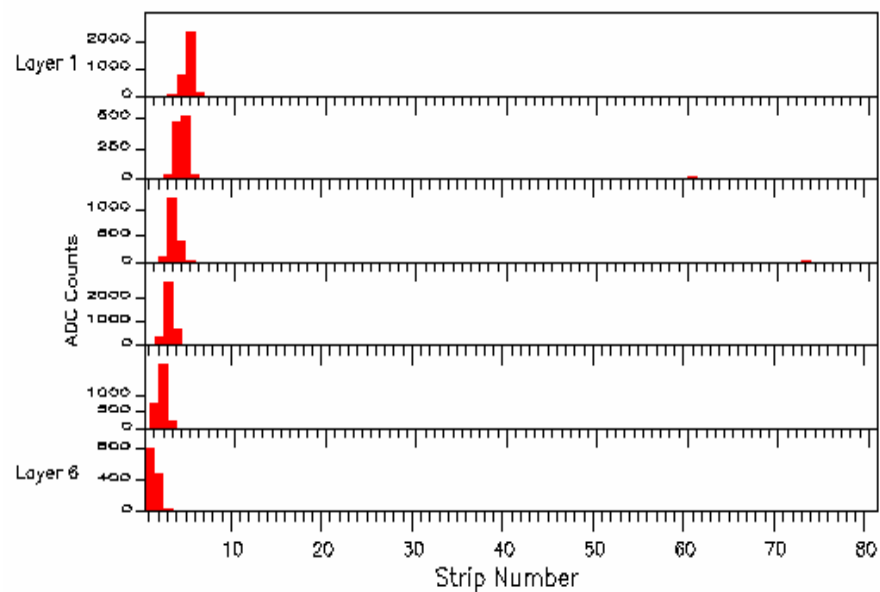




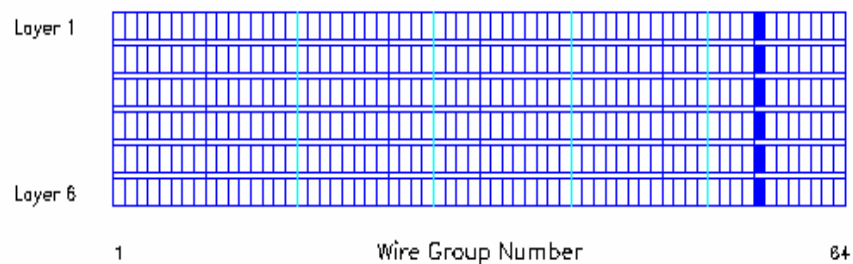
Event Display

RUN 4045 EVENT 11662

STRIPS



WIRES

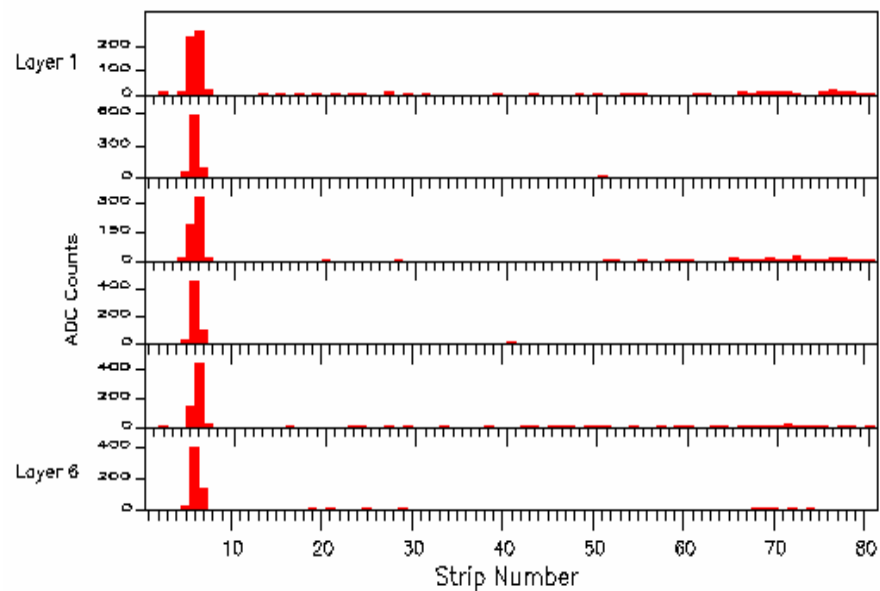




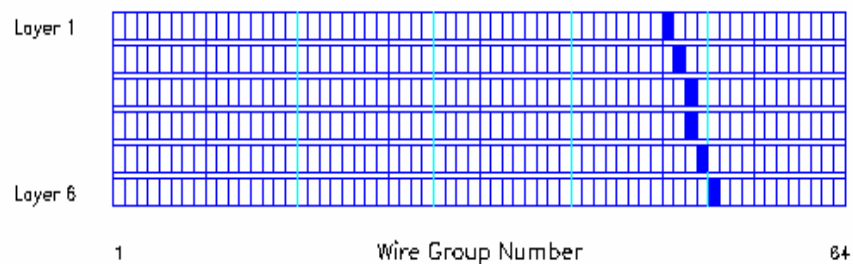
Event Display

RUN 4045 EVENT 11823

STRIPS



WIRES

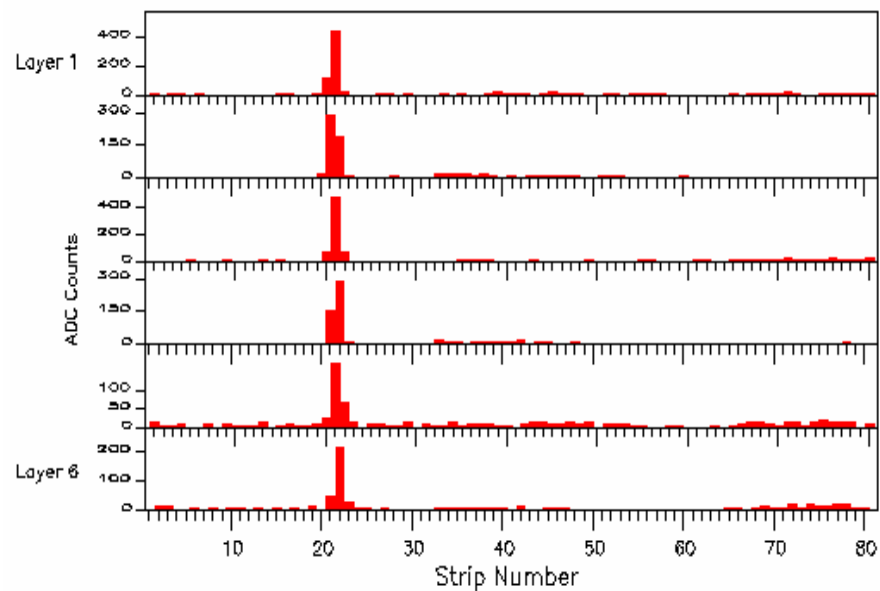




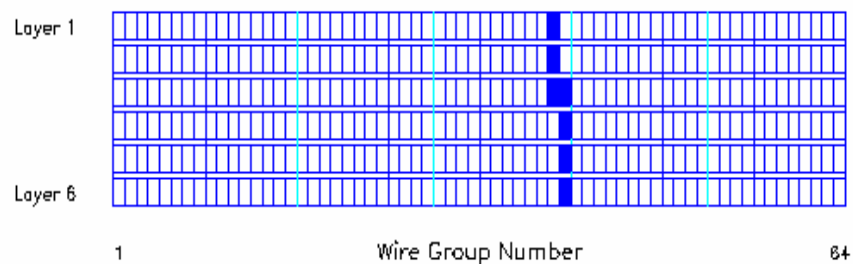
Event Display

RUN 4045 EVENT 11943

STRIPS



WIRES

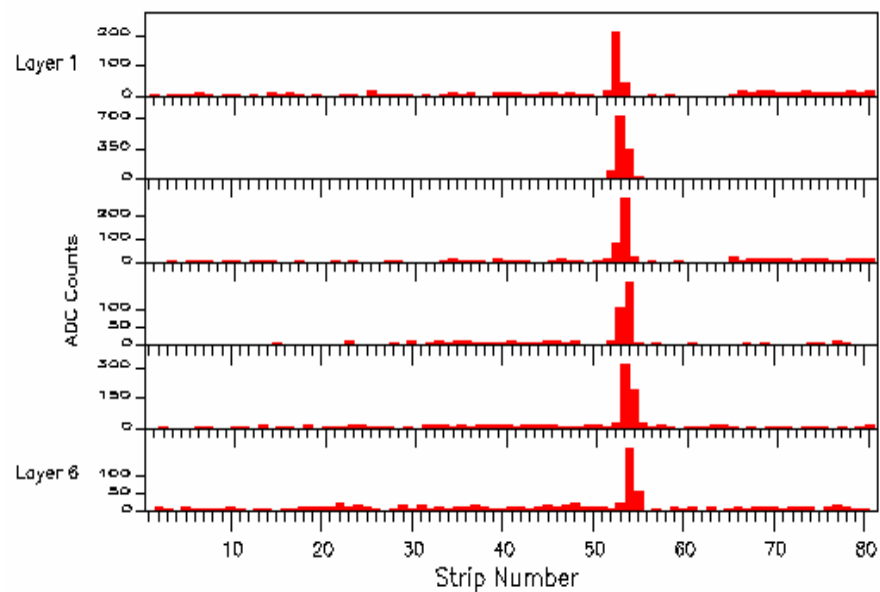




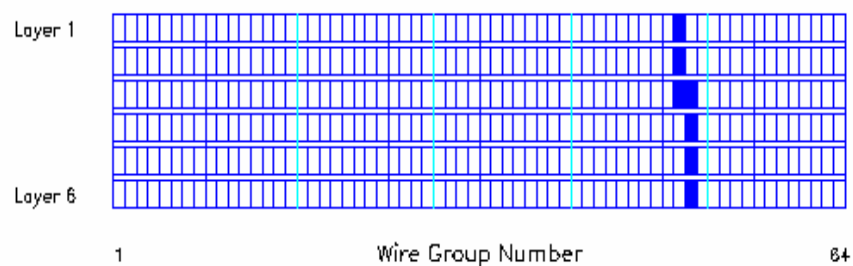
Event Display

RUN 4045 EVENT 12124

STRIPS



WIRES

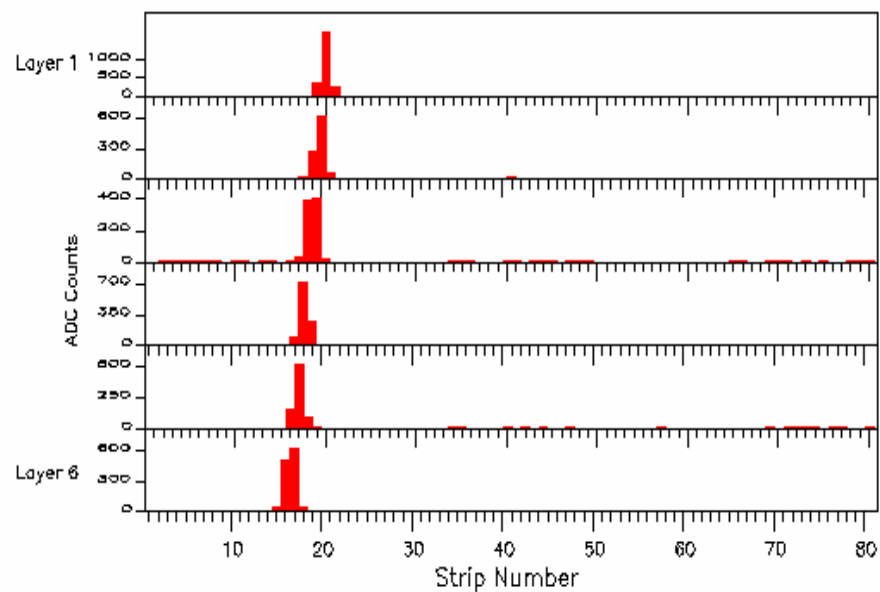




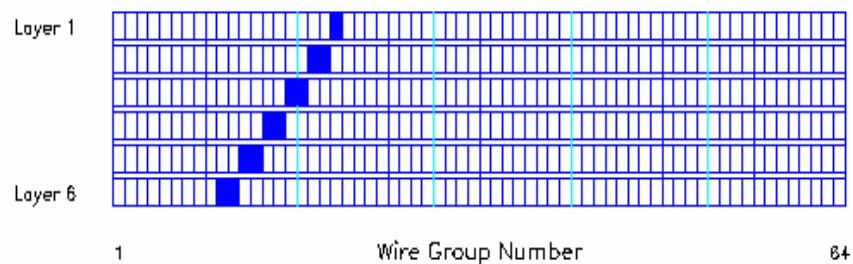
Event Display

RUN 4045 EVENT 12380

STRIPS



WIRES

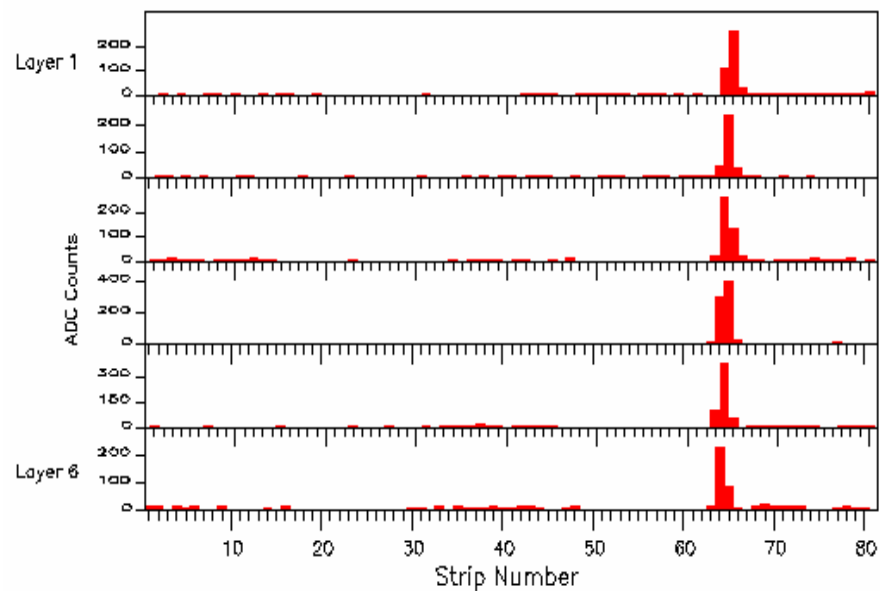




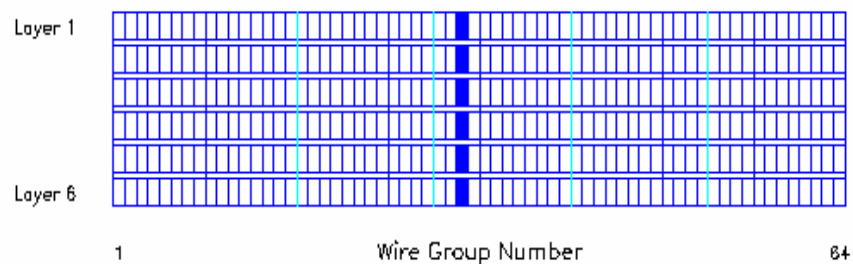
Event Display

RUN 4045 EVENT 12629

STRIPS



WIRES

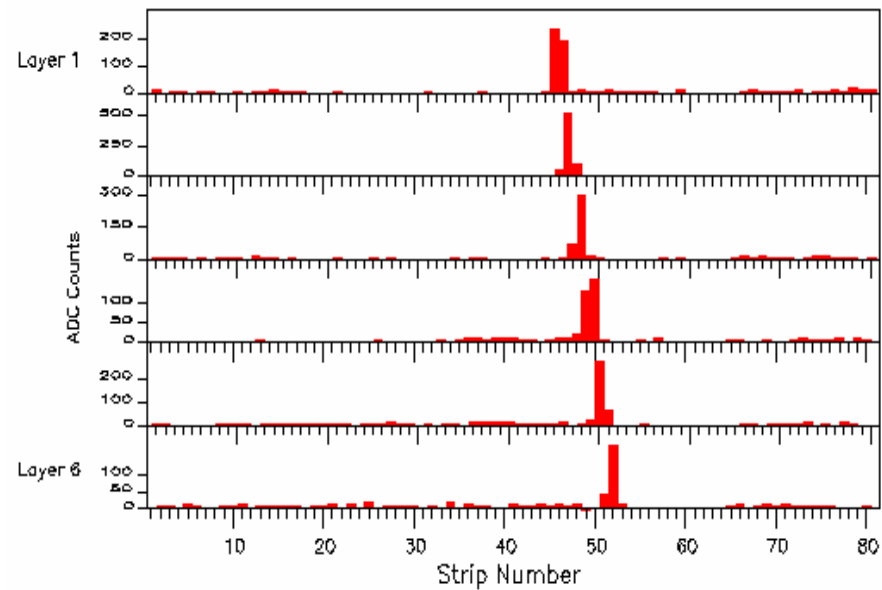




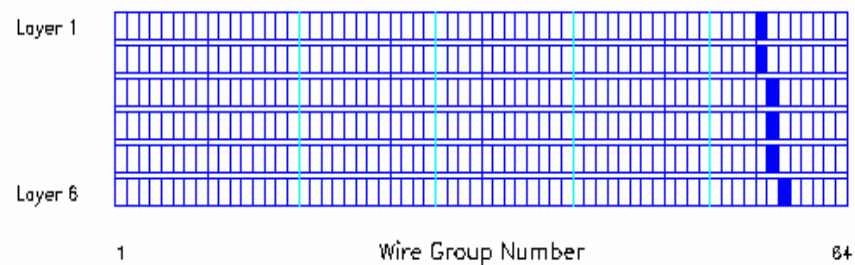
Event Display

RUN 4045 EVENT 12816

STRIPS



WIRES

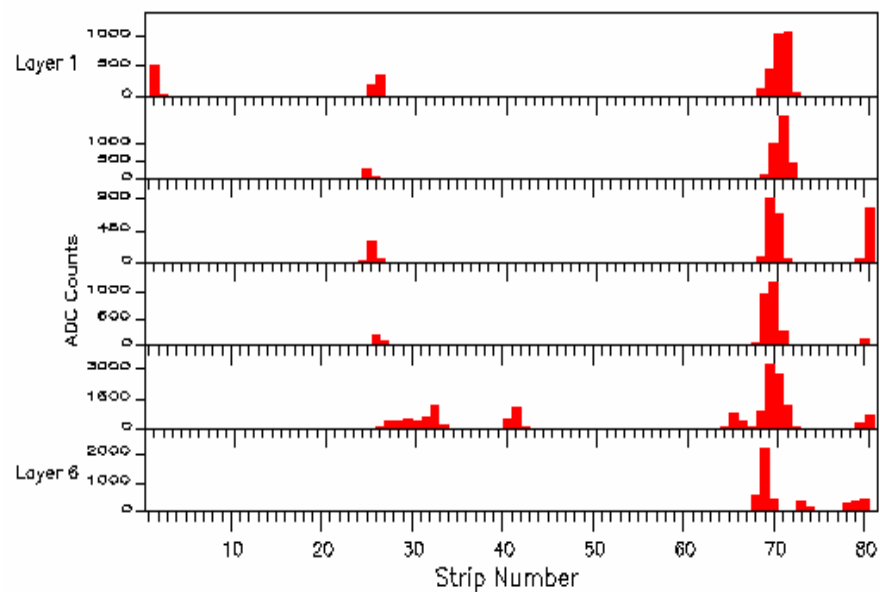




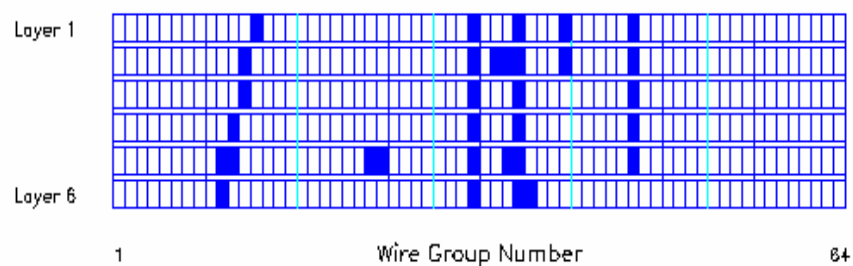
Event Display

RUN 4045 EVENT 12944

STRIPS



WIRES

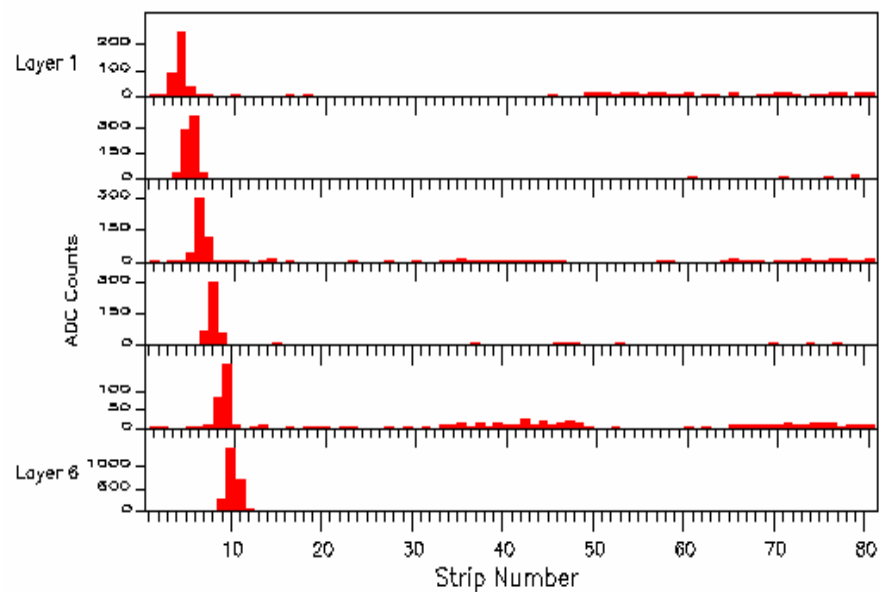




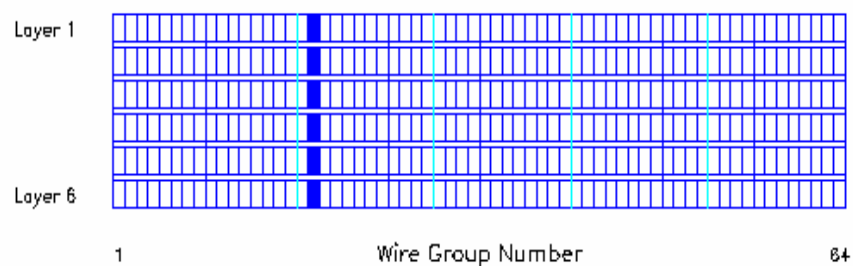
Event Display

RUN 4045 EVENT 13413

STRIPS



WIRES

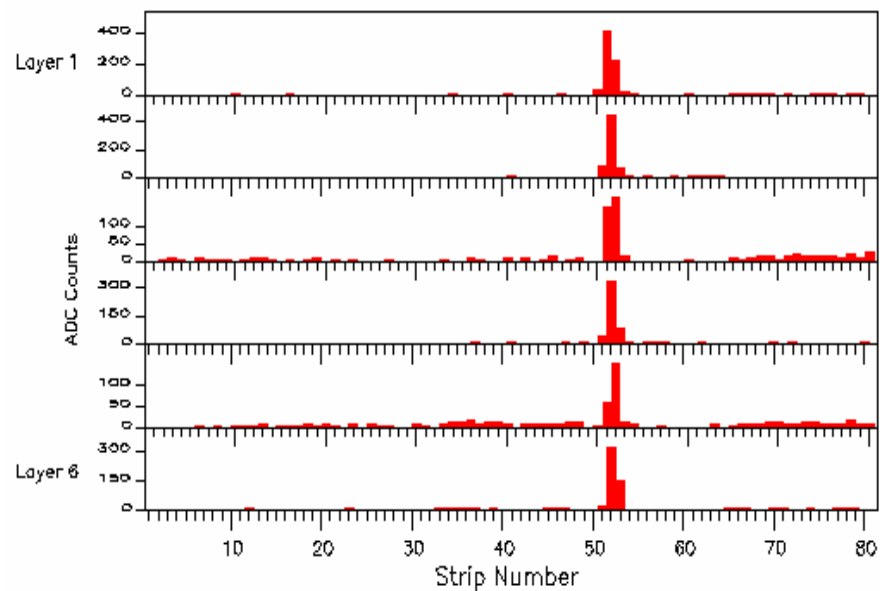




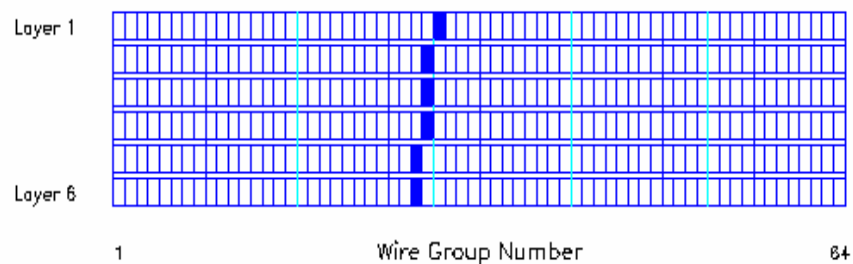
Event Display

RUN 4045 EVENT 13740

STRIPS

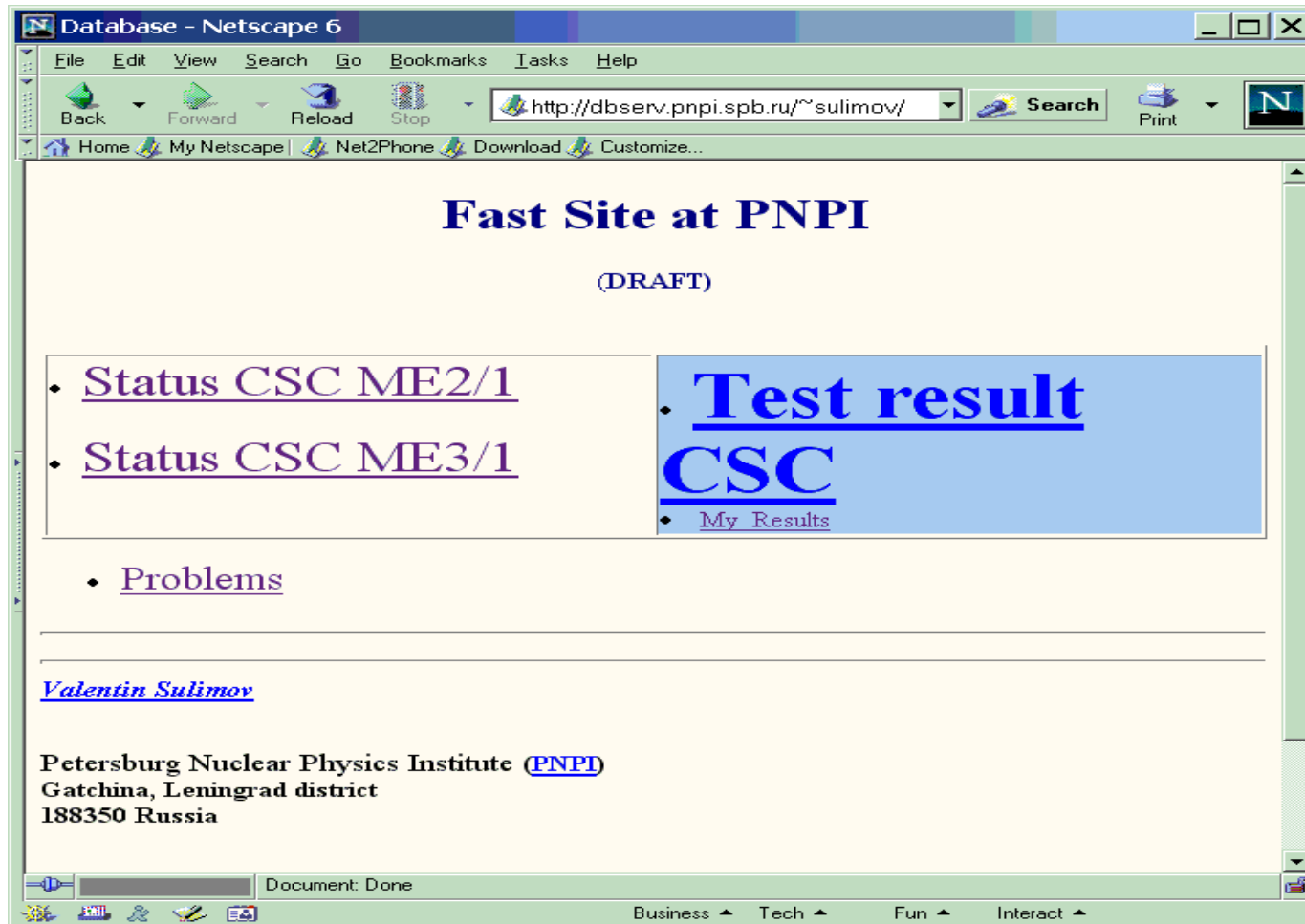


WIRES





Saving Results





Problems

#	Date	CSC#	Object	Brief description	Action	Comment
		ME2/1-26	001			
1.	27-Feb-2003	ME2/1-26	D360 #556	Here	replaced with #585	V.Barashko's conclusion: it was broken connector.
2.	3-Mar-2003	ME2/1-26	CFEB#410	Comparators	replaced with #591	
		ME2/1-22	002			
3.	17-Mar-2003	ME2/1-22	AFEB#1090	test_12 failed	replaced with #3278	
4.	11-Mar-2003			NEW software for DAQ V4R3M		
		ME2/1-07	003			
5.	19-Mar-2003	ME2/1-26	Cable TL3 CSC-CFEB	grounded	replaced	
		ME2/1-11	004			
6.	31-Mar-2003	ME2/1-07	LVMB#088	test_9 failed, wrong current for 3.3v CFEB_5	replaced with #092	Here
7.	02-Apr-2003			NEW lisas_test_manager(12-Mar)		
8.	07-Apr-2003			NEW software V4R4M		
9.	07-Apr-2003	ME2/1-07	CFEB#596	test_16	replaced with #201	Here
10.	08-Apr-2003	ME2/1-07	CFEB#599	test_21 comparators	replaced with #286	Here



Transportation to CERN





Transportation to CERN





Последняя мюонная камера перед отправкой в CERN






ISR Organization

EMU
Management

ISR Manager
P.Levchenko

Deputy/Infrastructure
R.Breedon


Shipping/Receiving
S. Otwinowski/B.Lisowski

Tests A 
A.Petrinin/B.Lisowski

CSC Handling 
A.Baldychev/A.Vorobyev

 Tests B
V.Sulimov/K.He

Tooling
A. Vorobyev

Alignment 
R. Breedon/A.Petrinin

Safety
A. Lanaro/P.Levchenko

Repairs
TBD (case by case)

Information
Storage/Pool
(Database,
Inventory, WEB)
I. Vorobiev,
V. Andreev

HV Cables
B. Lisowski

 Skew Clear
V. Andreev/K.He

DCS Cables
R.Breedon/B.Lisowski

Extra Activity
Test Beam, P5...

LV Cable
S.Lusin/B.Lisowski



ISR People

UF

1. Peter Levchenko

UCLA

1. Bo Liu

2. Bohdan Lisowski

3. Christina Matthey

4. Stanislaw Otwinowski

5. Valeri Andreev

6. Xiaofeng Yang

7. Mikhail Ignatenko

UCD

1. Richard Breedon

CMU

1. Igor Vorobiev

2. Nikoaly Bondar

3. Alexander Goliahc

PU

1. Adam Bujak

2. Imre Pal

PNPI

1. Alexander Baldychev

2. Alexander Shchetkovskiy

3. Alexandre Denissov

4. Andrei Vorobiev

5. Anatoly Petrunin

6. Leonid Chipunov

7. Vitaly Lebedev

8. Viatcheslav Tarakanov

9. Viatcheslav Goloubev

10. Serguei Vavilov

11. Andrey Fetisov

12. Valentin Soulimov

IHEP China

1. Hansheg Sun

2. Weiren Zhao

3. Kanglin He

5. Hangling Zhyang

6. Guian Yang



ISR Areas General View

#1



#2



#1



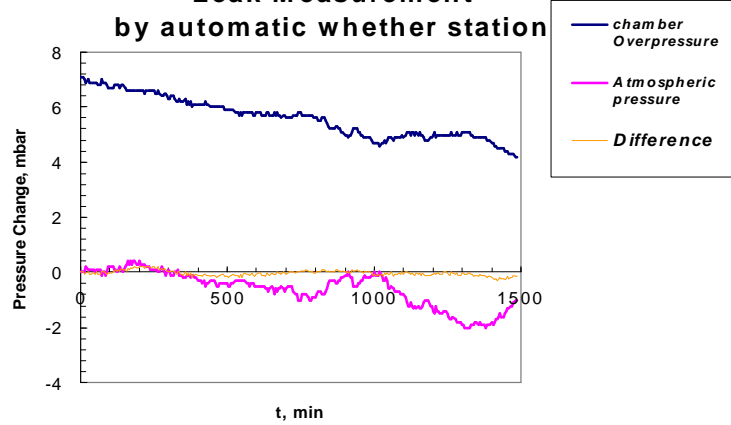
#3





Tests A at ISR

Leak Measurement
by automatic whether station



Automatic Leak
Measurement (ALMD)
#3.

Broken wire and
HV connectivity
#1,#2.





Tests B at ISR and SX5





ISR Status

	2003	2004	Total
Installed	90	126	216
Tested	143	139	282
Received	159	175	334



CERN CSC Web Site

<http://cmsdoc.cern.ch/CSC/CERN/>



**WEB master
Igor Vorobiev.**



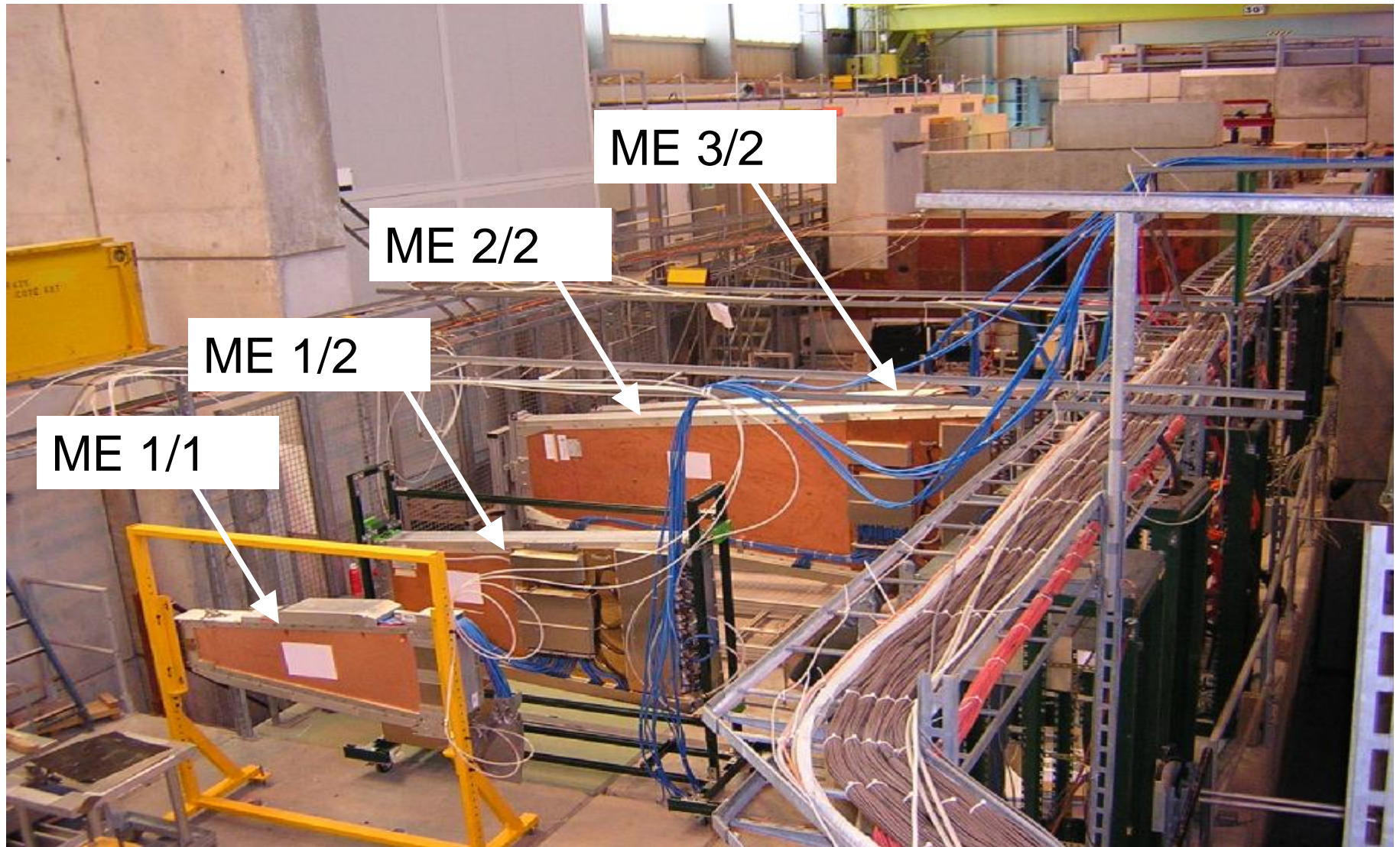
Clean Room at ISR

In fact CR has appeared as the LAB for LV,HV and DCS developments





X5A Test Beam Layout



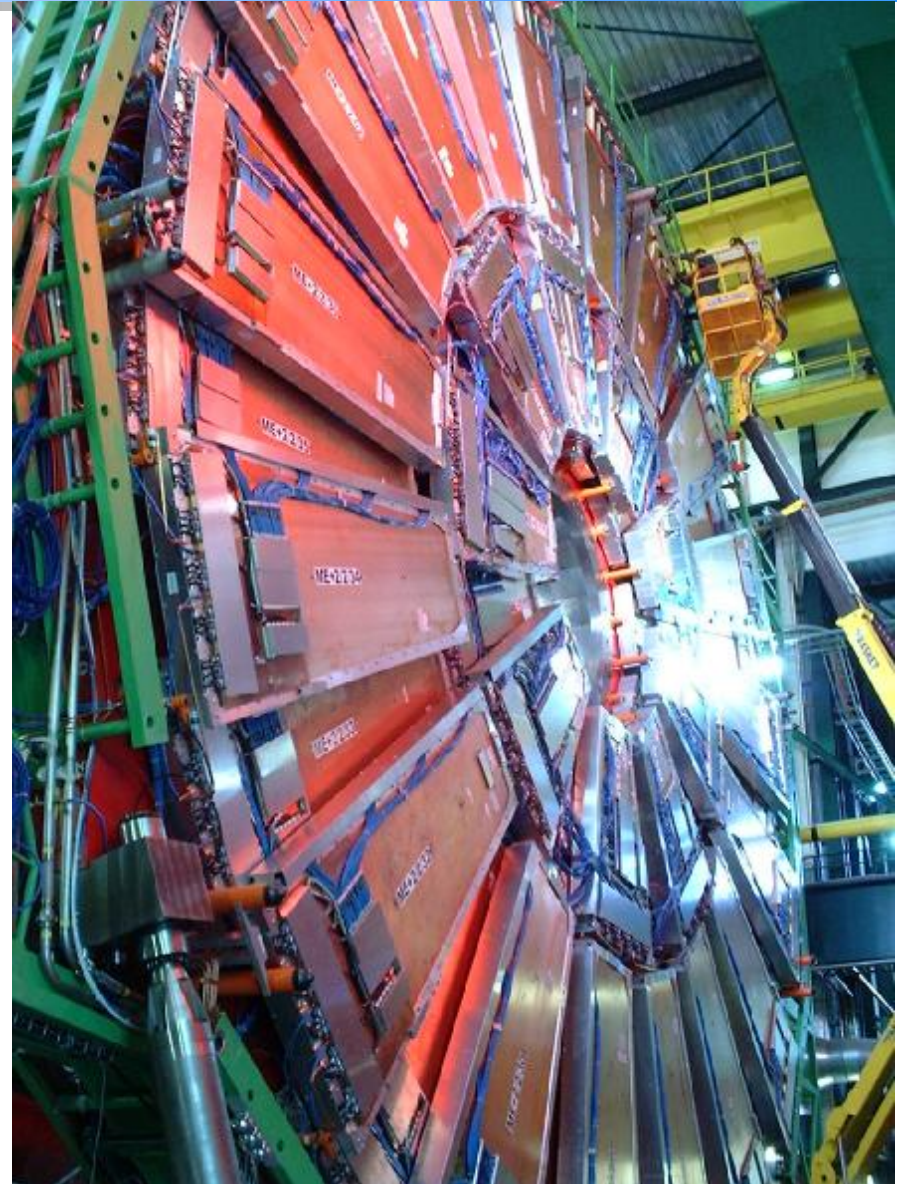


CSC installation: excellent progress

- **Installation of stations ME+/-2,3 are completed!**
- **216 CSC are installed.**

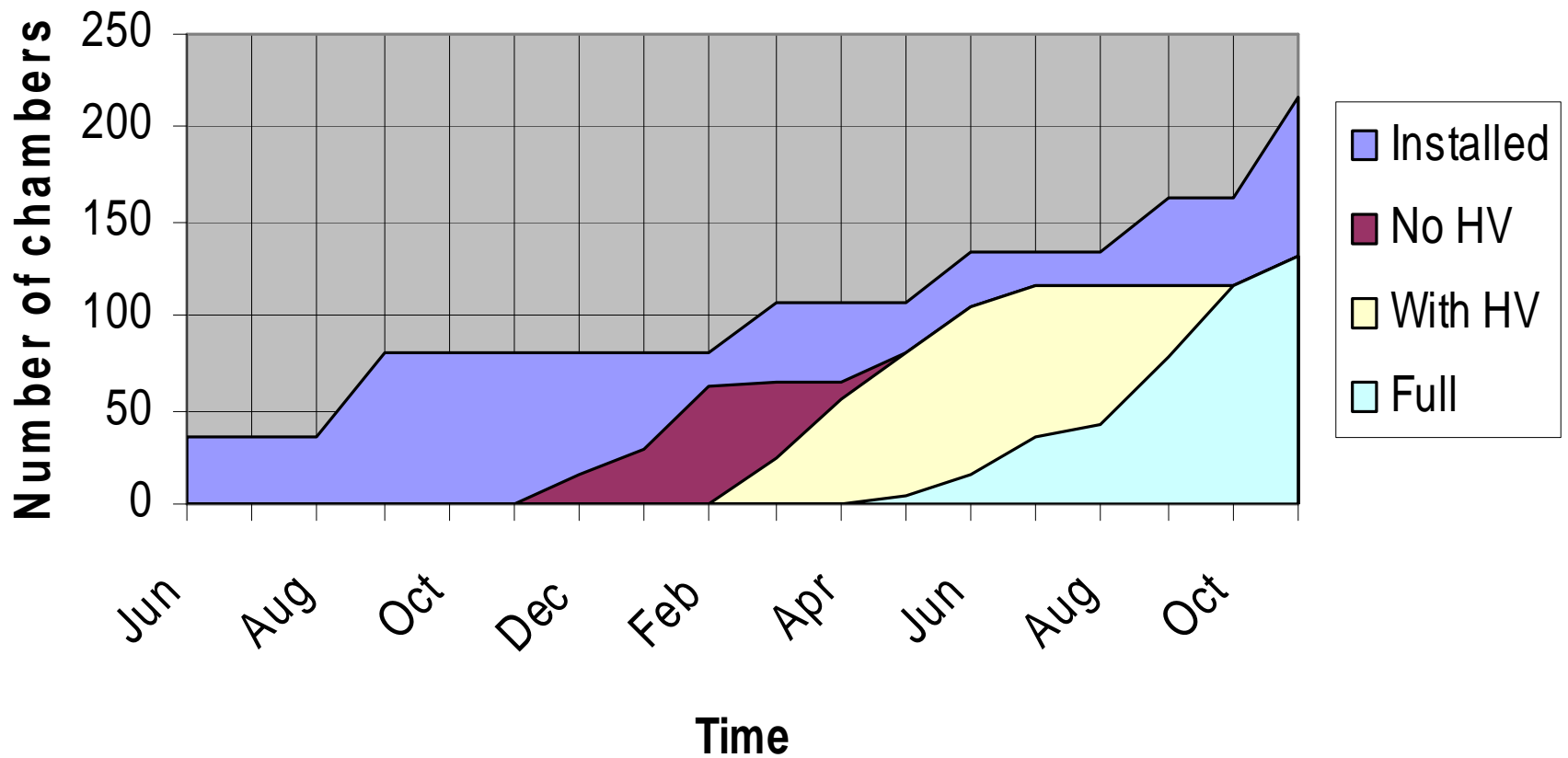
In 2005:

- **Install ME4/1**
- **Install ME1/1, back ME1/2 (schedule depends on other subsystems)**





Chamber commissioning at SX5



SX5 has used DAQ and software developed for FAST sites



Minister Fursenko at ISR



TEST B AREA @ November 27
2004





President Chirac at SX5

