

LHCf: installation & commissioning

Measurement of Photons and Neutral Pions in the
Very Forward Region of LHC

- Short introduction about LHCf
- Status of the detectors
- Status of the Arm1 installation

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Letter Of Intent: May 2004

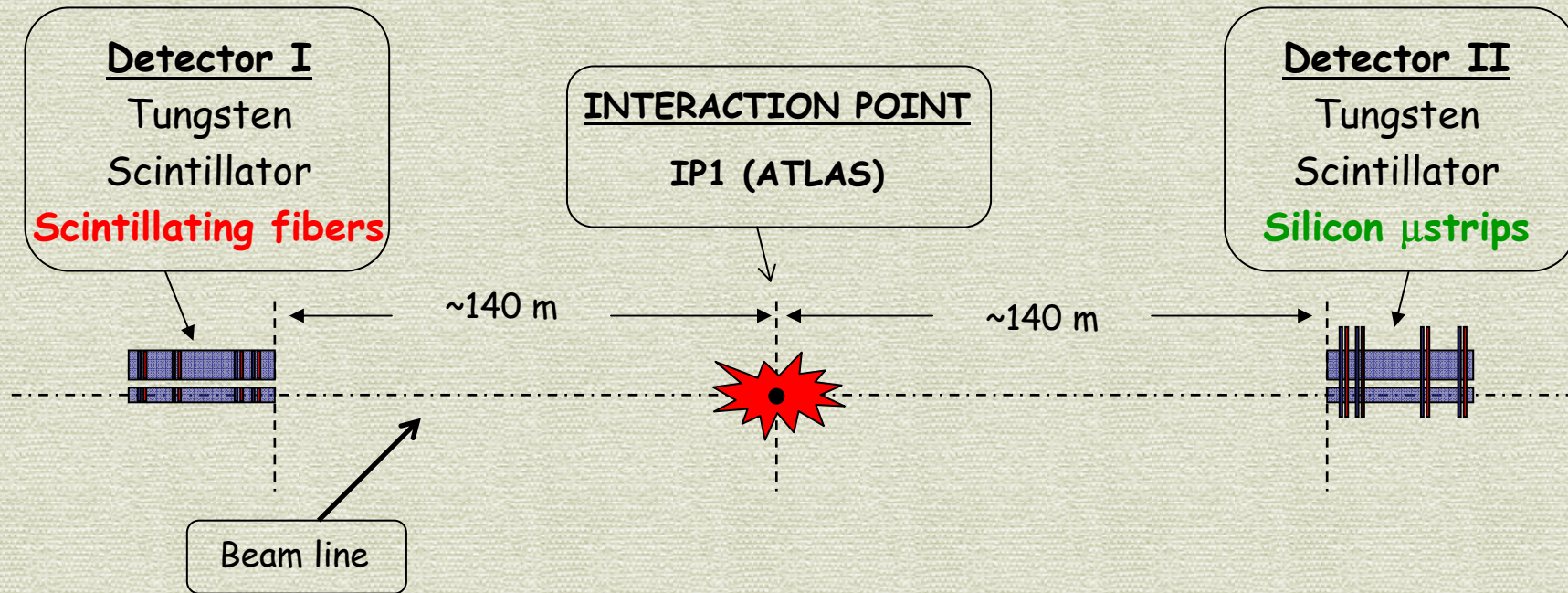
Technical report: September 2005

Technical Design Report: February 2006

LHCC approval: June 7th, 2006

- Neutral pions and photons production cross section at the highest energies in the very forward region
- $7 \text{ TeV} + 7 \text{ TeV} \rightarrow 10^{17} \text{ eV}$ in the laboratory frame
- Study of atmospheric showers
(Energy calibration, Nuclei identification)
- Cosmic ray physics \leftrightarrow Accelerator physics
- Data taking: beginning of LHC
(even at 450 GeV, see Sako-san tomorrow presentation)

LHCf location in the IP1 of LHC



Detectors should measure energy and position of γ from π^0 decays \longrightarrow e.m. calorimeters with position sensitive layers

Two independent detectors on both sides of IP1

- ✓ Redundancy
- ✓ Background rejection

Detector #1

Impact point (η)

2 towers ~24 cm long stacked vertically with 5 mm gap

Lower: 2 cm x 2 cm area

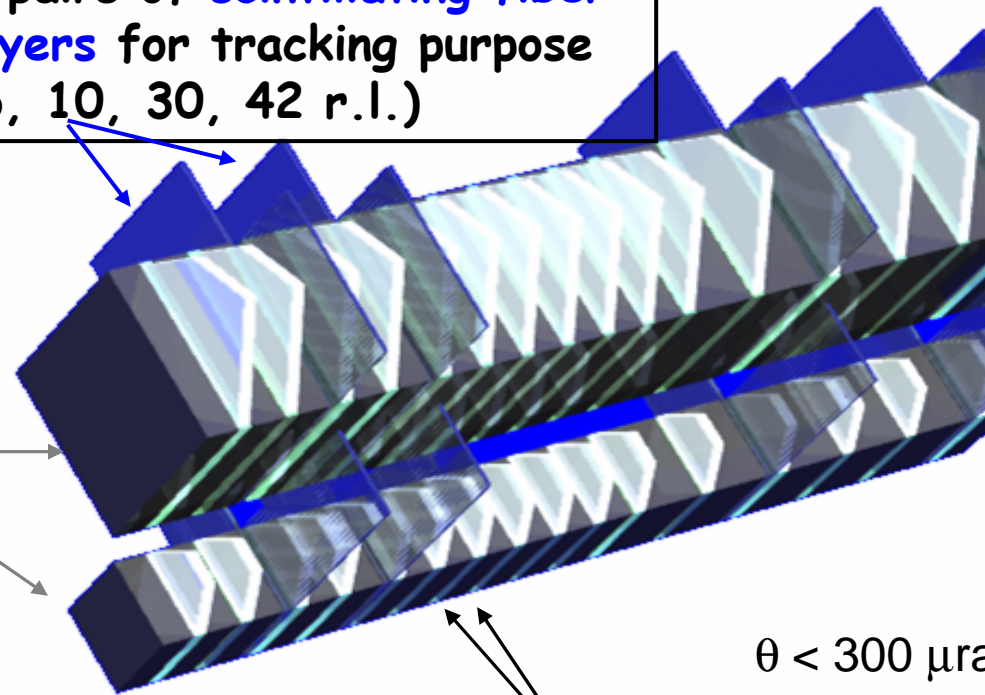
Upper: 4 cm x 4 cm area

4 pairs of scintillating fiber layers for tracking purpose (6, 10, 30, 42 r.l.)

Absorber

22 tungsten layers 7mm thick
→ 44 X_0 ($1.6 \lambda_I$) in total

(W: $X_0 = 3.5\text{mm}$, $R_M = 9\text{mm}$)



$\theta < 300 \mu\text{rad}$

Energy

16 scintillator layers (3 mm thick)

Trigger and energy profile measurements

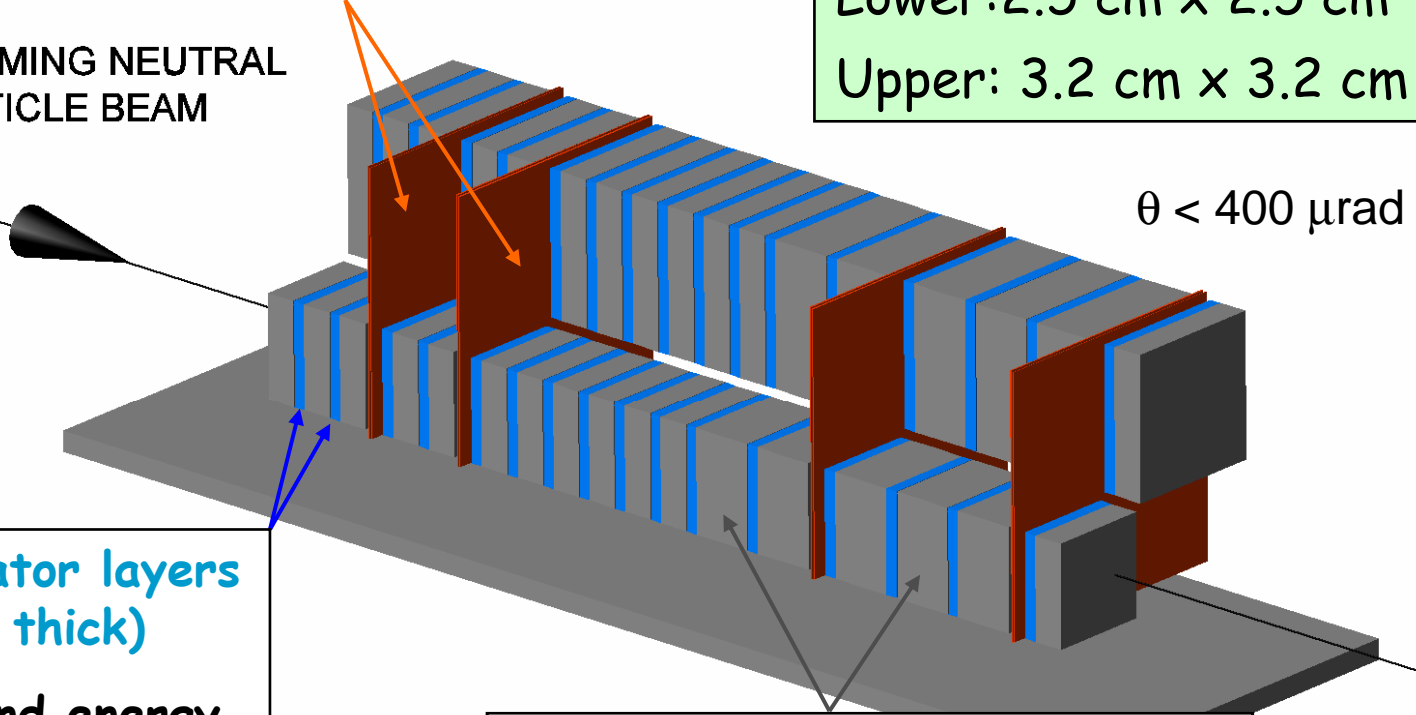
Detector # 2

We use LHC style electronics and readout

4 pairs of silicon microstrip layers (6, 12, 30, 42 r.l.) for tracking purpose (X and Y) → **impact point**

2 towers 24 cm long stacked on their edges and offset from one another
Lower: 2.5 cm x 2.5 cm
Upper: 3.2 cm x 3.2 cm

INCOMING NEUTRAL PARTICLE BEAM

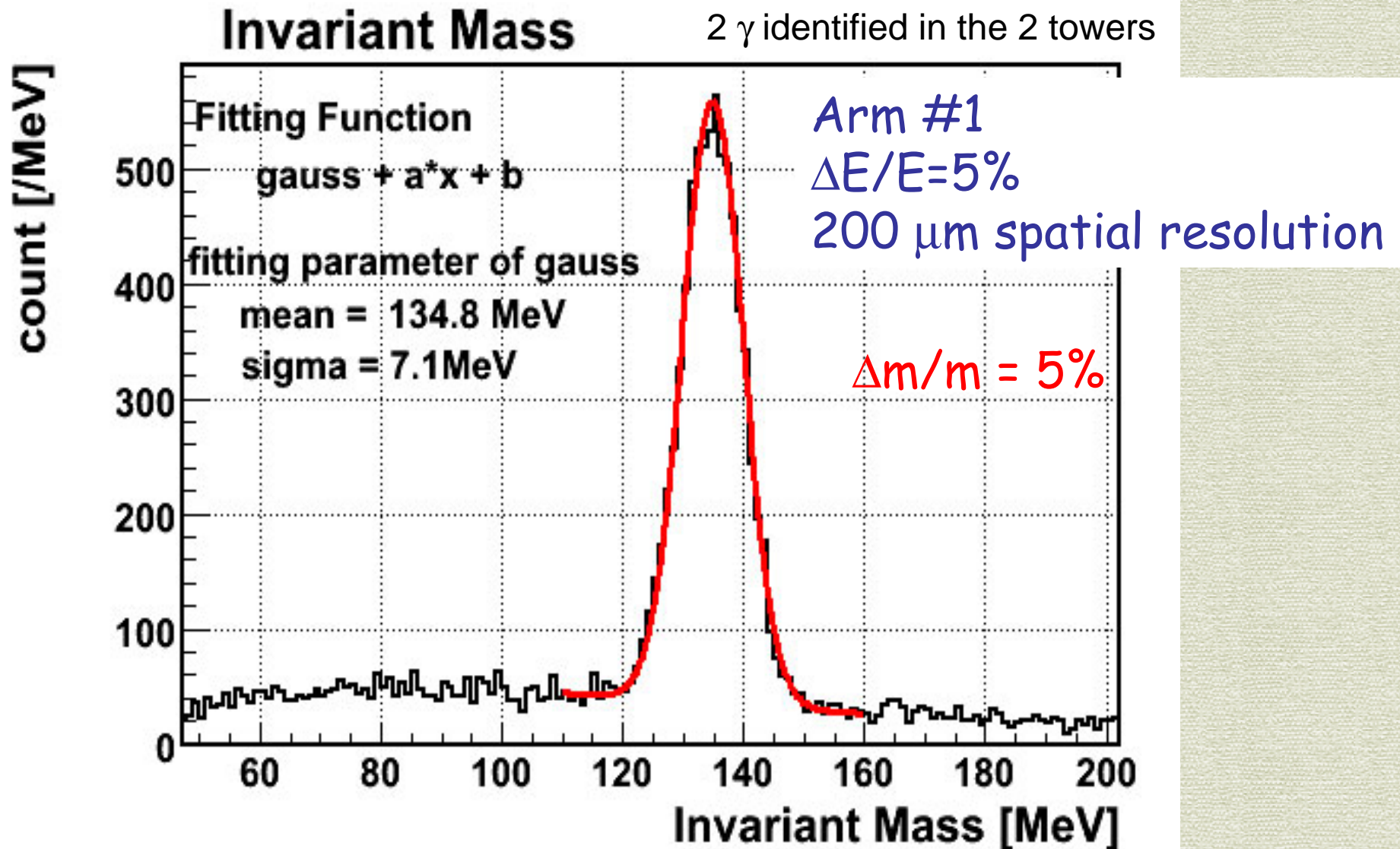


16 scintillator layers (3 mm thick)
Trigger and energy profile measurements

Absorber
22 tungsten layers 7mm thick
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Energy

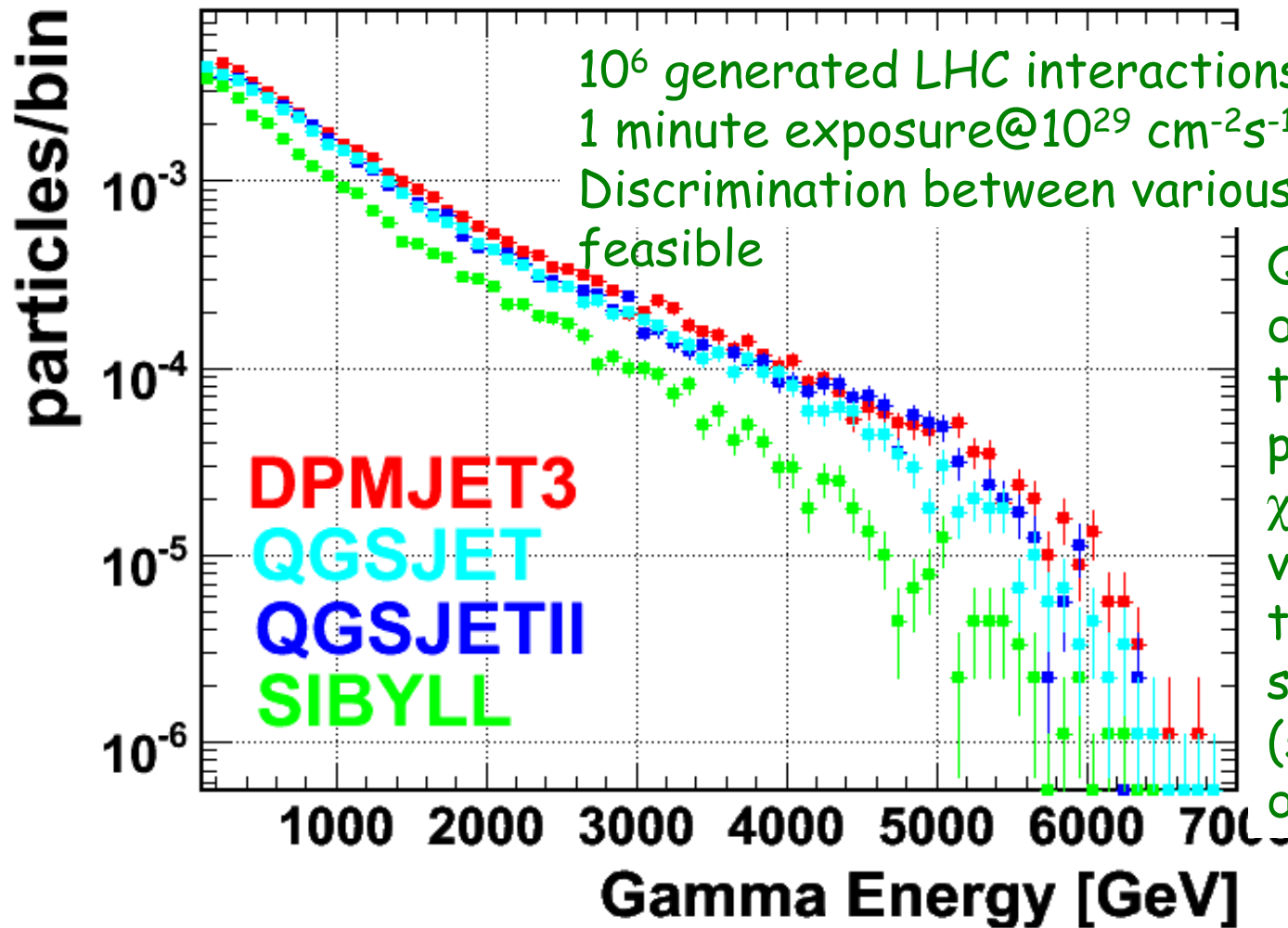
π^0 mass resolution



Monte Carlo γ ray energy spectrum

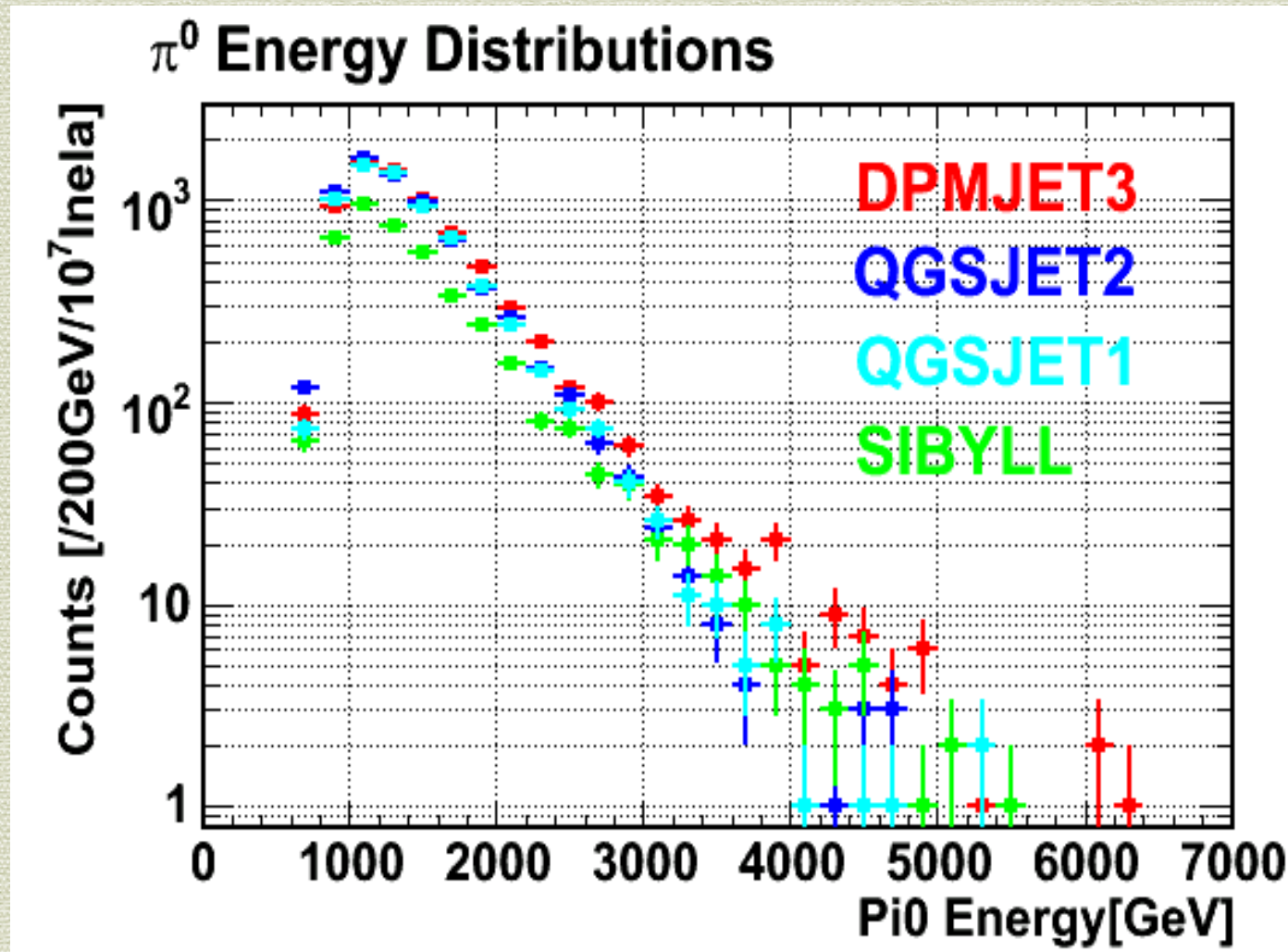
(5% Energy resolution is taken into account)

Gamma Energy Spectrum of 20mm square at Beam Center

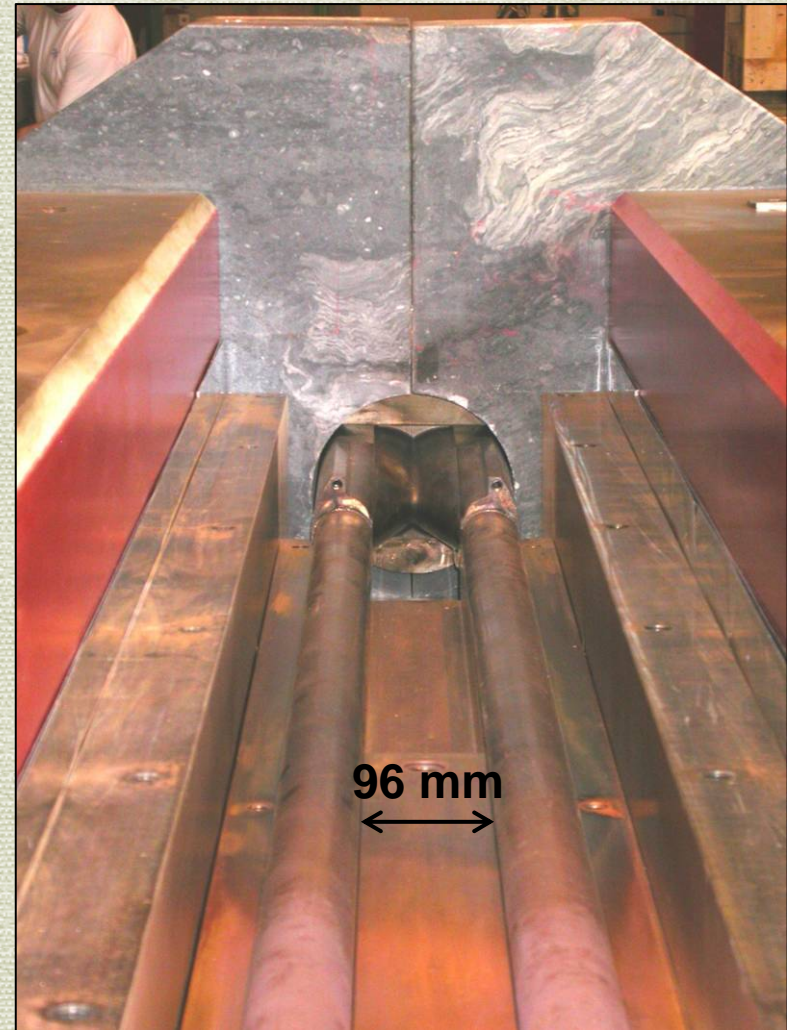
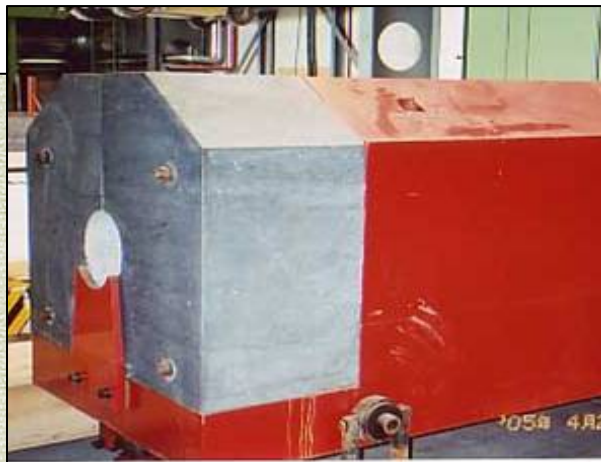
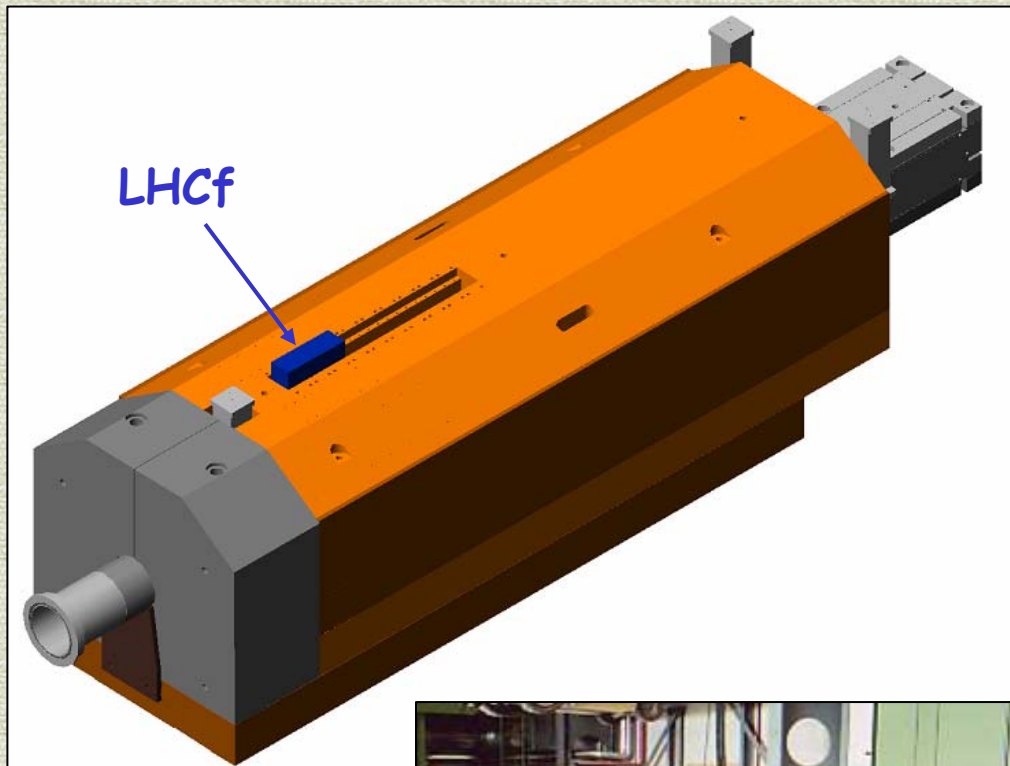


Quantitative
discrimination with
the help of a
properly defined
 χ^2 discriminating
variable based on
the spectrum
shape
(see TDR for
details)

Energy spectrum of π^0 expected from different models (Typical energy resolution of γ is 3 % at 1TeV)

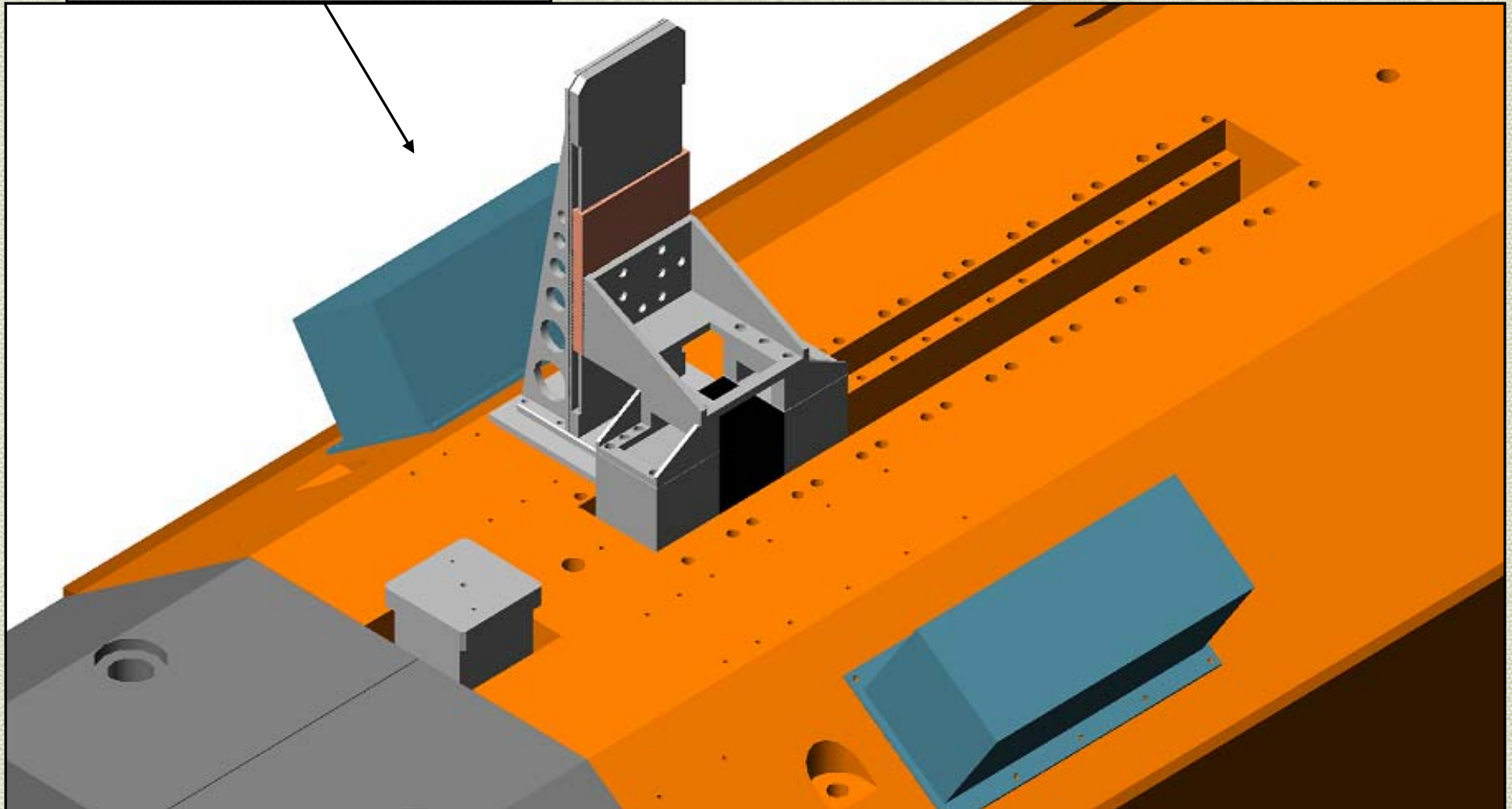


Installation of the detectors in the TAN absorbers at 140m from IP1



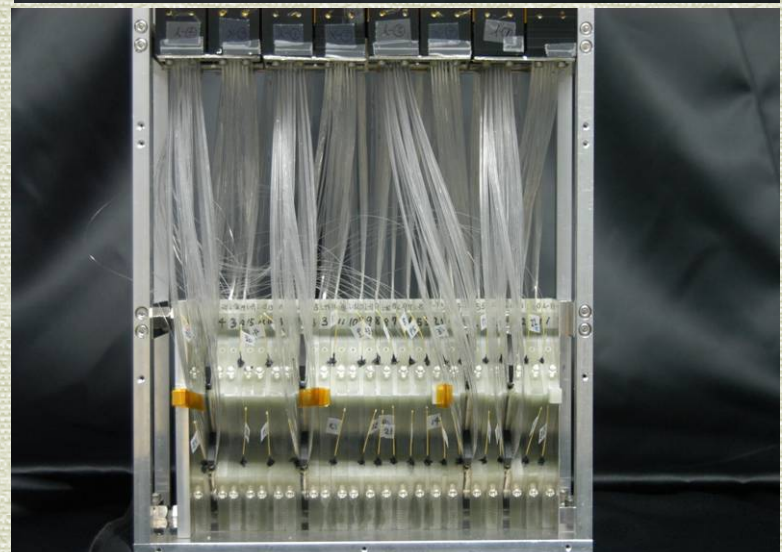
TAN and LHCF

box ~ $(15 \times 15 \times 40) \text{ cm}^3$



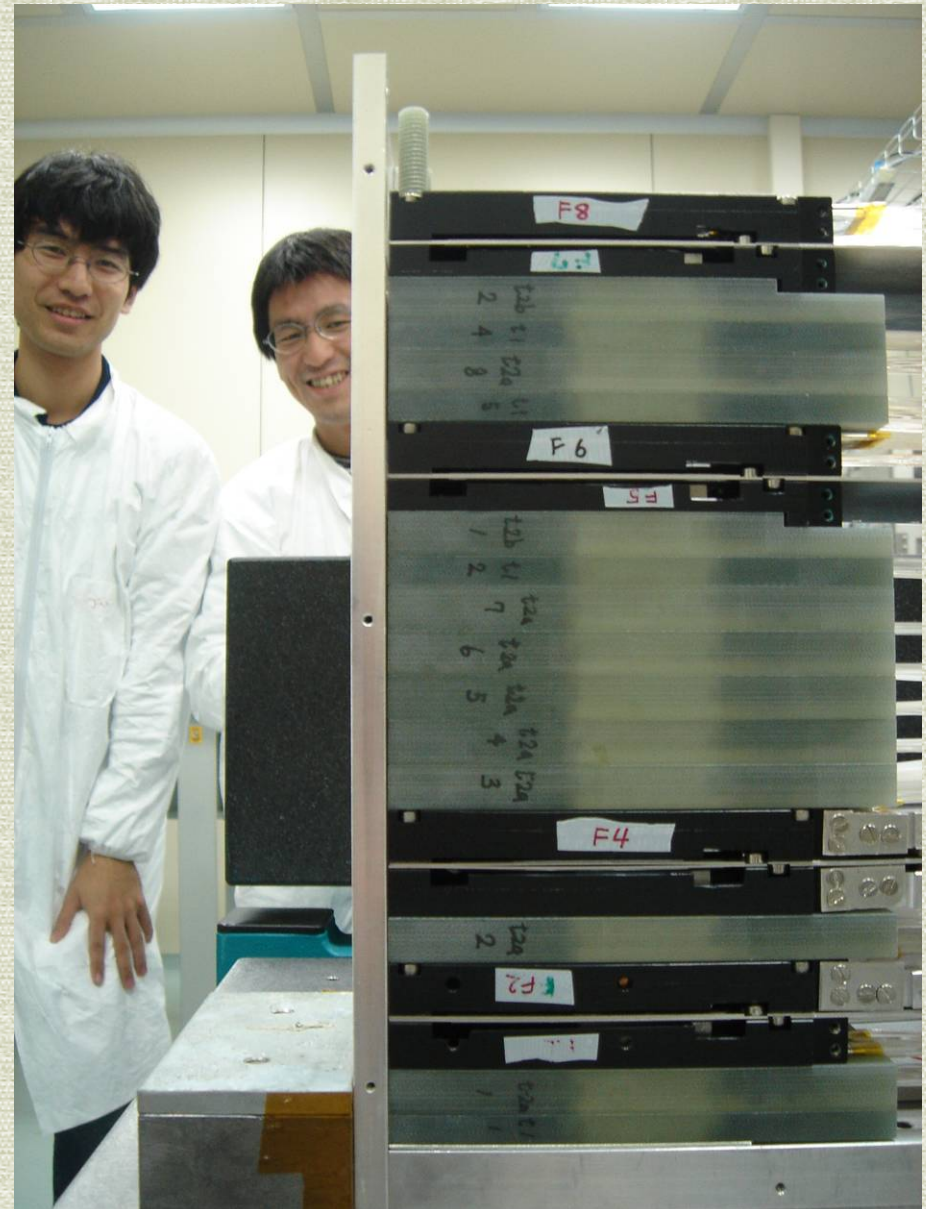
Where we are with Arm1?

- Arm1 was fully assembled in Japan in July 2006 (scintillators + fibers + Tungsten) and brought to CERN for the Beam Test of August 2006



Where we are with Arm2?

- Plastic scintillators + Light guides + Tungsten:
 - Production in Japan finished in July 2006
- Silicon modules:
 - 1 module is ready
 - 3 modules are in production
- Assembly of Arm2:
 - Preliminary assembly was done in August 2006 (Test beam)
 - Final assembly will be done in February 2007



SPS Beam Test

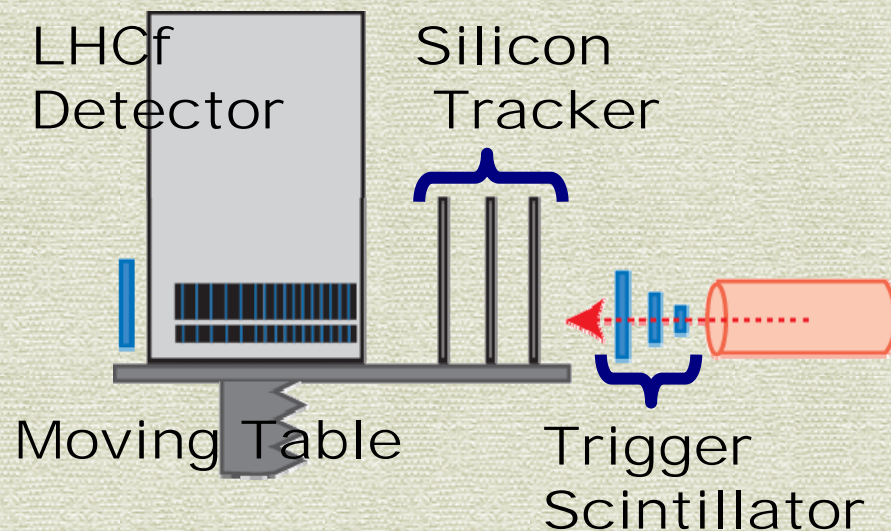
- CERN : SPS T2 H4
- 2006 Aug. 28 - Sep. 4
- Incident Particles
 - Proton 150,350 GeV/c
 - Electron 100,200 GeV/c
 - Muon 150 GeV/c

Test was successful

Analysis is under way for

- Energy calibration of the calorimeters
- Spatial resolution of the tracking systems

Setup





Adriani

Banerji

D' Alessandro

Hagenauer

Viciani

Turner

Tricoli

Torii

Tamura

Sumi

Shimizu

Kasahara

Masuda

Matsumoto

MenJo

Muraki

Noce

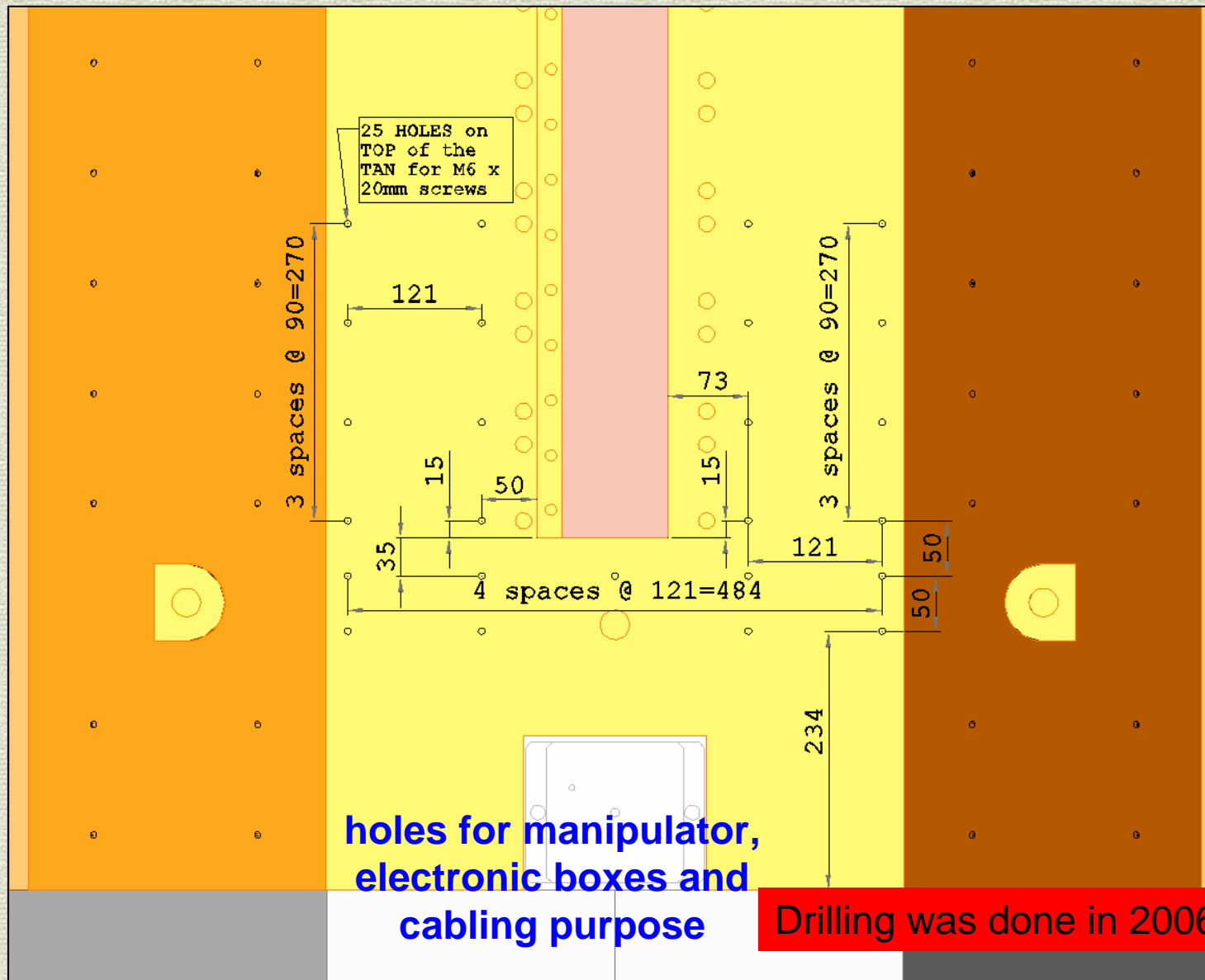
Sako

LHC Beam Test: 2006 AUG. - SEP

LHCf installation in the TAN

- Long preparatory job:
 - Modifications of the TAN
 - Transport machine / Fork lift
 - Cables from USA15 to tunnel
 - Electronic racks in USA15
- Pre-Installation (before baking out of the beam pipe)
- Final installation before closure of tunnel

Holes on the TAN - top and side face



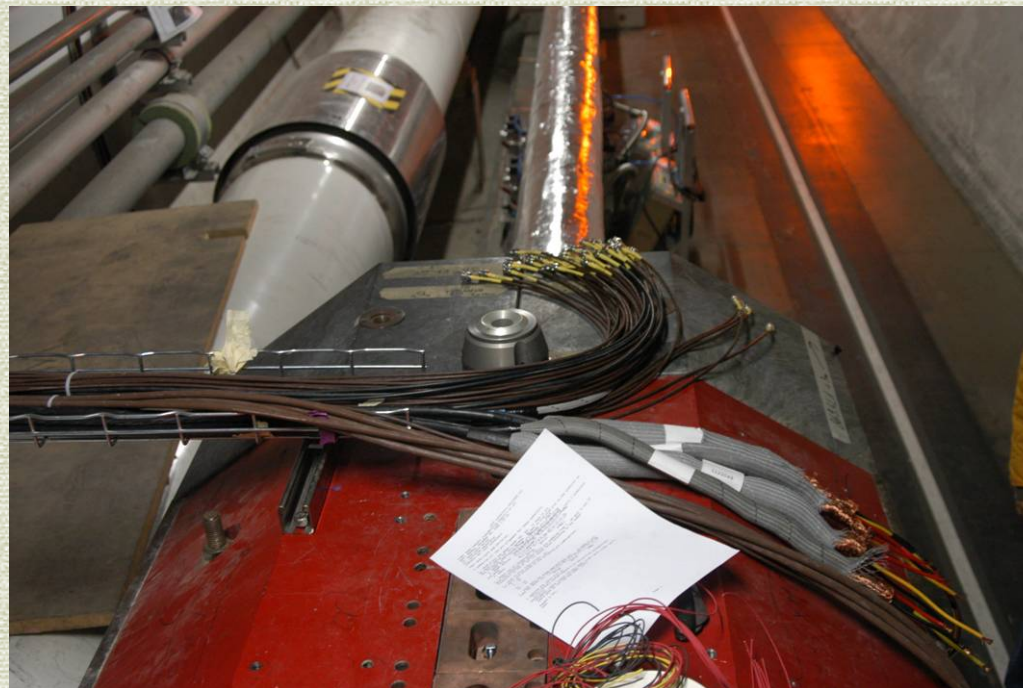
Transport in the tunnel

Modification of the transporter Fork Lift to allow LHCf transportation in the tunnel and insertion in the TAN



Cables installation

- Most of the control electronics and all the power supply system are located in the USA15 Atlas control room
- > 200 m distance!!!
- All the necessary cables have been pulled (~100 cables!!!)
- Connector work is almost finished
- All the optical fibers 'guides' have been installed
- Optical fibers for Arm1 were blown in the guides
- Optical fibers for Arm2 will be pulled in the next few weeks



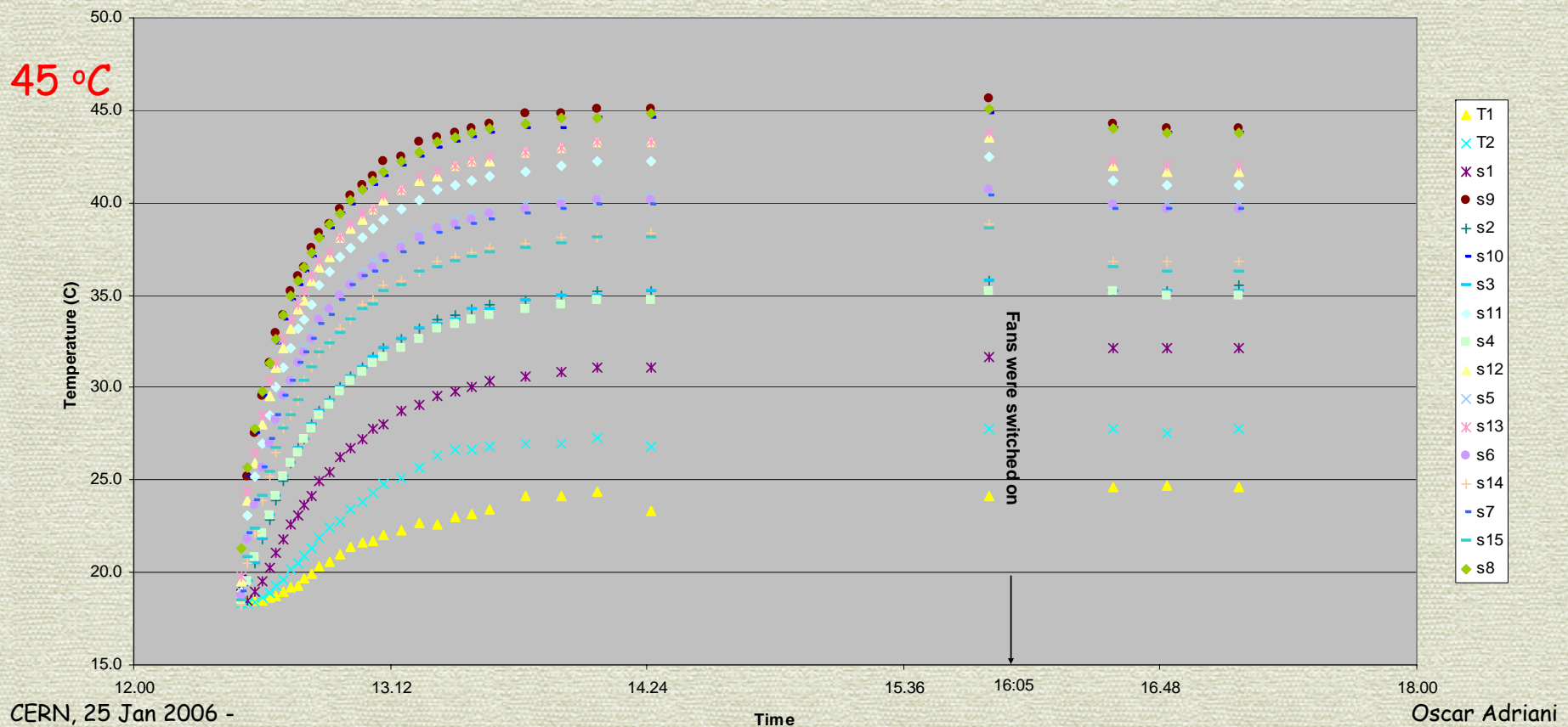
Electronic racks in USA15

- 2 racks are allocated for LHCf in USA15
 - Power supply
 - DAQ computers
 - VME crates
 - NIM crates
 - Patch panels
 - Laser system (calibration)



Thermal tests in the TAN

- 100 W dissipated deeply inside the TAN
- Temperature measurements were done in the real TAN with a thermal model of LHCf in November 2006
- No major problems (no cooling is necessary!!!!)



Now the real installation in LHC...

The idea is that installation takes place in 2 steps:

Pre-installation

Final installation

In between the 2 installation the baking out of the beam pipe will be done (200 °C), so the detectors should be removed

Pre-Installation dates have been fixed in Fall 2006

- LSS1L (Arm1)

 - 8/01/2007 to 26/01/2007 → FINISHED!

- LSS1R (Arm2)

 - 23/04/2007 to 11/05/2007

The dates for the final installation are still under discussion (possibly after the beam test in August 2007?)

Arm1 pre-installation

Thanks to all
people involved in
the installation!!!!

- TS/LEA
- Transport team
- Cables team
- Atlas
- Safety
- Etc. etc. etc.

From 8/01/2007 to 26/01/2007

No major problems came out

Cables → OK

Transport and installation → OK

Laser calibration → OK

Power supply from USA15 → OK

Manipulator and movements → OK

Arm1 was dismantled yesterday

Small increase of noise is under
investigation (grounding?)

TAN slot before and after CU bars removal

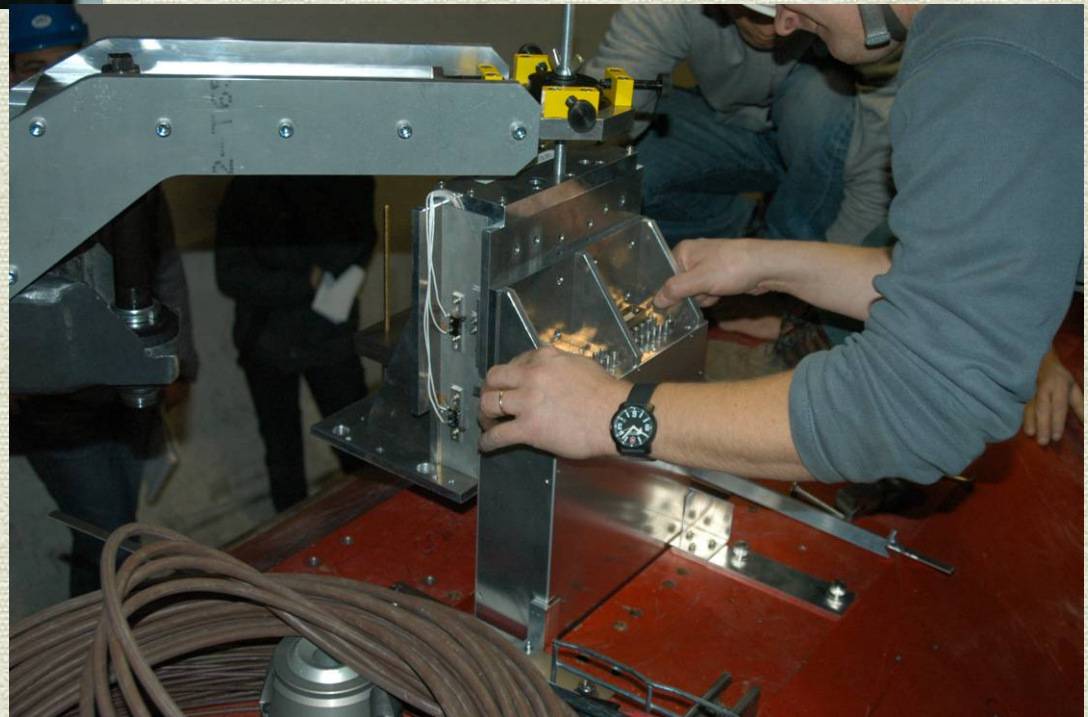
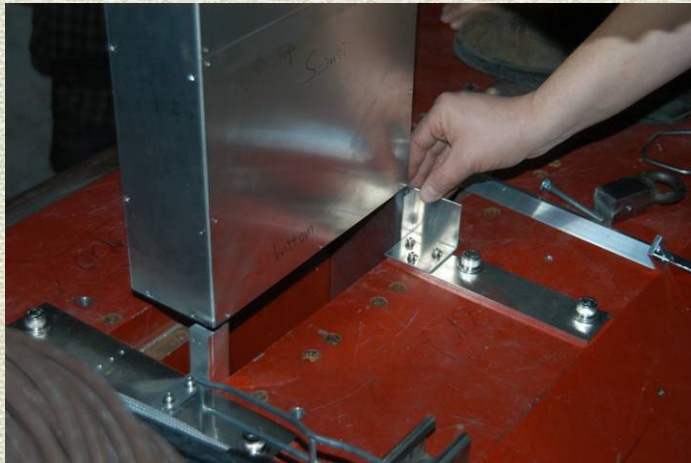


CERN, 25 Jan 2006 -



Oscar Adriani

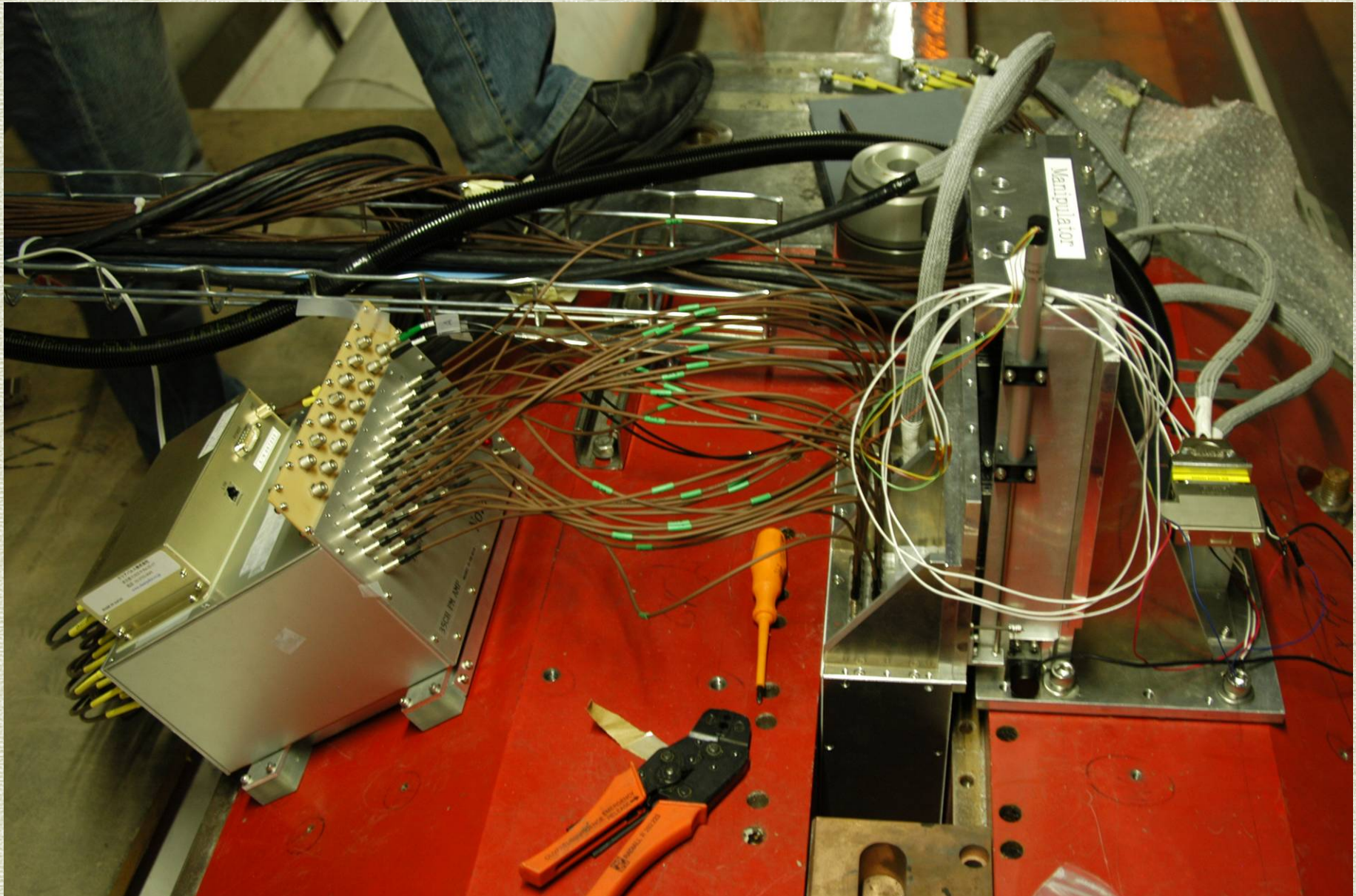
Transport and insertion in the TAN



LHCf Arm 1 - Installation completed
within 15 minutes!



Arm1 and the electronic box



Laser for calibration (USA15 and tunnel)



Conclusions

- A huge work has been done to organize the installation
- Pre-installation of Arm1 was succesful
- Pre-installation of Arm2 will be done in April
- Final installation dates are under discussion
- LHCf will be ready for the first LHC collisions!