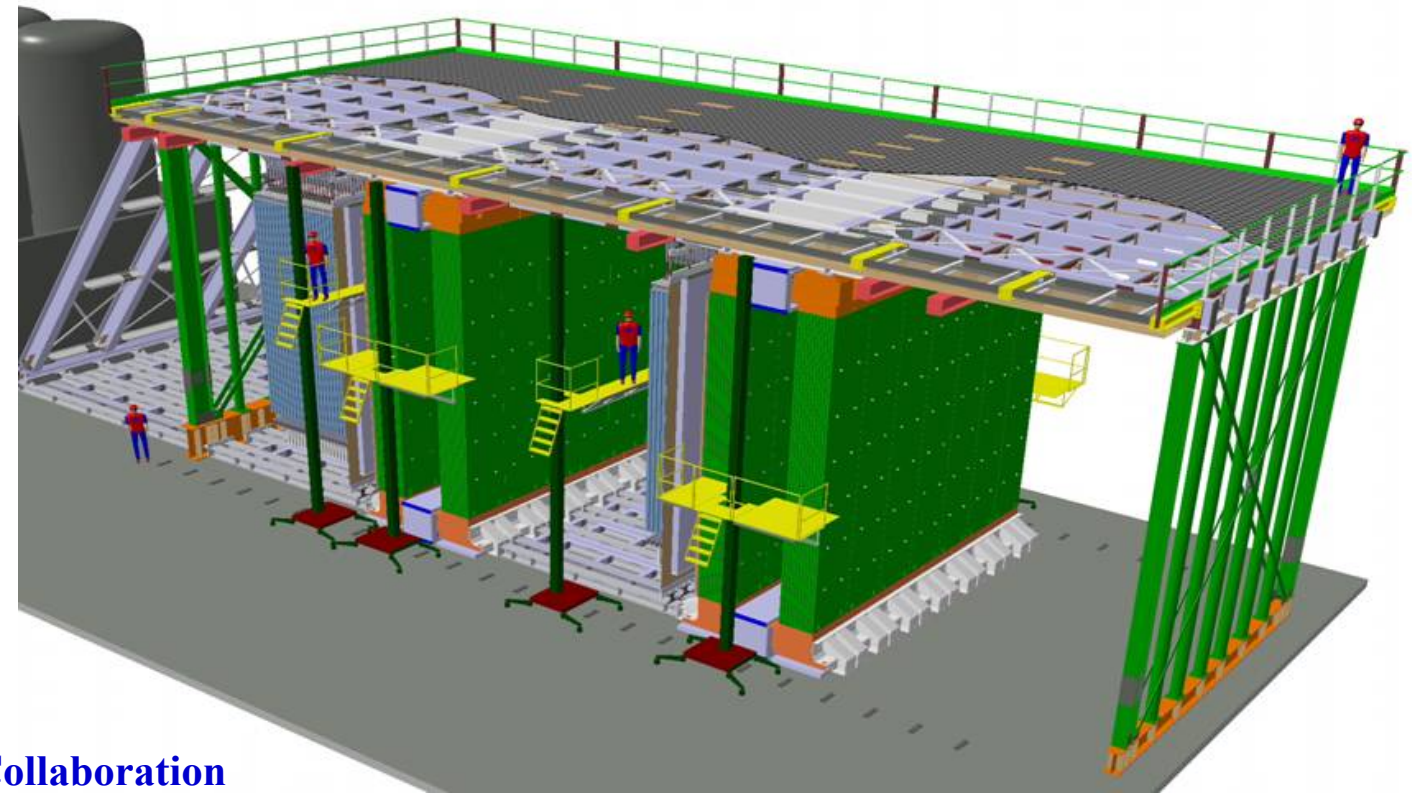
SPS Committee
Status of OPERA/CNGS1
July 6th , 2004

1. Achieved and next Milestones
2. Status of detector construction
3. Physics Performance: update
4. Conclusions



Yves Déclais
on behalf of the OPERA Collaboration

COLLABORATION

36 groups
~ 165 physicists

Belgium
IIHE(ULB-VUB) Brussels

Bulgaria
Sofia University

China
IHEP Beijing, Shandong

Croatia
Zagreb University

France
LAPP Annecy, IPNL Lyon, LAL Orsay, IRES Strasbourg

Germany *
Berlin, Hagen, Hamburg, Münster, Rostock

Israel
Technion Haifa

Italy
Bari, Bologna, LNF Frascati, L'Aquila, LNGS, Naples, Padova, Rome, Salerno

Japan
Aichi, Toho, Kobe, Nagoya, Utsunomiya

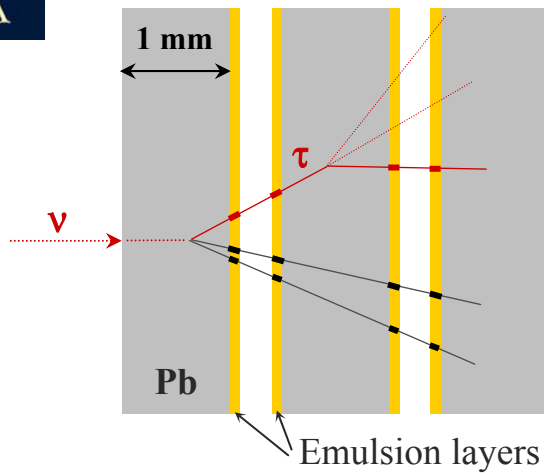
Russia
INR Moscow, ITEP Moscow, JINR Dubna, Obninsk

Switzerland
Bern, Neuchâtel

Turkey
METU Ankara

•German participation to OPERA now granted

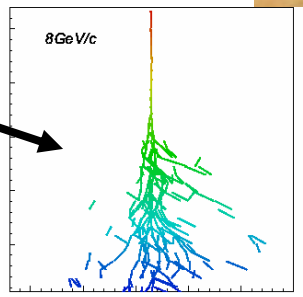
The basic unit : the « brick »

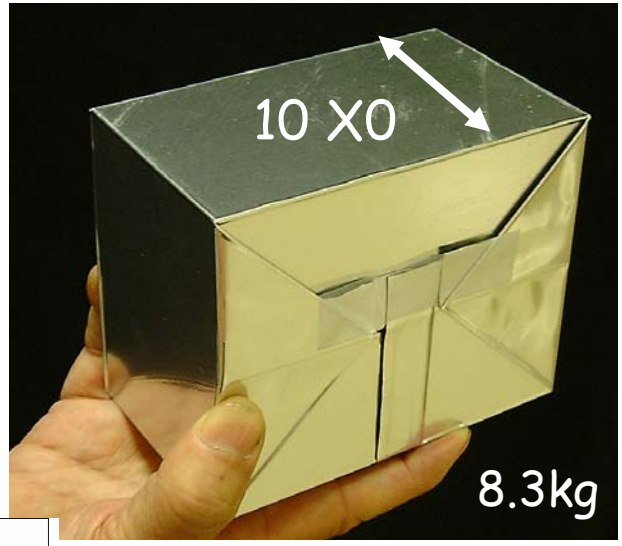


- Based on the concept of the Emulsion Cloud Chamber (**ECC**)
- **56 Pb sheets 1mm + 56 emulsion layers**
- Solves the problem of compatibility of large mass for neutrino interactions + high space resolution in a completely **modular** scheme

ECC are completely stand-alone detectors:

- Neutrino interaction vertex and kink **topology** reconstruction
- Measurement of the **momenta** of hadrons by multiple scattering
- **dE/dx** pion/muon separation at low energy
- **Electron identification** and measurement of the energy of the electrons and photons





10.2 x 12.7 x 7.5 cm

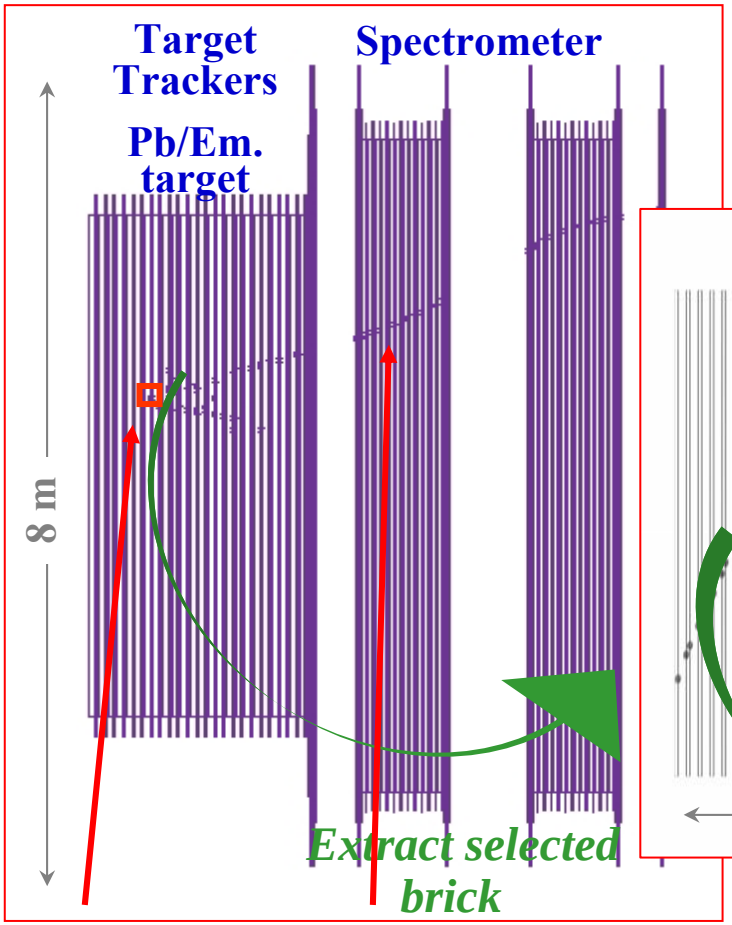
ECC Tecnique validated by the direct observation of ν_τ: **DONUT** 2000

Use of the Electronic detectors

- **trigger** and **localization** of neutrino interactions
- **muon** identification and momentum/charge measurement

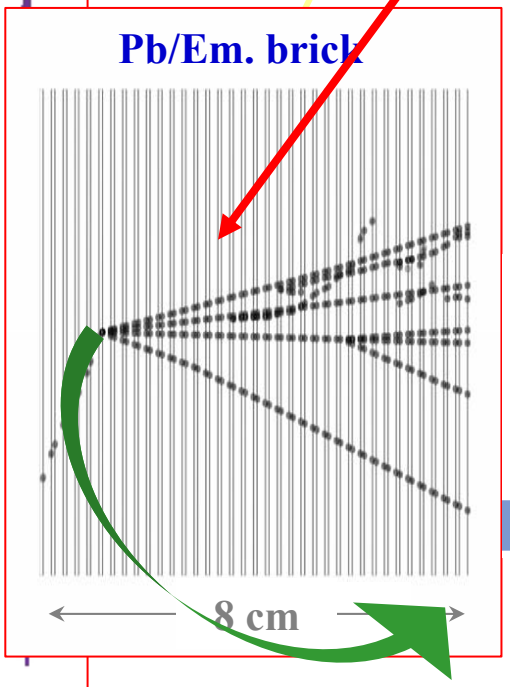
→ need for a **hybrid** detector

Electronic detectors:

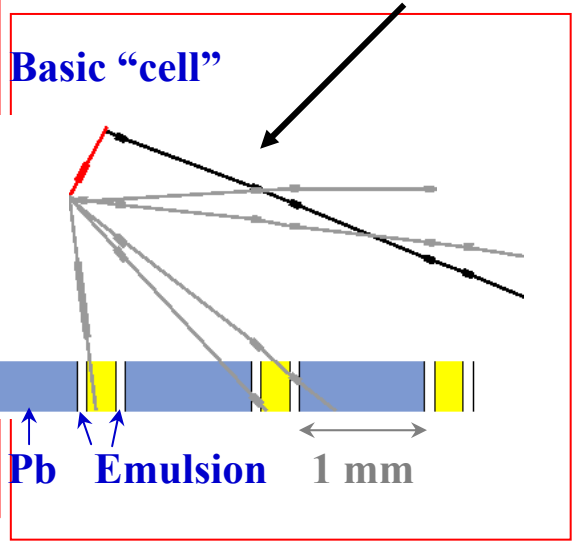


ECC emulsions analysis:

Vertex, decay kink e/γ ID, multiple scattering, kinematics



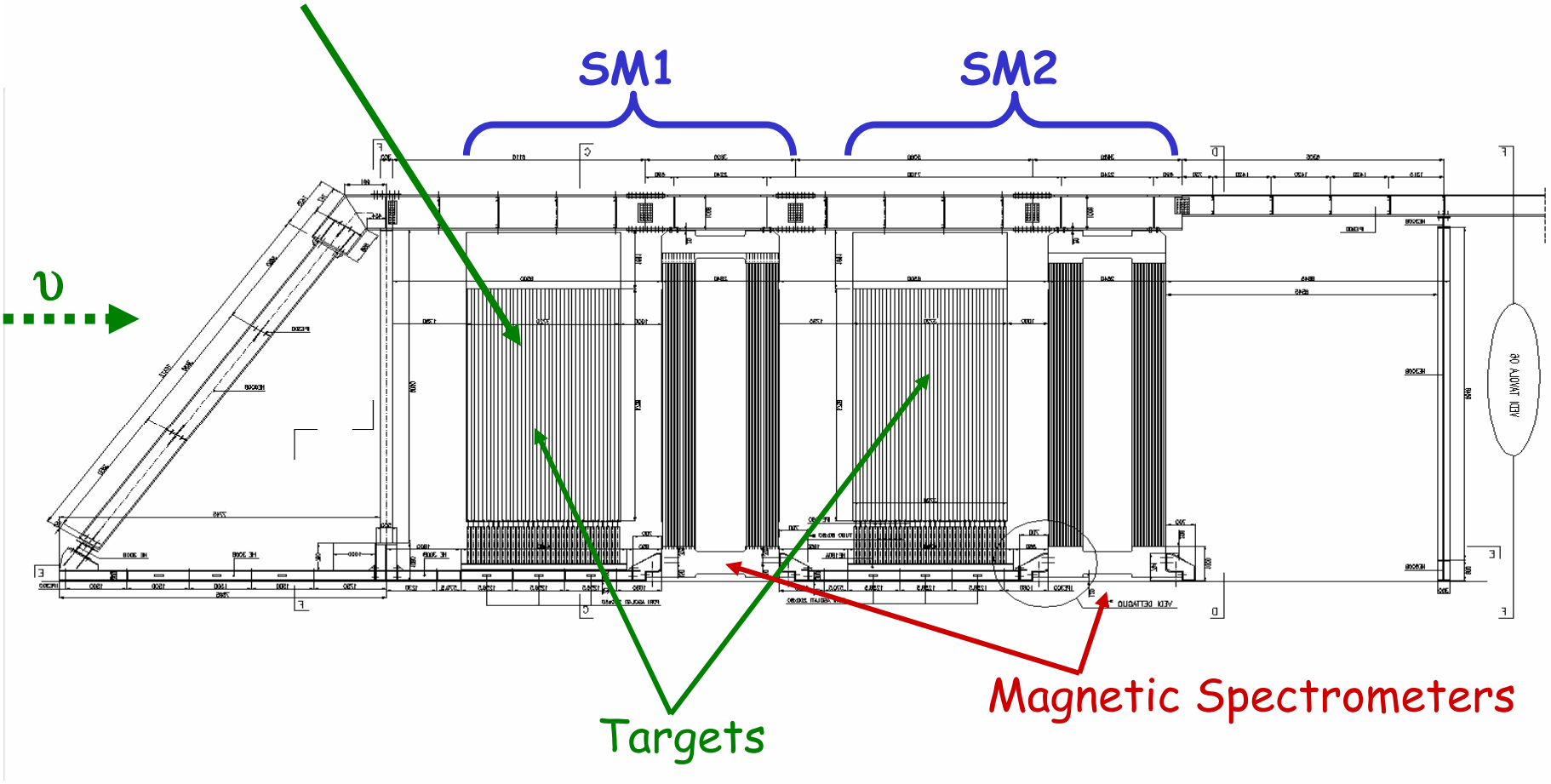
Link to mu ID,
Candidate event



Brick finding, muon ID, charge and p

OPERA structure with two Super-Modules

31 target planes / supermodule (in total: 206336 bricks, 1766 tons)



Proposal: July 2000, installation at LNGS started in May 2003

Milestones

Achieved :

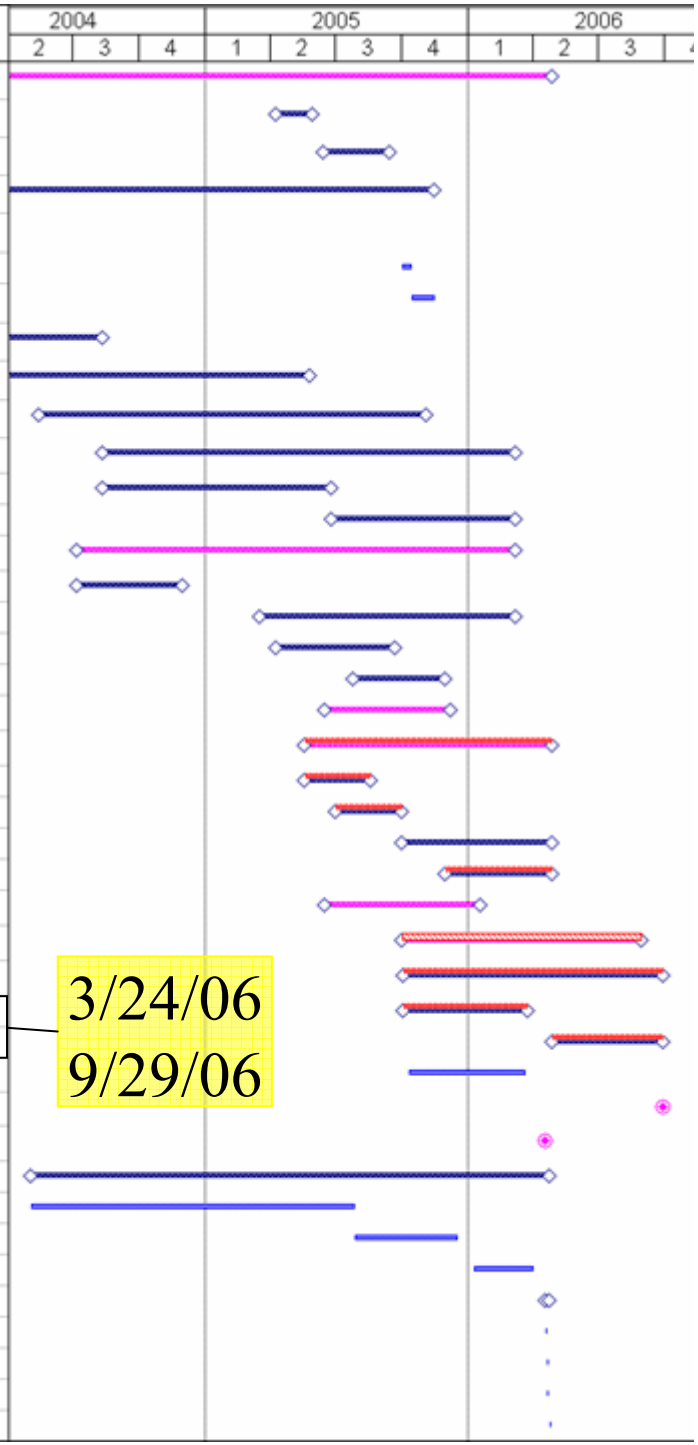
- **Refreshing facility installed**
- **First magnet completed**
- **Brick packaging decision**
- **BAM ordering**
- **Scanning speed 20cm^2/h**

Next Milestones

1. **Target installation commissioning: sep 04**
2. **Emulsion delivery @ LNGS : oct 04**
3. **BMS automation validation : dec 04**
4. **BAM commissioning @ factory : feb 05**
5. **Start brick filling : sep 05**

General Planning

ID	Task Name	Duration	Start	Finish
226	INSTALLATION IN GS EXPERIMENT HALL C	153.83 w	Mon 2/10/03	Thu 4/27/06
227	C R & ELECTRONIC ROOM	7 w	Fri 4/8/05	Mon 5/30/05
233	BAM	13 w	Mon 6/13/05	Wed 9/14/05
237	SPECTROMETERS (2 MAGNETS & RPC's)	134.03 w	Mon 2/10/03	Mon 11/14/05
238	Preliminary working	15 w	Mon 2/10/03	Wed 5/28/03
239	Veto plane mechanics	2 w	Fri 9/30/05	Fri 10/14/05
240	Veto plane detector	4 w	Fri 10/14/05	Mon 11/14/05
241	Magnet 1	58.35 w	Fri 5/30/03	Wed 8/11/04
274	Magnet 2	95.15 w	Fri 5/30/03	Wed 5/25/05
311	TARGET TRACKERS MOUNTING	72 w	Fri 5/14/04	Fri 11/4/05
330	TARGET WALLS	73.94 w	Wed 8/11/04	Tue 3/7/06
331	SM1	41.18 w	Wed 8/11/04	Fri 6/24/05
410	SM2	32.76 w	Fri 6/24/05	Tue 3/7/06
489	XPC's & PRECISION TRACKERS	79.34 w	Mon 7/5/04	Tue 3/7/06
490	XPC 1	20.88 w	Mon 7/5/04	Tue 11/30/04
496	Precision tracker 1	46.24 w	Wed 3/16/05	Tue 3/7/06
529	XPC 2	23.05 w	Fri 4/8/05	Wed 9/21/05
535	Precision tracker 2	18 w	Mon 7/25/05	Tue 11/29/05
568	CABLING (detector to control room)	24.35 w	Wed 6/15/05	Tue 12/6/05
571	MANIPULATORS	44.8 w	Wed 5/18/05	Thu 4/27/06
572	SM1 cavern side	13 w	Wed 5/18/05	Fri 8/19/05
578	SM1 corridor side	13 w	Thu 6/30/05	Fri 9/30/05
585	SM2 cavern side	25.8 w	Fri 9/30/05	Thu 4/27/06
589	SM2 corridor side	17.43 w	Wed 11/30/05	Thu 4/27/06
594	COMMISSIONNING WITHOUT BRICKS	27.35 w	Wed 6/15/05	Tue 1/17/06
597	ECC BRICK MANUFACTURING WITH BAM	43 w	Fri 9/30/05	Wed 8/30/06
599	WALL BRICK FILLING (2b/min 8h/day)=960 bricks)	47.2 w	Mon 10/3/05	Fri 9/29/06
600	SM1 brick filling	21.6 w	Mon 10/3/05	Fri 3/24/06
602	SM2 brick filling	21.6 w	Thu 4/27/06	Fri 9/29/06
604	COSMIC DATA TAKING WITH BRICKS	20 w	Mon 10/10/05	Tue 3/21/06
605	FULL DETECTOR COMPLETED	0 d	Fri 9/29/06	Fri 9/29/06
606	CNGS Beam delivery	0 d	Wed 4/19/06	Wed 4/19/06
607	OPERA RUNNING	94.6 w	Mon 5/3/04	Mon 4/24/06
608	OPERA LNGS external building	60 w	Mon 5/3/04	Wed 7/27/05
609	Emulsion processing laboratory	20 w	Thu 7/28/05	Fri 12/16/05
610	Processing tests	12 w	Mon 1/9/06	Fri 3/31/06
611	OPERA brick processing cycle	0.8 w	Wed 4/19/06	Mon 4/24/06
612	First brick extraction	1 d	Wed 4/19/06	Wed 4/19/06
613	Brick cosmic rays exposure	1 d	Thu 4/20/06	Thu 4/20/06
614	Emulsion development	1 d	Fri 4/21/06	Fri 4/21/06
615	Emulsion shipping to scanning labs	1 d	Mon 4/24/06	Mon 4/24/06



Magnet installation

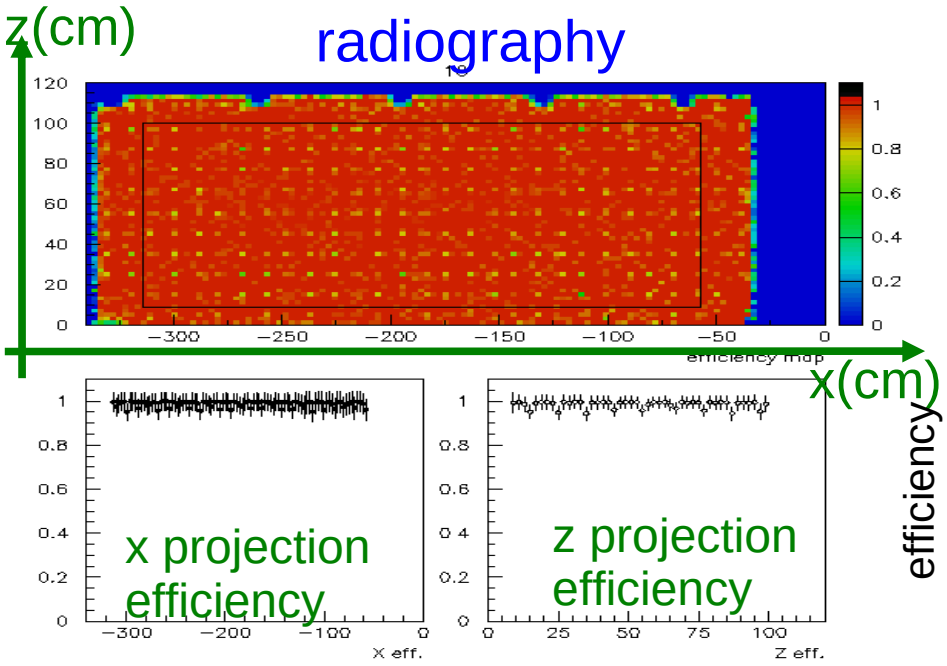
OPERA in Hall C : end of june 04

SM1 & SM2 Superstructures in the factory

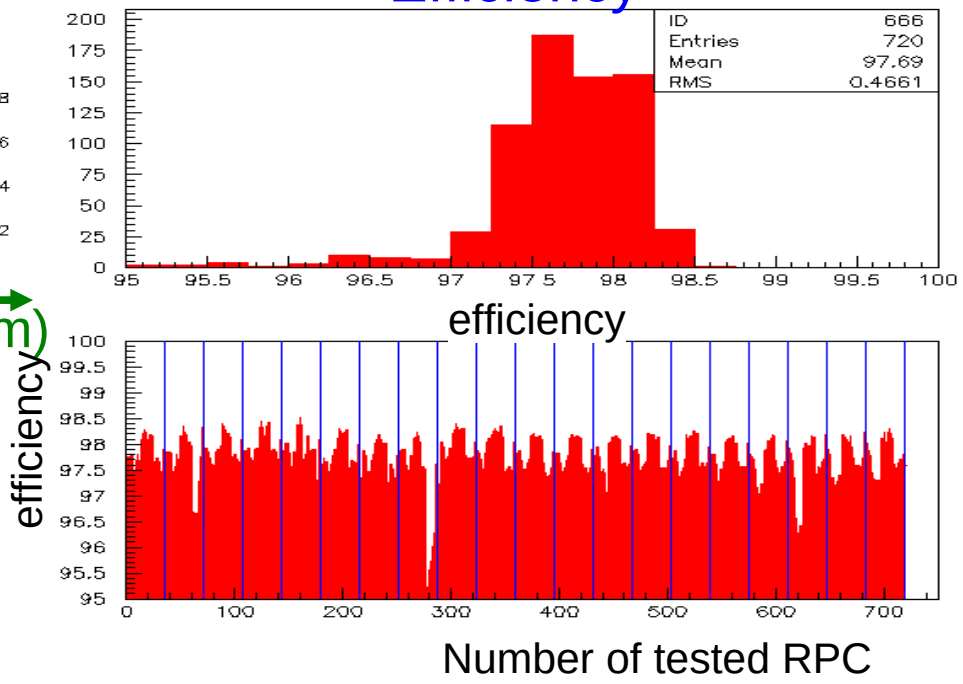
RPCs : tests and installation

- **End installation 1rst Spectrometer on May 19th, with success**
- **End production RPC but some contingency due to high level rejection (20%)**
- **End production of strips**
- **Electronics in a good shape (FEB with some month delay, DAQ controller ready)**
- **Ready to start installation 2nd Spectrometer in September**

RPC radiography



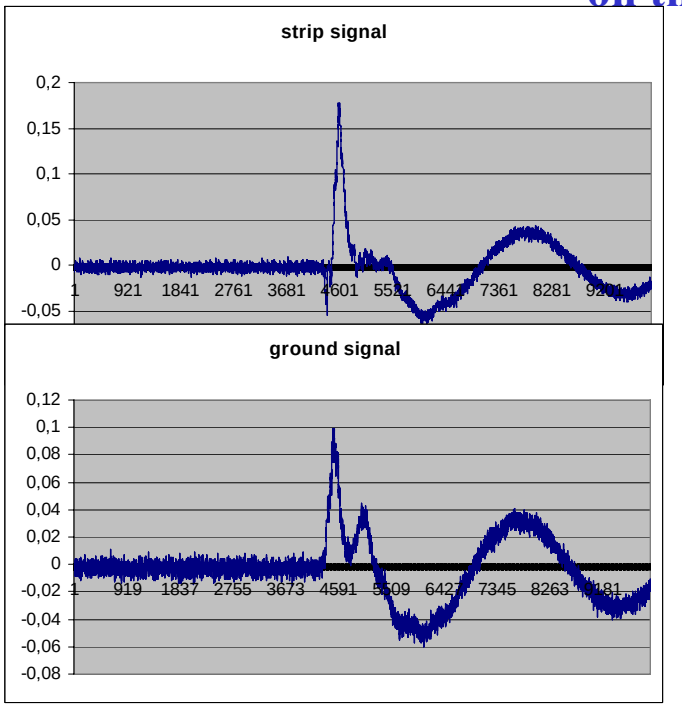
RPC Average Efficiency

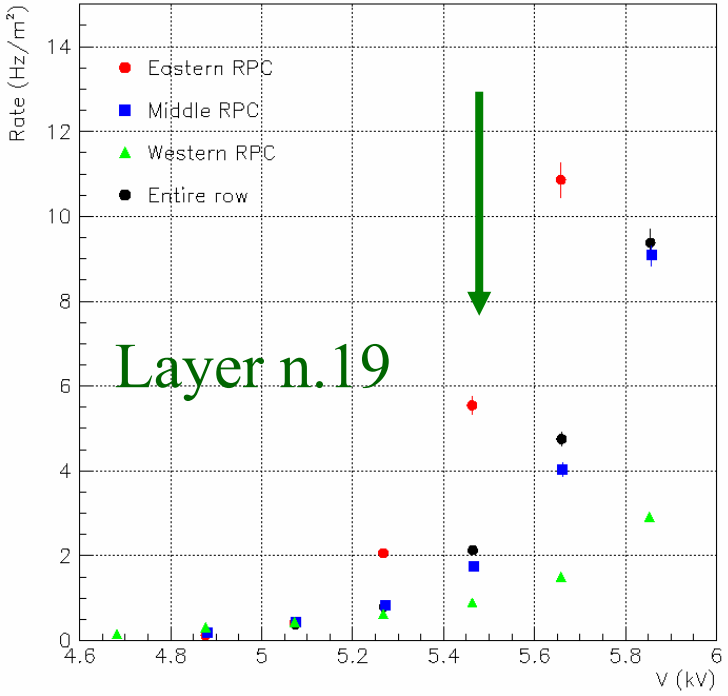


RPCs : Tests in situ

Gaz : $Ar/C_2H_2F_4/i\text{-}C_4H_{10}/SF_6$=75/20/4/1 (premixed bottles)

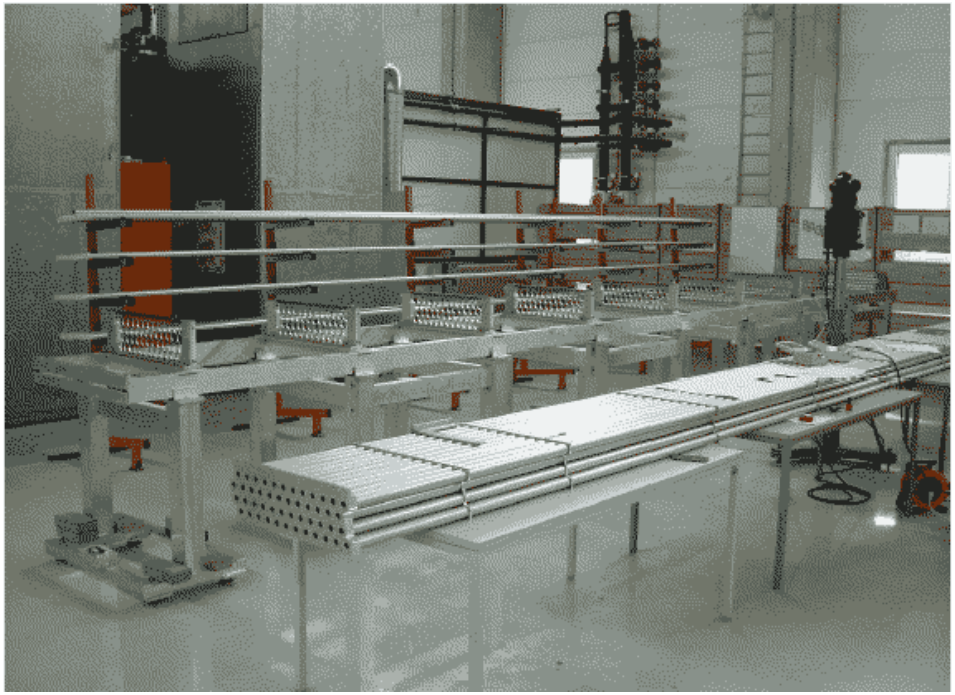
- **The counting rates at the operating point are of the order of few Hz/m² (to be compared with 30Hz/m2 without shielding And 200-400 Hz/m² outside the cavern)**
- **The counting rates are higher for the eastern RPC (near the lateral wall of Hall C)**
- **There is not a plateau, but an exponential dependence on the operating voltage**





Precision tracker

- 96 modules / Supermodule
- 2 modules in test @ DESY
- electronics tested (front end and TDC)
- mass production ready



Precision Tracker : funding issues

- Present BMBF funding period: jan2004 – june2006
  Uni Hamburg receives funds for march2004-june2006
  ~ 1.05 M Euro
  (asked in 2004 for 1.6 M Euro:
  invest 900k, salaries 520k + travel & transp.)

Money flow from BMBF:
2004: 370kEuro
2005: 490kEuro
2006: 190kEuro

Note:
No funding for full gas system
(only development & prototype)
HERA-B muon gs ?

this is the cost for 1 SM
(~2/3 of full material cost, ~1/2 salaries, 1/2 tt)

(Updated) need to complete full detector in time:
330kEuro (Material) + 370kEuro (man power) = 700kEuro

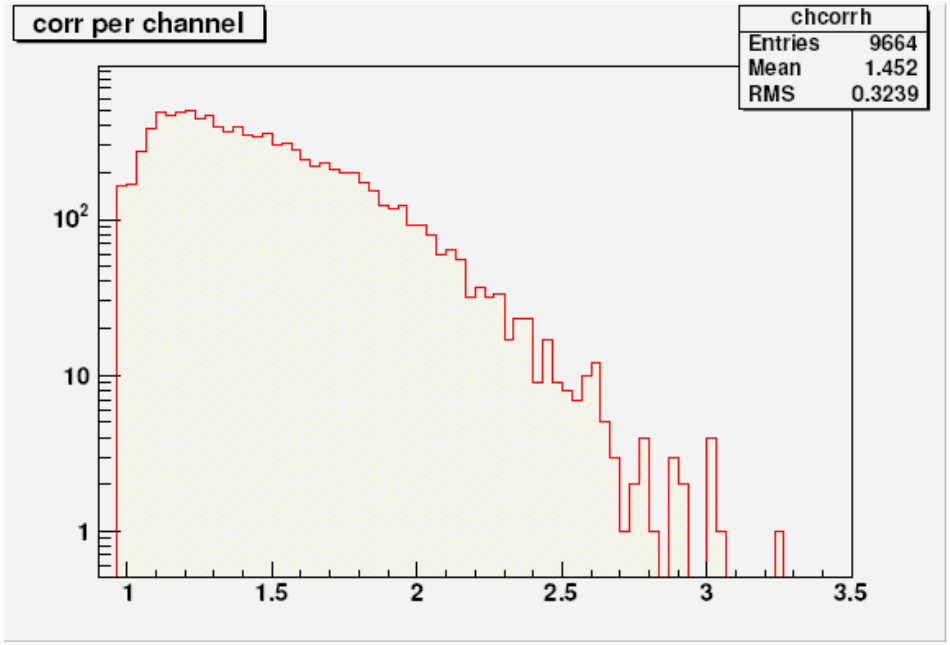
Target Tracker : deliveries

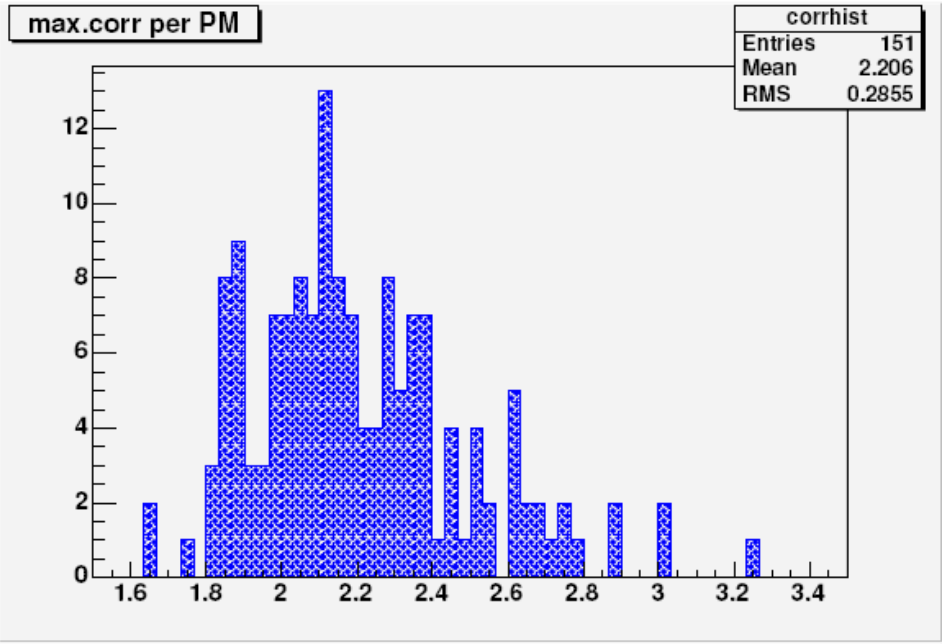
- **mass production ongoing for :**
  for scintillator strips, fiber, MAPMT, electronics
- **MAPMT tests ongoing : efficiency OK**

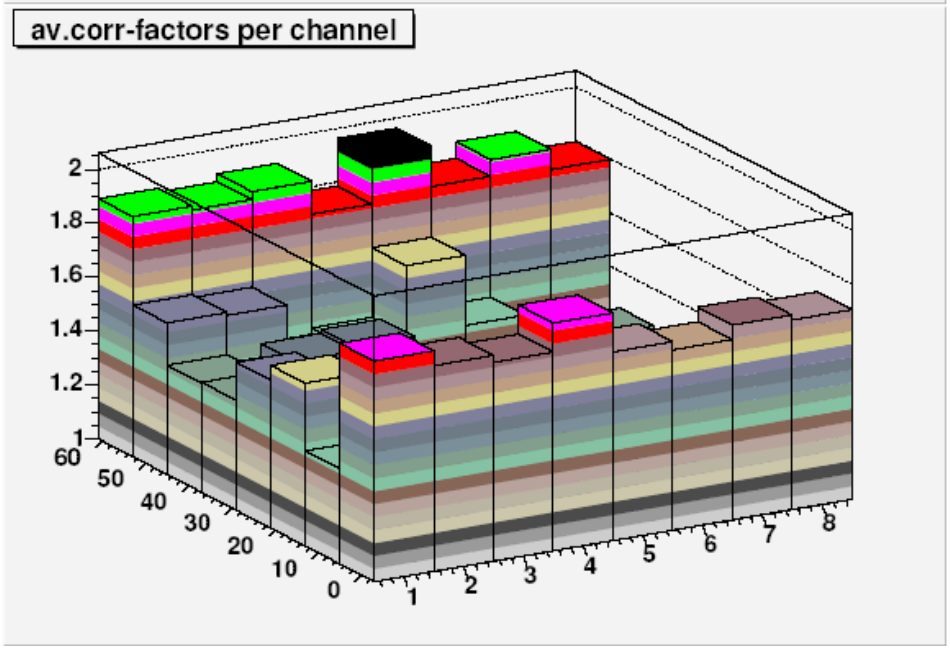
- 3 PMT's rejected from 32 PMT's delivered in 2003
- 3 PMT's rejected from first 32 PMT's delivered in 2004
- Only 2 PMT's rejected from last 96 PMT's

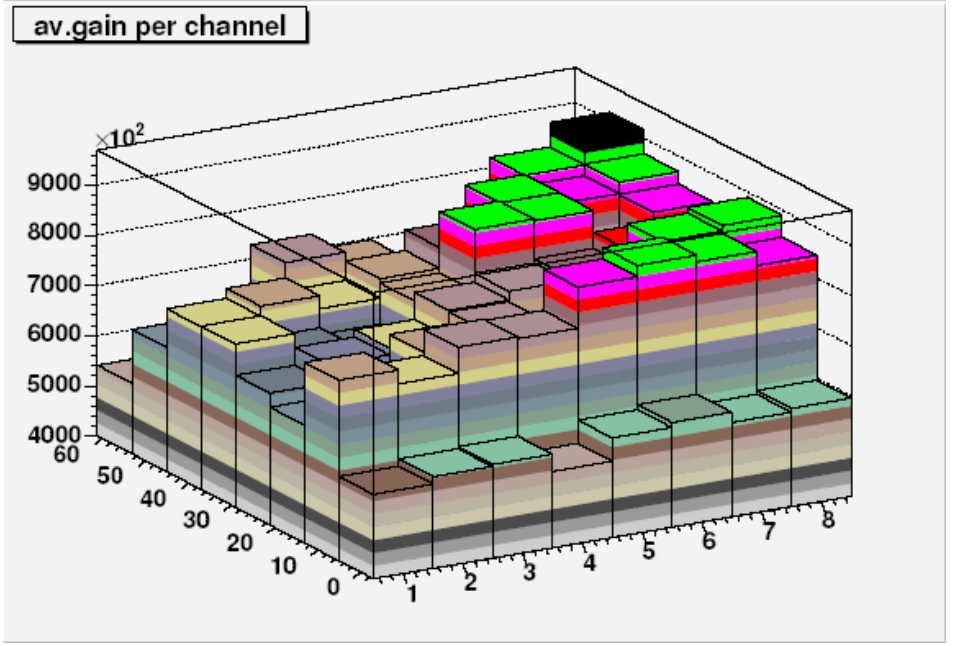
After few iterations and feedback given to Hamamatsu, the PMT quality is improving.

Gain for the first 160 MAPMTs

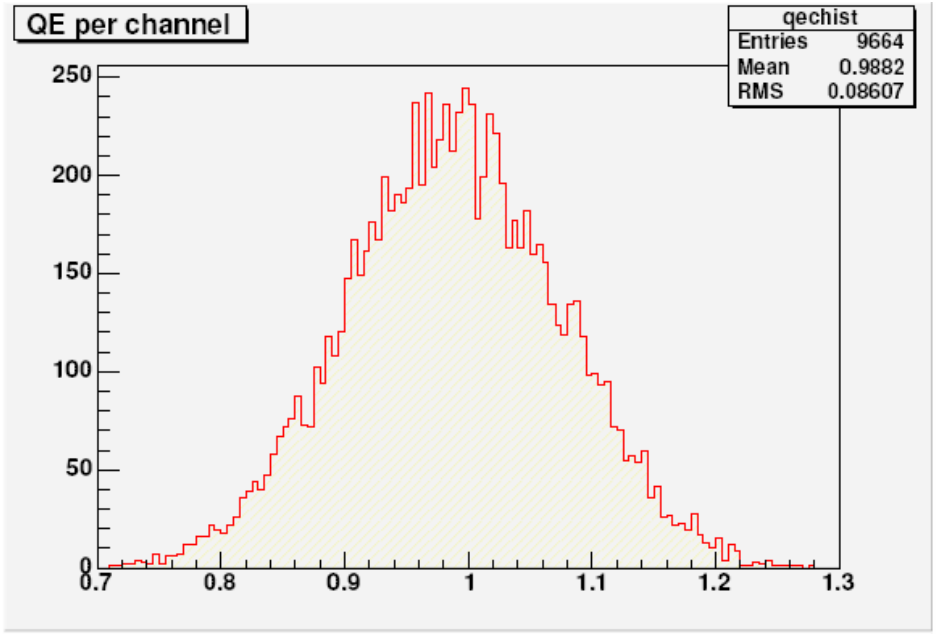


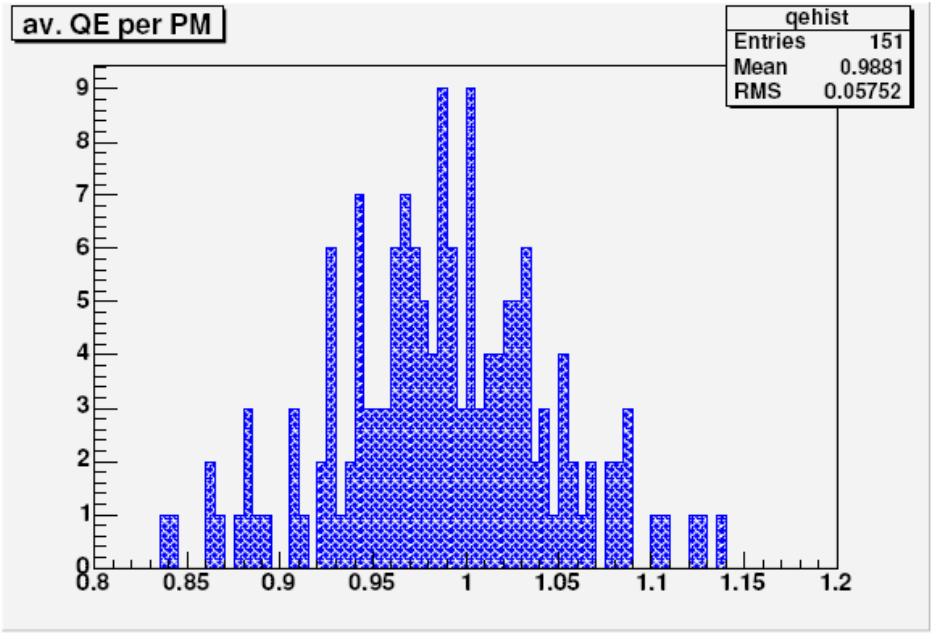


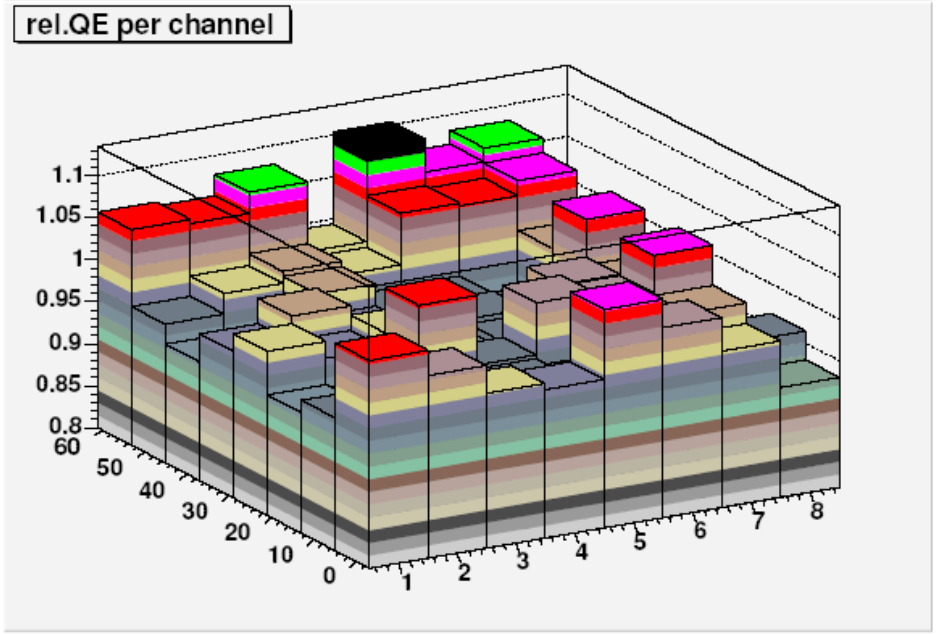


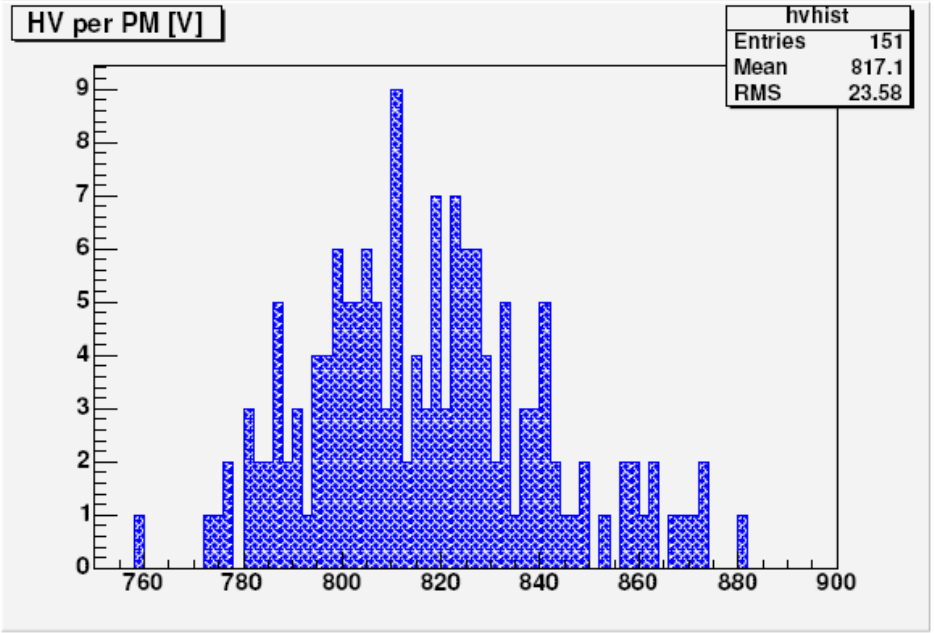


Quantum efficiency for the first 160 MAPMTs

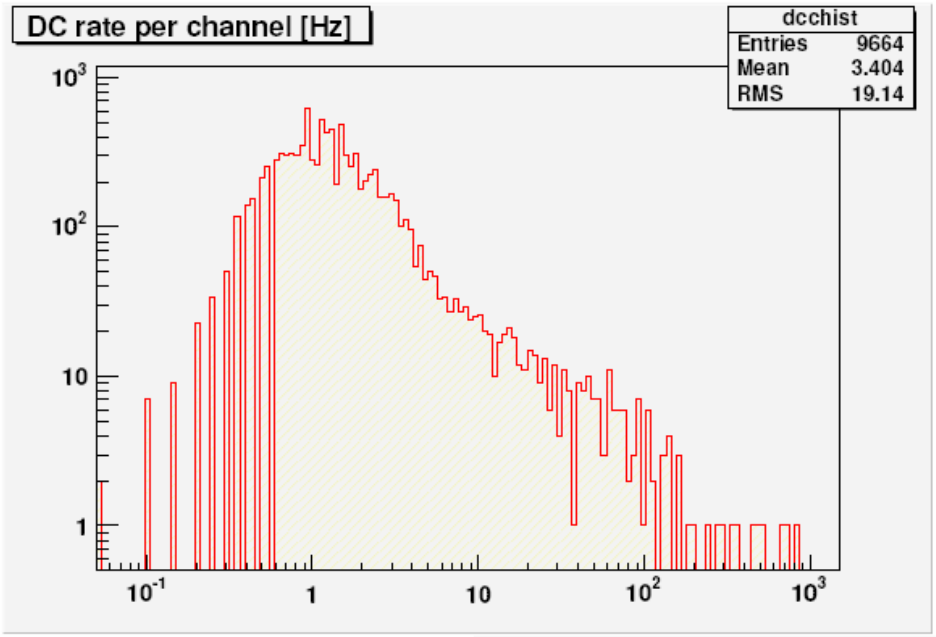


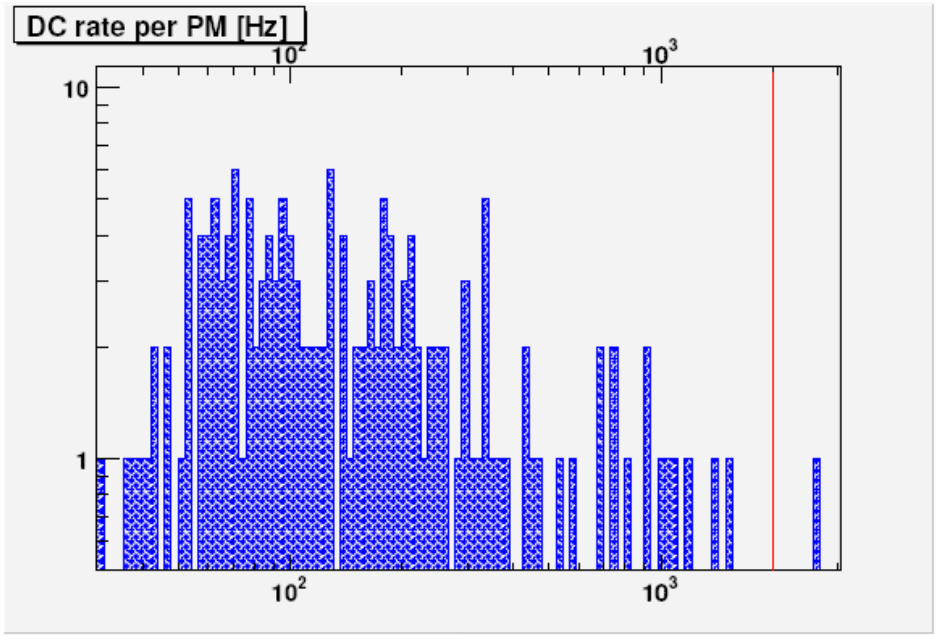


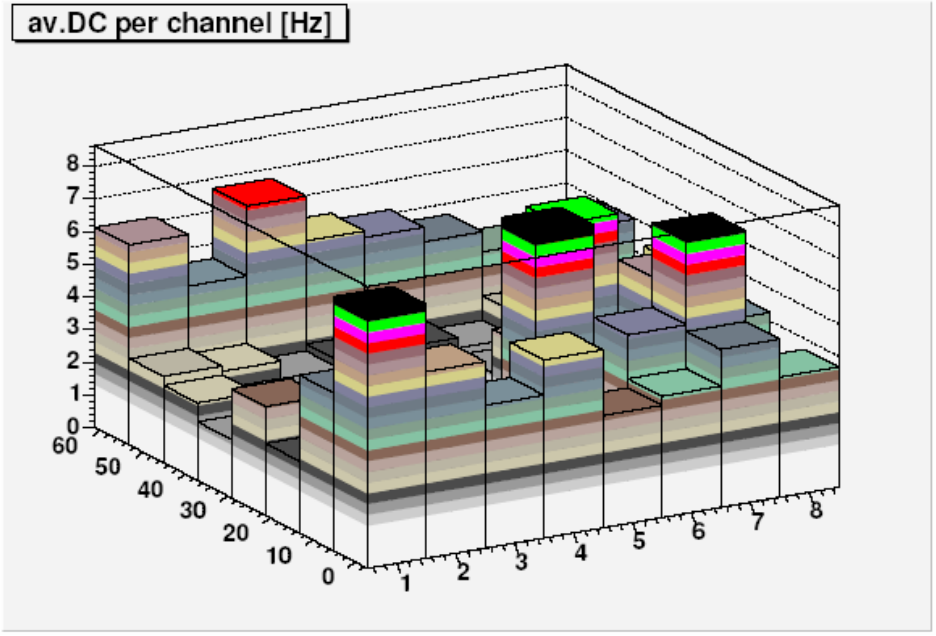




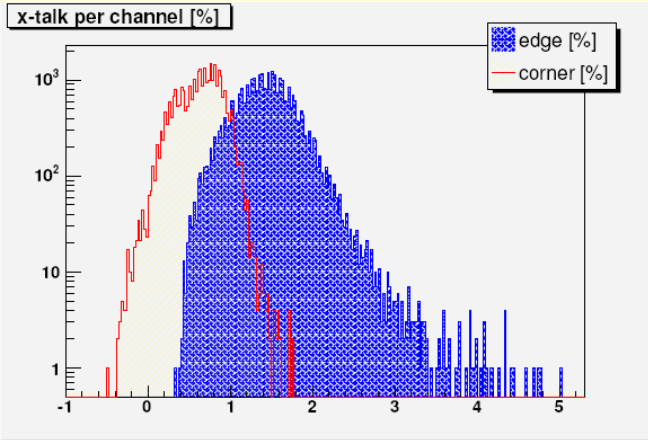
Dark current

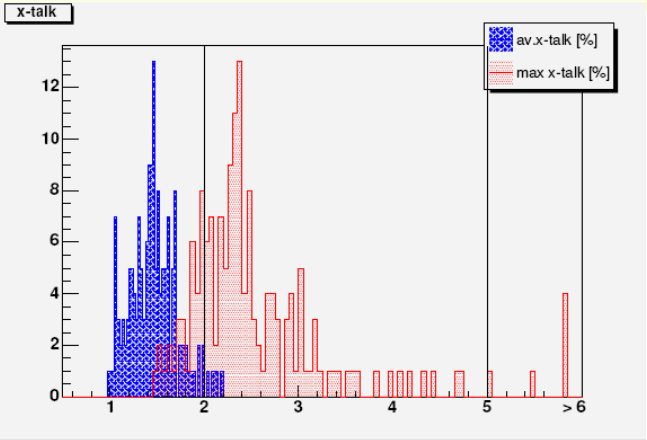






Cross Talk


x-talk per channel [%]
edge [%]
corner [%]


x-talk
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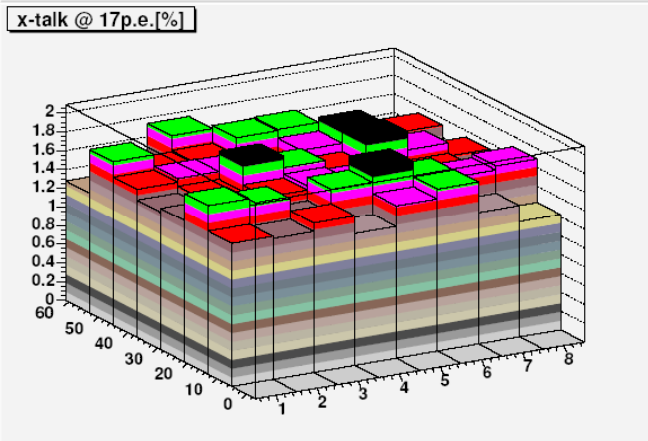
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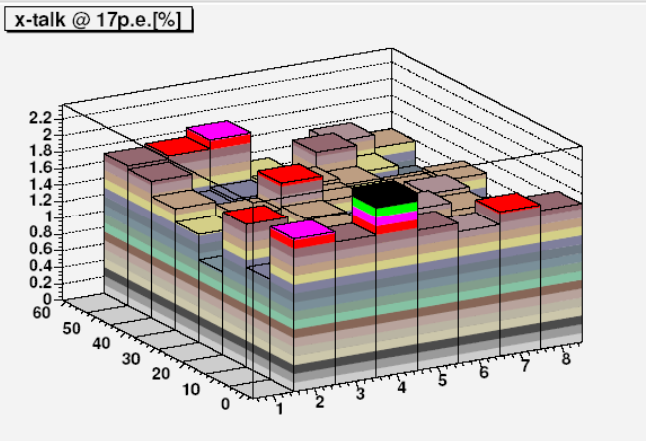
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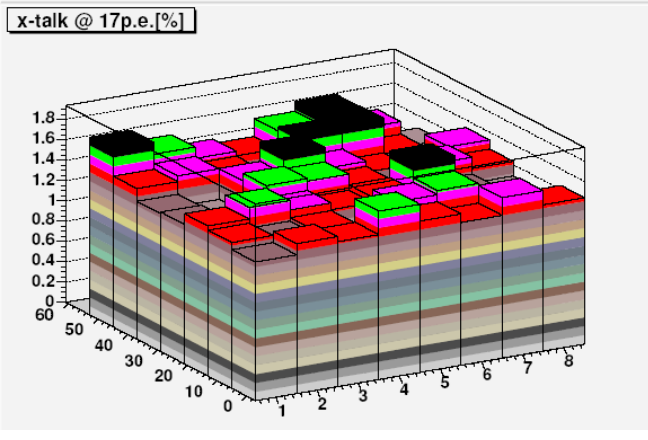
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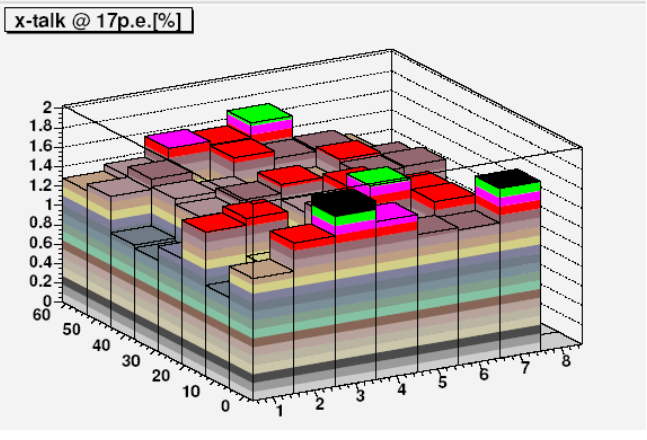
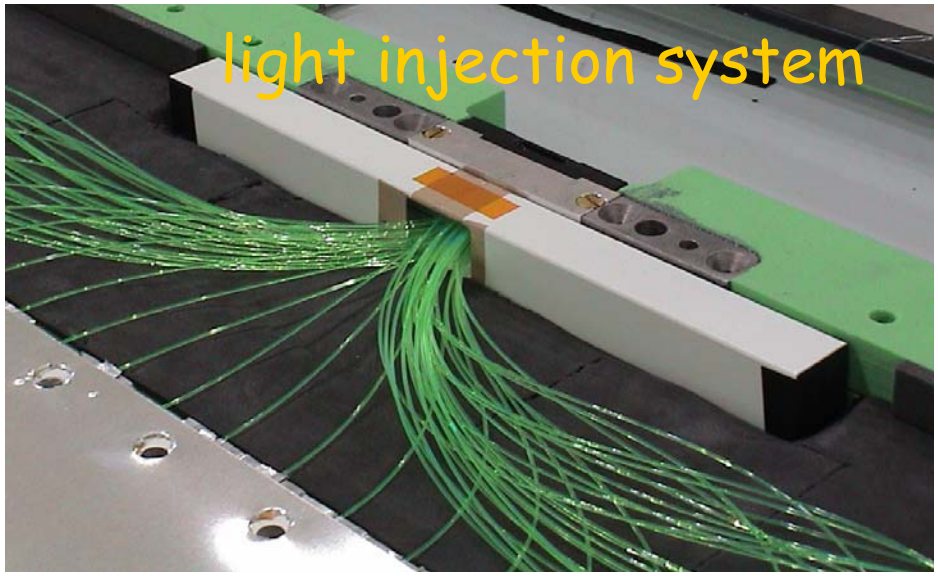
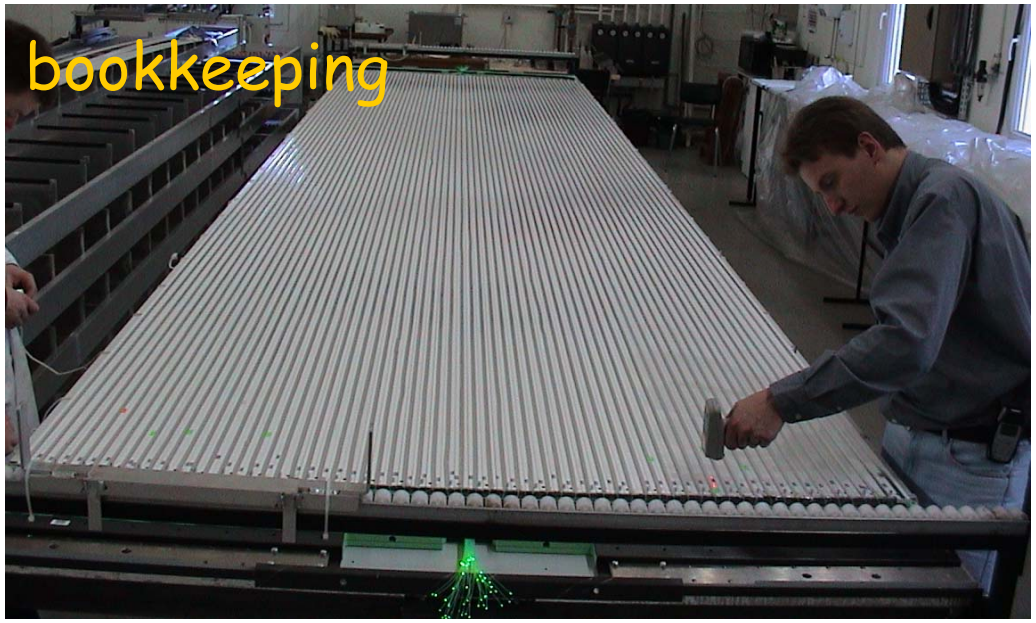
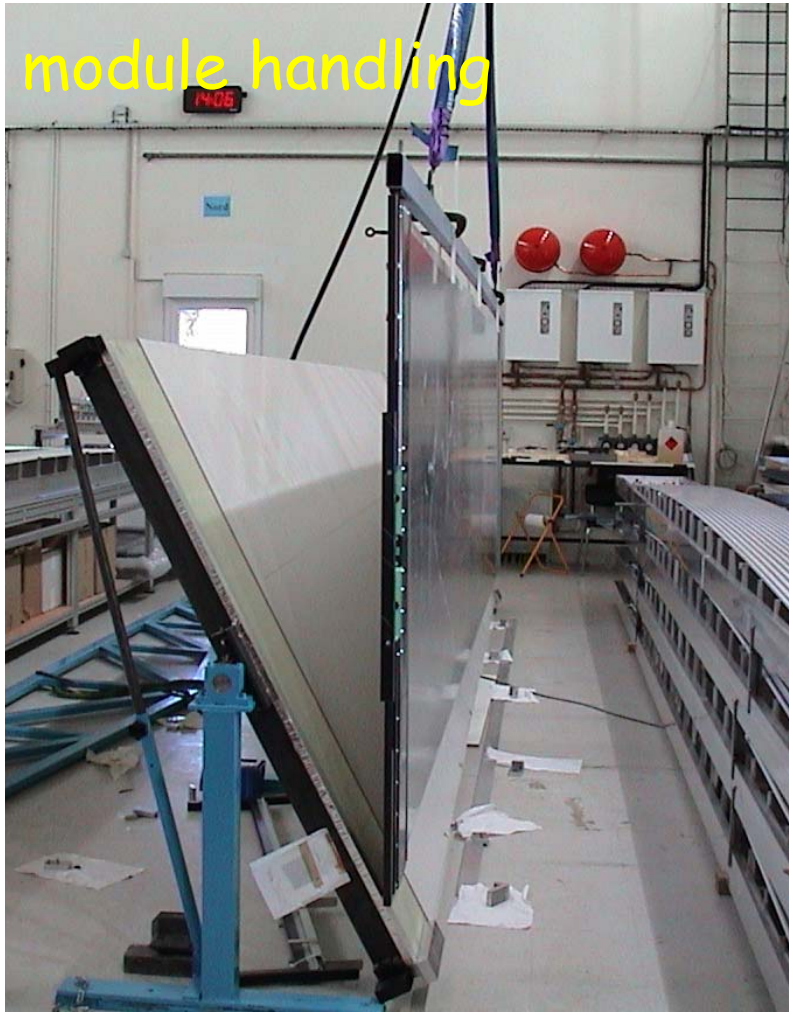

x-talk @ 17p.e.[%]

Target Tracker Modules Production



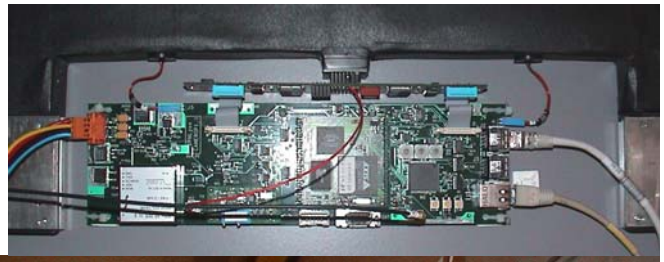


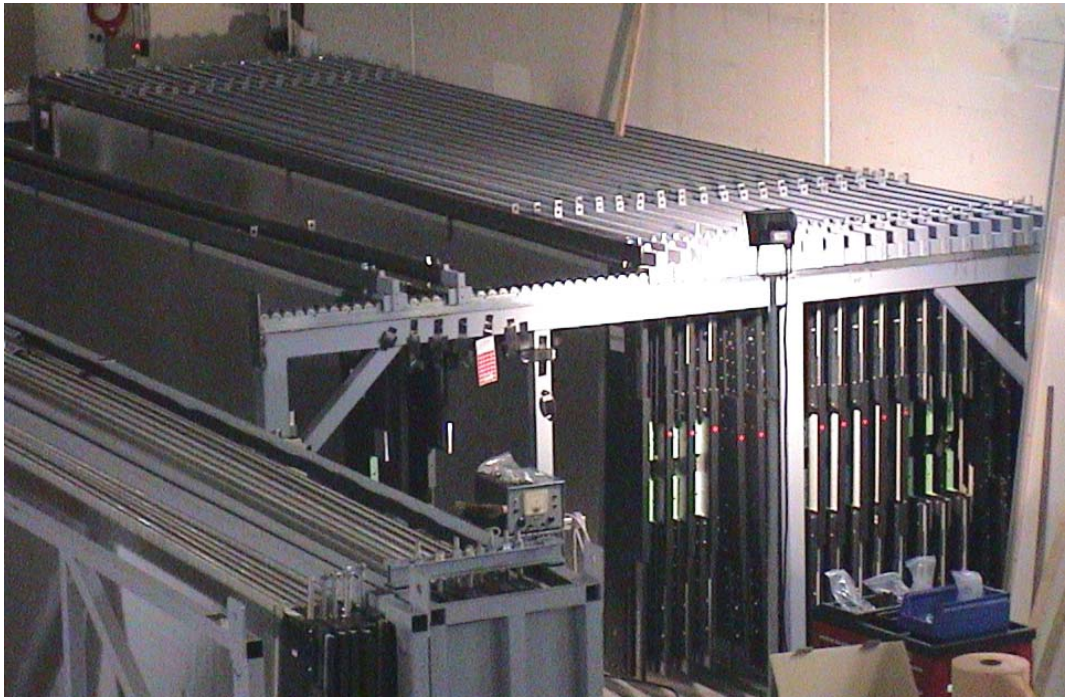
86 produced over 500



Target Tracker : Modules calibration

- 2 tables ready (equipped now with "final" electronics):
  - light tightness,
  - light injectors,
  - number of photoelectrons.



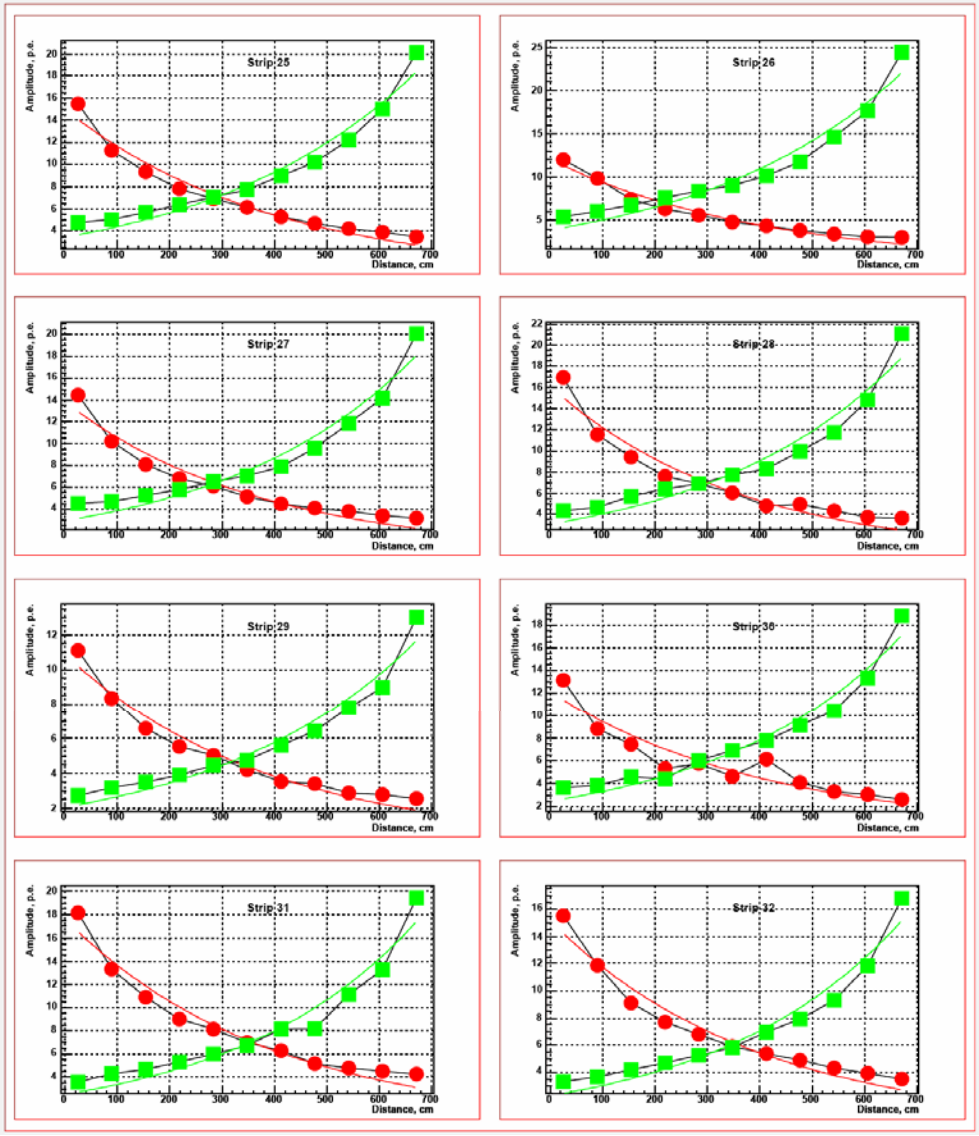


module storage area (cookie polishing, light tightness tests)

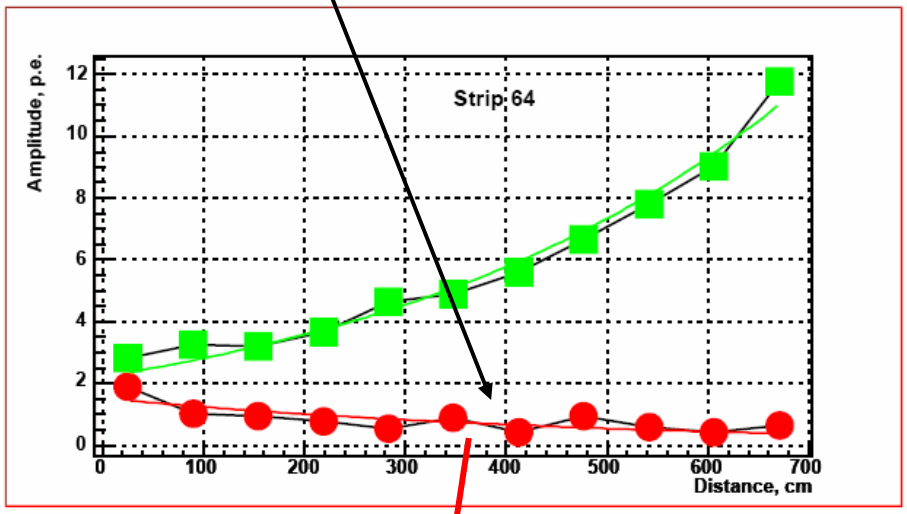
scanning tables

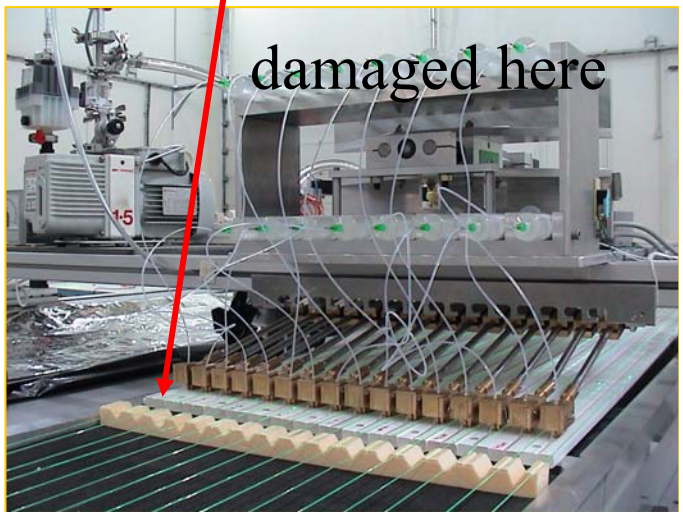
Status of the calibration

Module 36

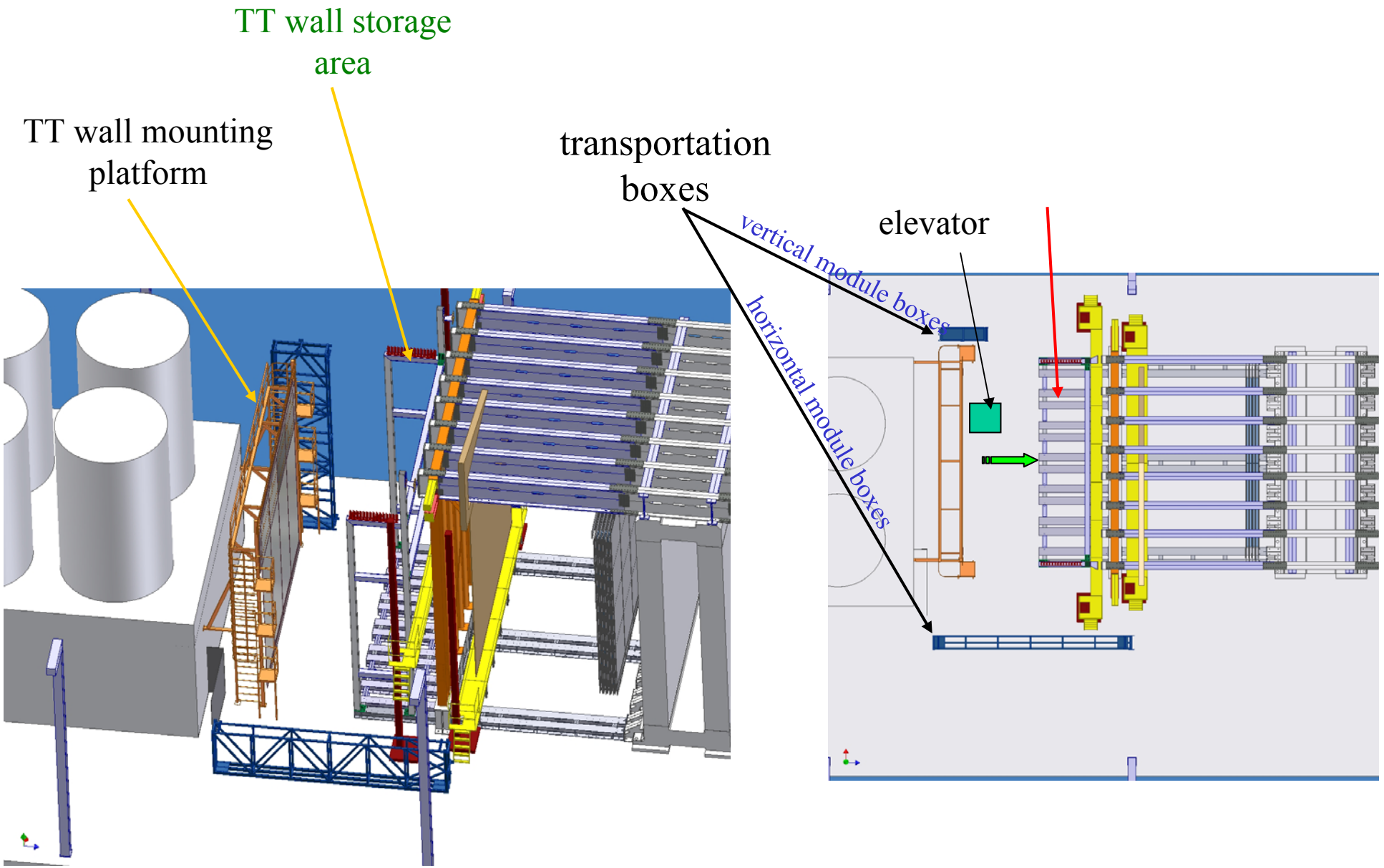


but since some time…

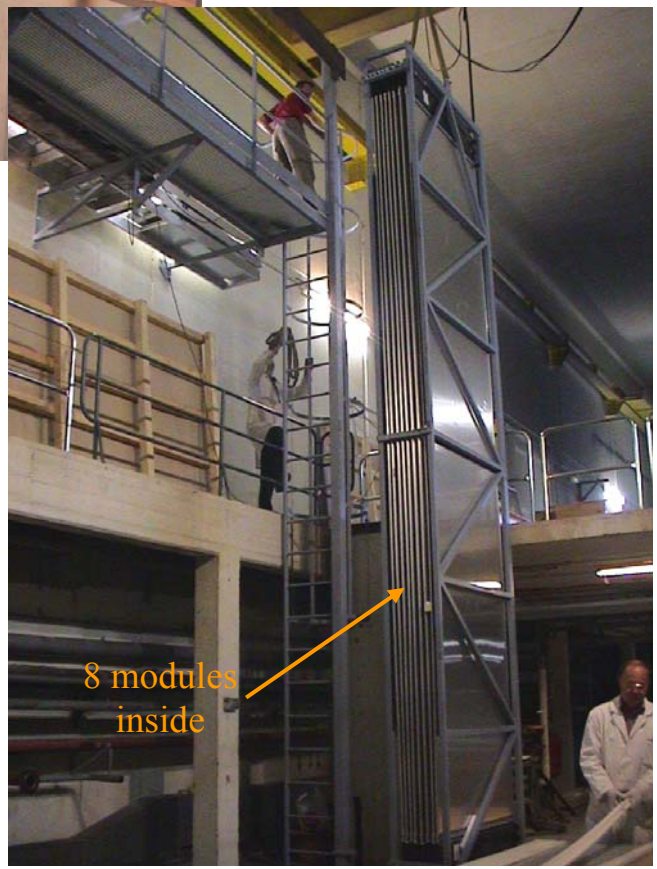


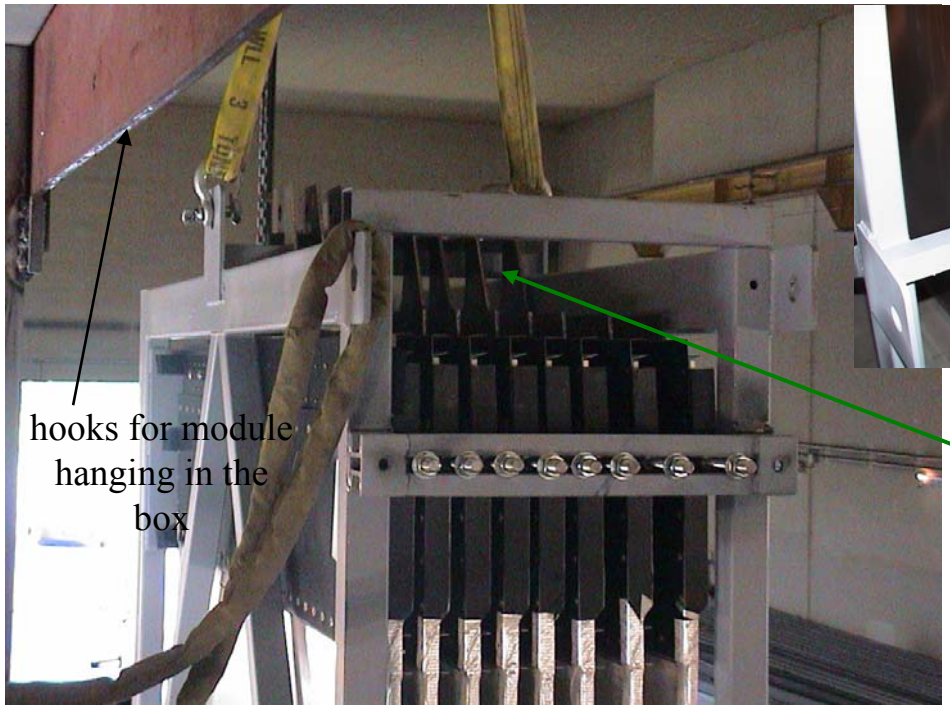


Target Tracker : Wall pre-assembly



Target tracker : wall 1 mounting @ Strasburg

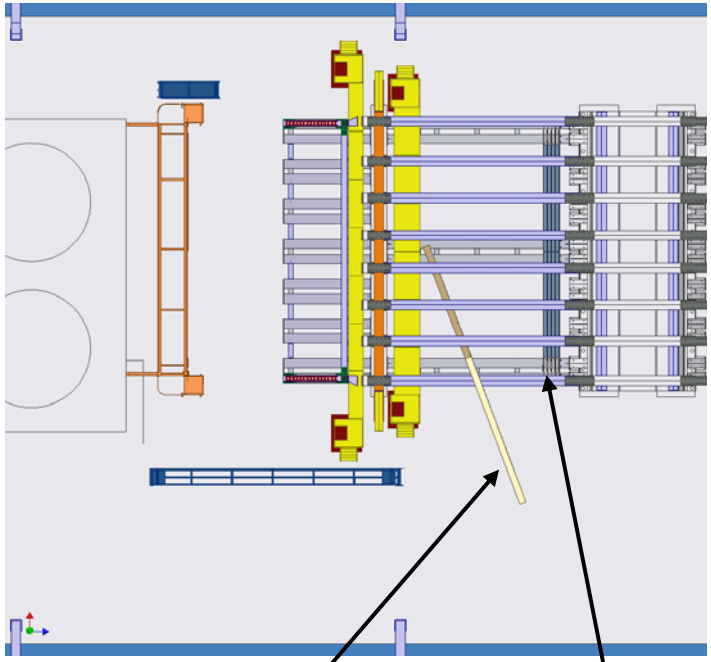


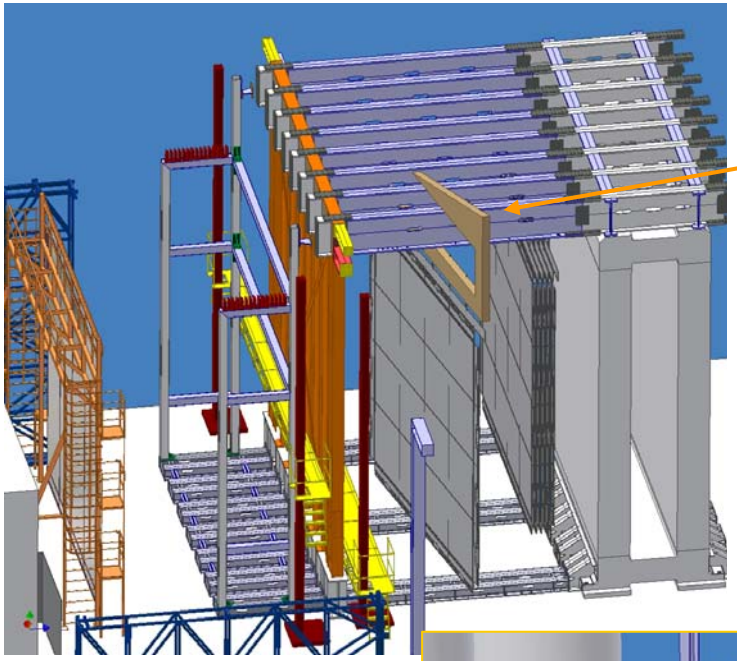


hooks for module
hanging in the
box

Target tracker : wall 1 mounting @ Strasburg

Target Tracker : wall insertion

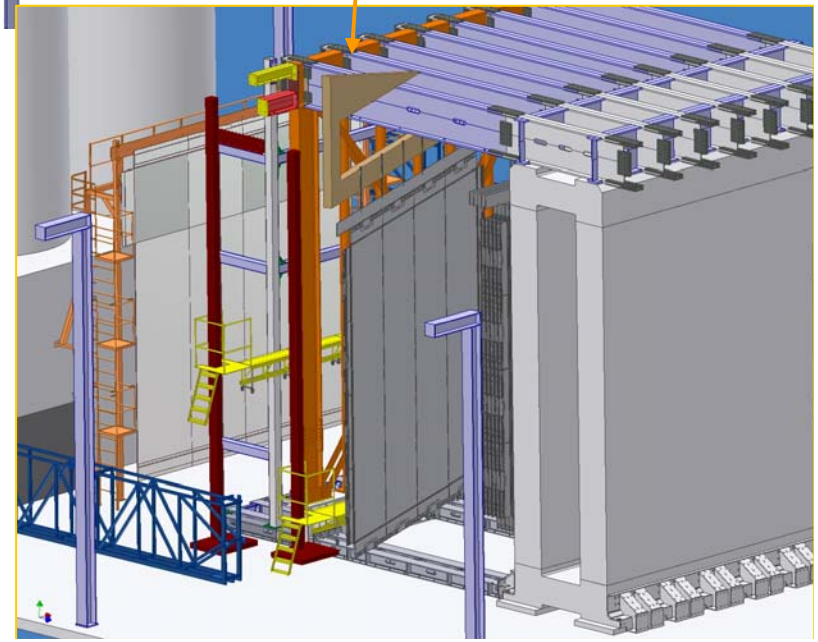




"hook" under study, construction and certification by a private company

during insertion of a TT wall

walls already inserted



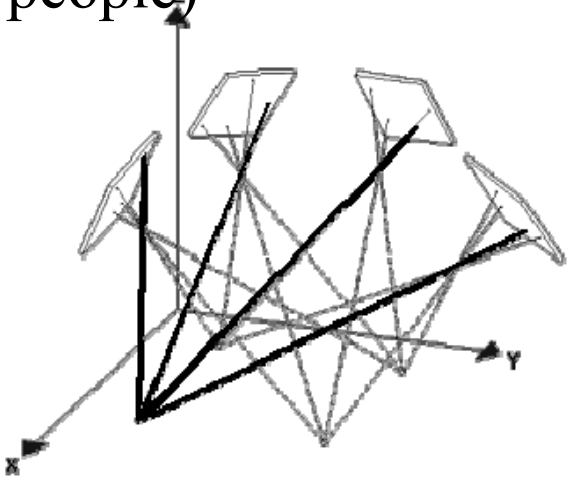
Alignment with Photogrammetry

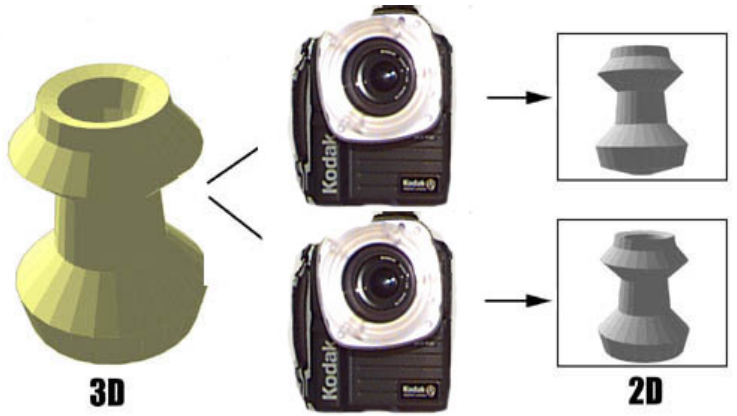
•Closed range targeted digital photogrammetry, widely used at CERN for the survey of LHC detectors

Environment with small free space around the detectors, large objects of 15-20 m have to be measured from a few m, during installation phase

Many points to be measured (dense microgeodetic network)

• Agreement between the CERN EST division and the LNGS to setup a service at LNGS (technology transfer and training of local people)

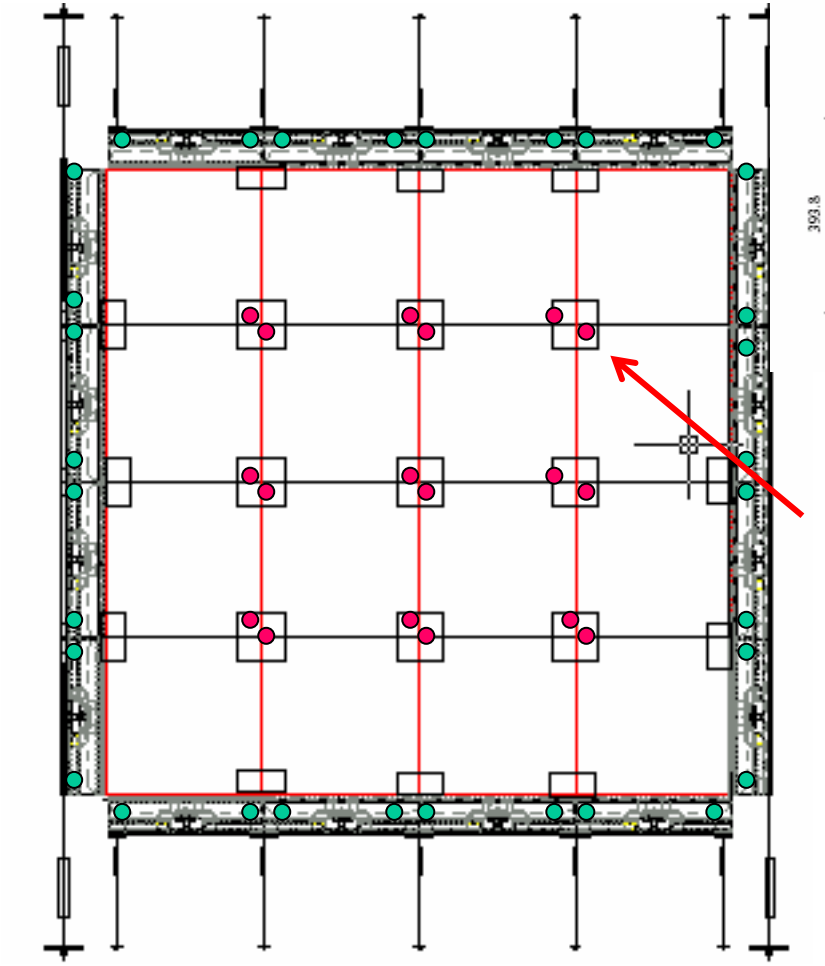




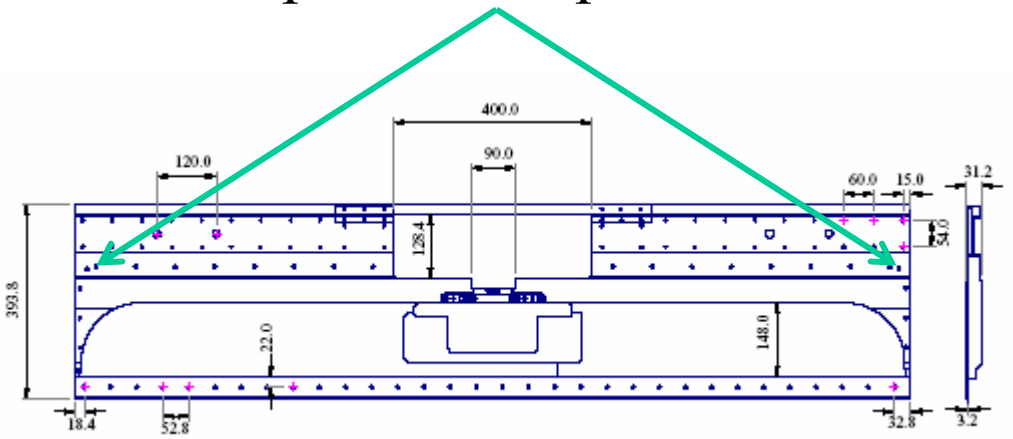
TT wall alignment : full scale training

CERN+LNGS experts

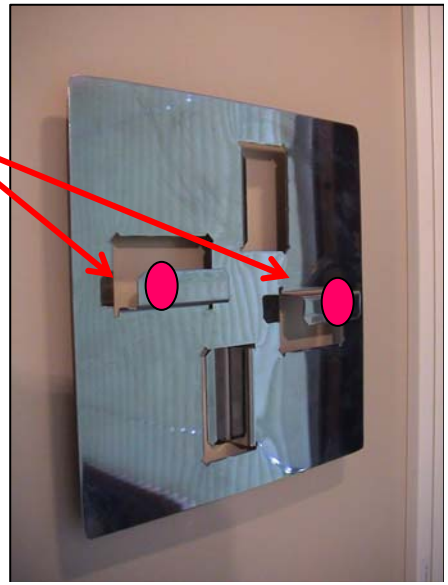
Targets on a TT biplane:



Targets in the precision holes of the end-caps 2/end-cap: 2*4*4=32 total



Targets on the *croisillons*, each doublet surveys the positions of the crossing point of 4 modules: 9x2= 18 targets in total



Measurements taken in Strasbourg on the first TT biplane

- Test and optimize the procedure on full size prototype
- Study as a function of the distance from the object
- Study of the planarity of the TT biplane
- Study of the rigidity during handling of the TT biplane
- Training of LNGS surveyors

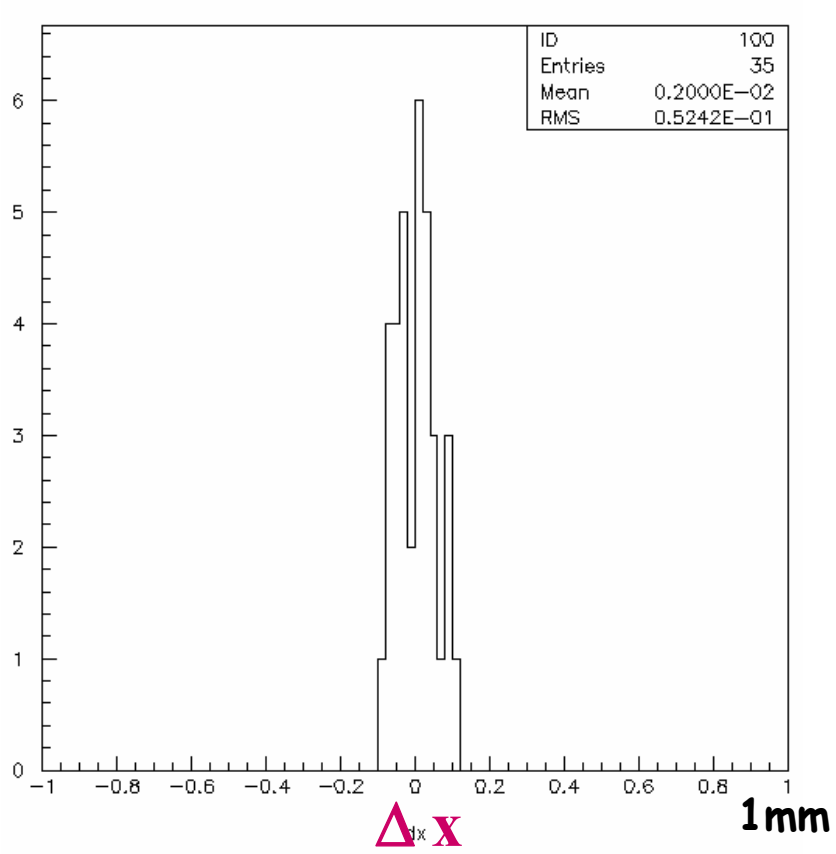
Photogrammetric Measurement 09.-11.06.2004

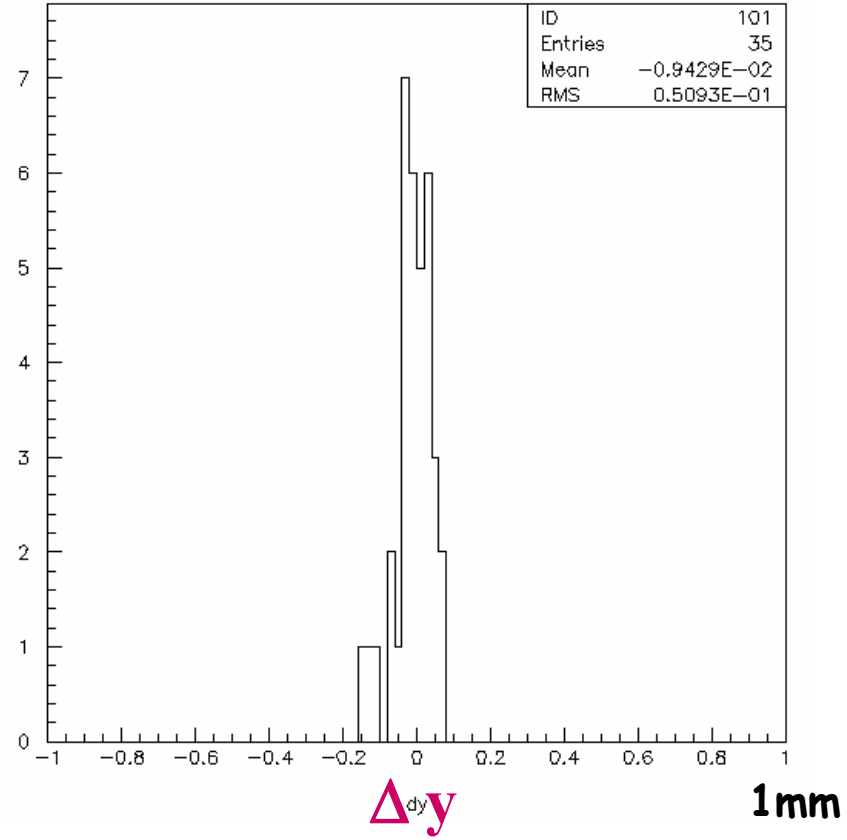
→ Survey technique succesfully applied to the TT biplane

Study of the deformations of the TT biplane

Used standard targets + extra 35 surface coded targets

Handling at maximal acceleration of the crane + reiterated shock cycles





No displacements observed within 0.2 mm, the TT behaves like an elastic object retaking its initial shape after handling

Brick Wall : production

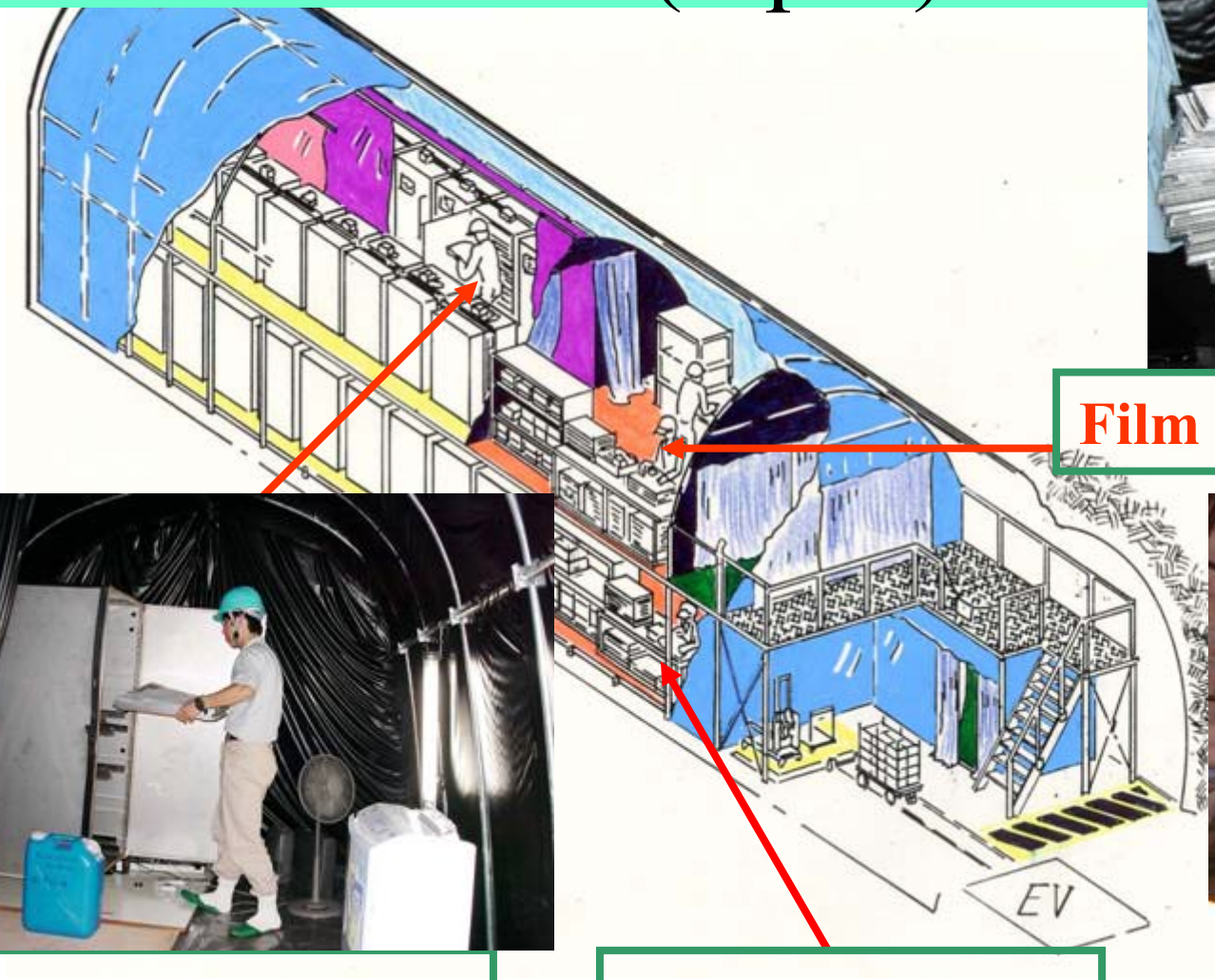
Tendering (start)	MAY 2003
Tendering (end)	OCT 2003
Production contracts signed	JAN 2004
First wall prototype built	JUL 2004
First wall delivered at LNGS	SEP 2004
Last wall delivered at LNGS	JUN → DEC 2005

Turnbuckles (commercial parts)	✓ @ LNGS
Columns, Brackets, Pins, Bottom Rails (COMIT)	✓ @ LNGS
Isertion tool (LNF)	✓ @LNF
Bolts (commercial parts)	Ordered (@LNF 5 July)
Top Rails (CECOM, LMM)	Built (@LNGS 8 July)

Reference marks positioning (for alignment)	✓ JUNE 2004
Rails installation/alignement 1st SM	JUL/AUG 2004
Walls installation/alignement 1st SM	SEP 04 → JUN 05
Rails installation/alignement 2nd SM	JUN/JUL 2005
Walls installation/alignement 2nd SM	JUL 05 → FEB 06

Refreshing facility in the TONO mine (Japan)

Film lay out on the plates



Film installation

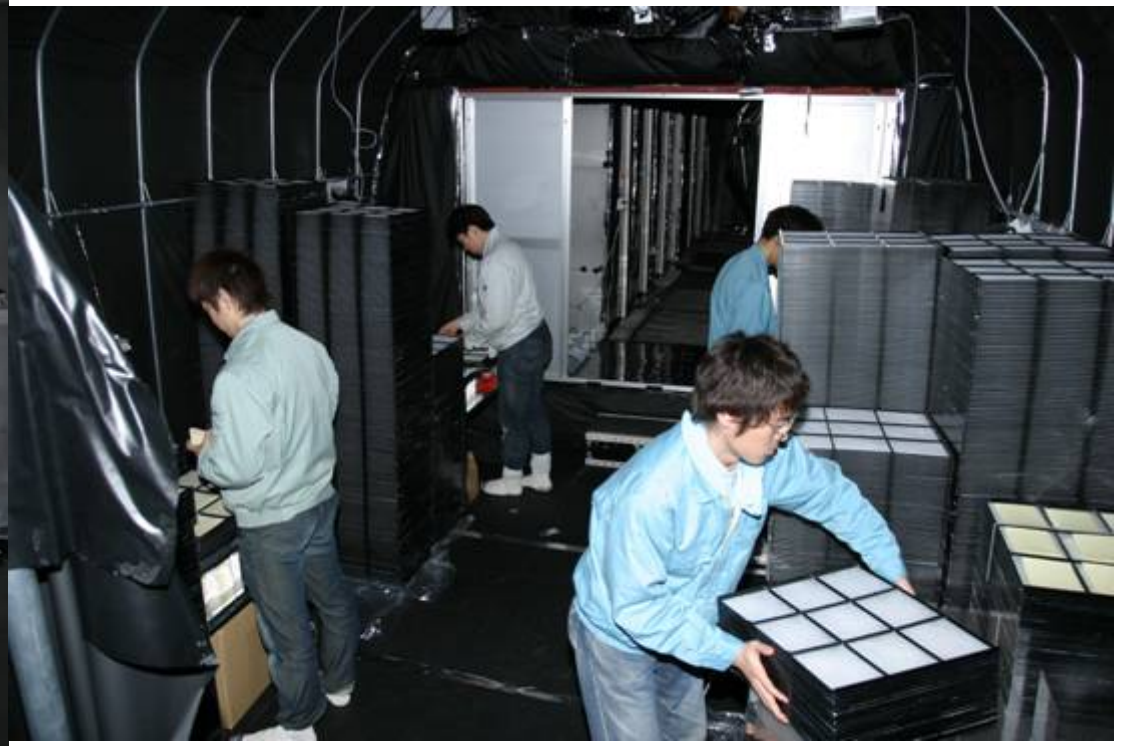
Vacuum packing

Room Size

4.5m×4.5m×20m

Refreshing facility in the TONO mine (Japan)

Running



Brick

Lead choice: Ternary Leads (Pb/Ag/Al or Pb/Ag/Sn)

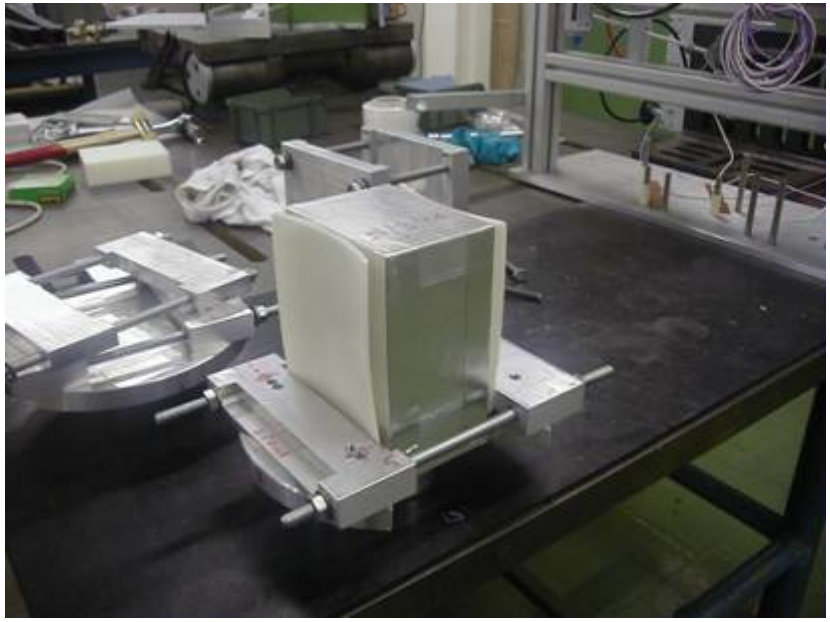
→ Pb/Ca may damage emulsion : water vapor on Ca produces Hydrogen gas

Mechanical packaging choosen (long term tests performed):

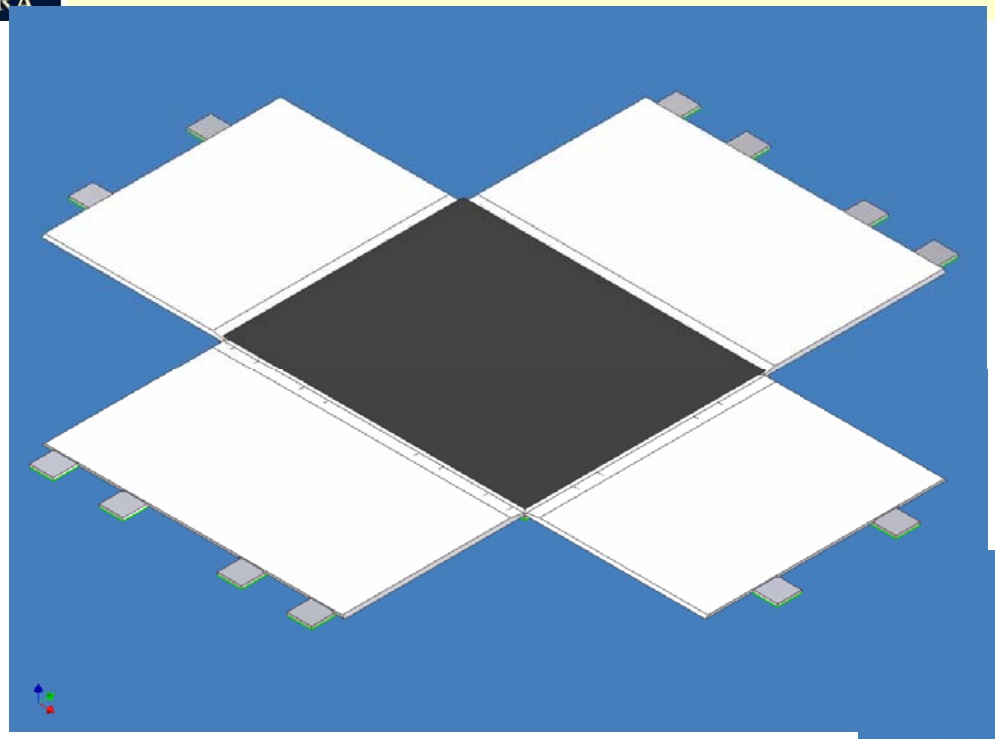
→Laminated film are fragile and vacuum may be lost during brick manipulation

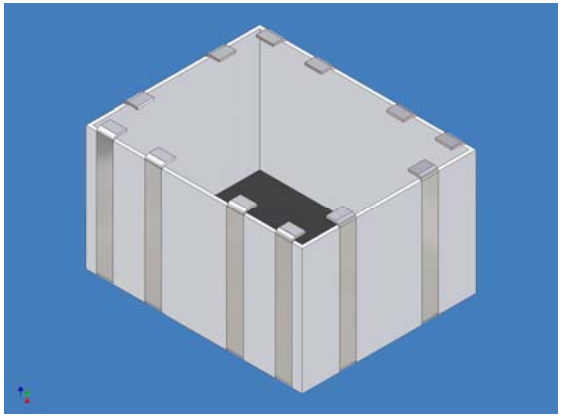
→ pressure maintained by mechanical structure and high resistance scotch tape

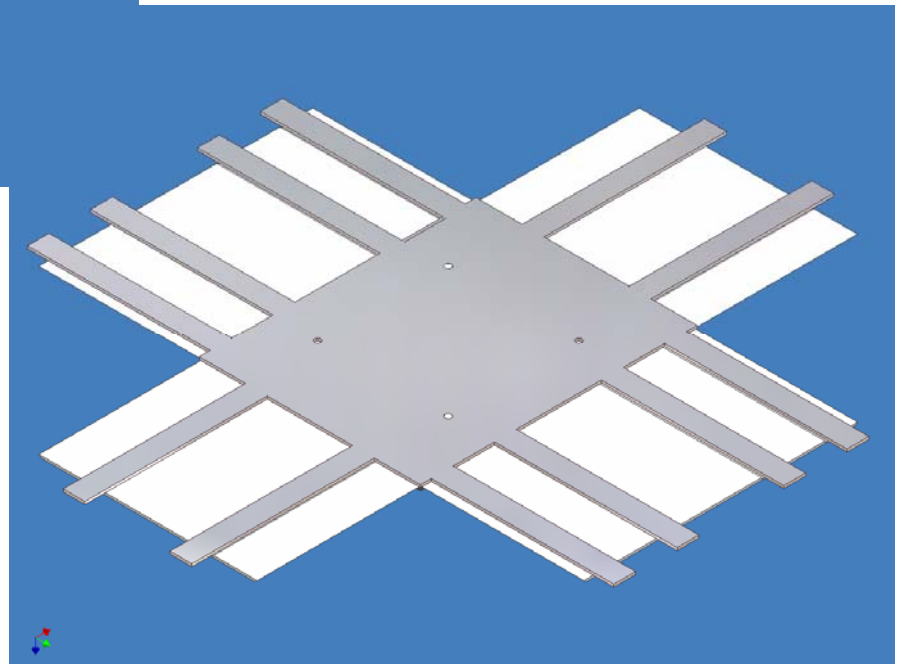
→ light tightness obtained by Al scotch tape



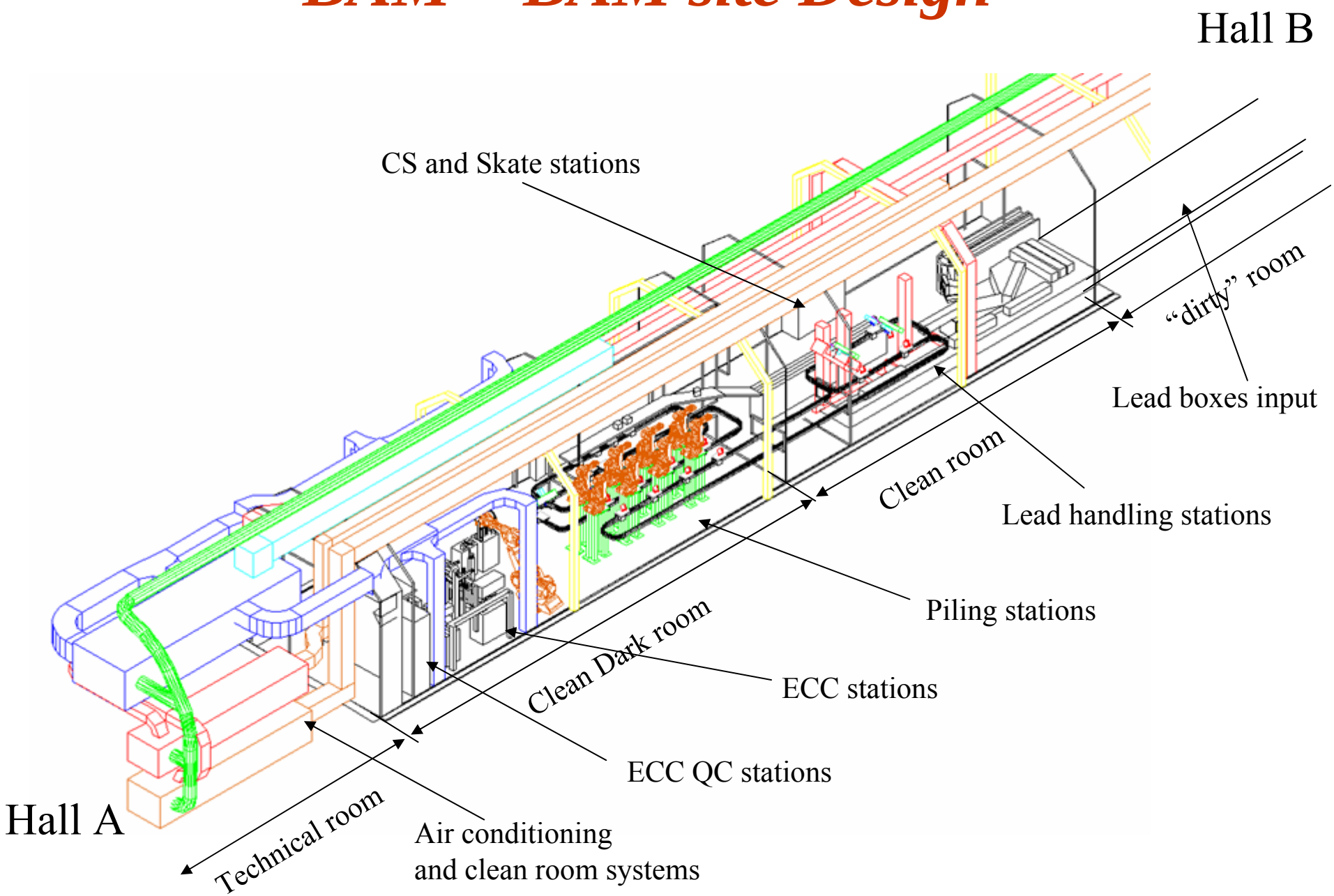
Details of Mechanical Packaging







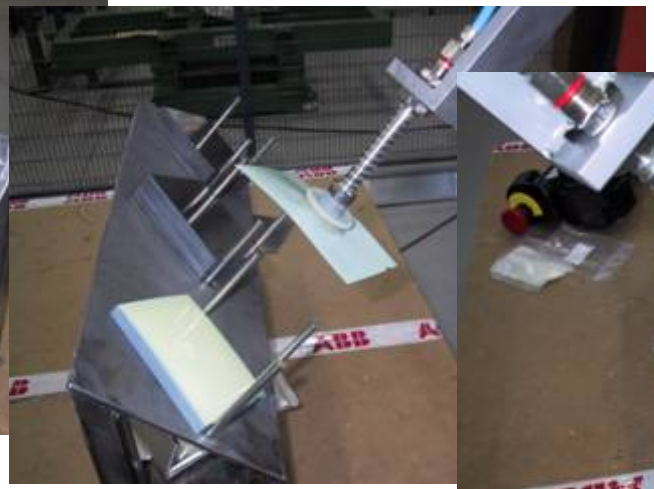
BAM + BAM site Design

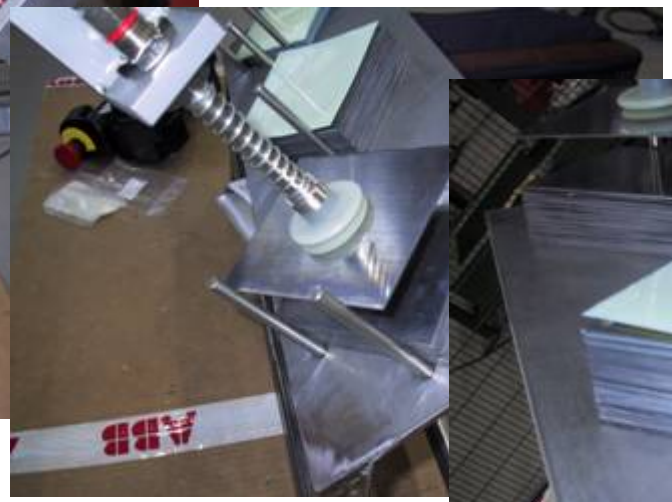


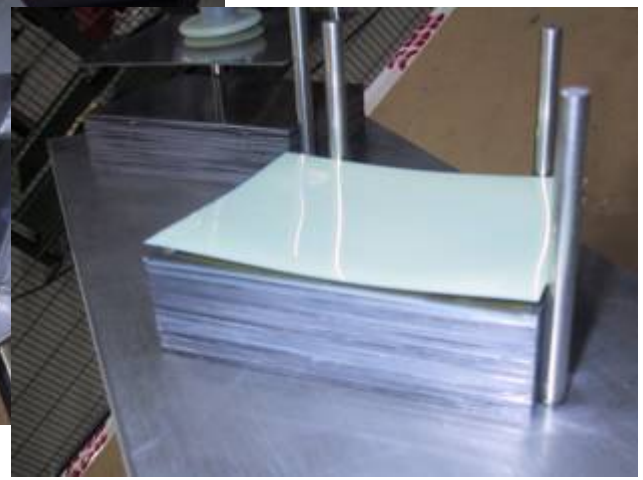
The piling station of the BAM

First mechanical tests of lead and emulsion manipulation with anthropomorphic ABB robot have started to check the precision in the piling operation

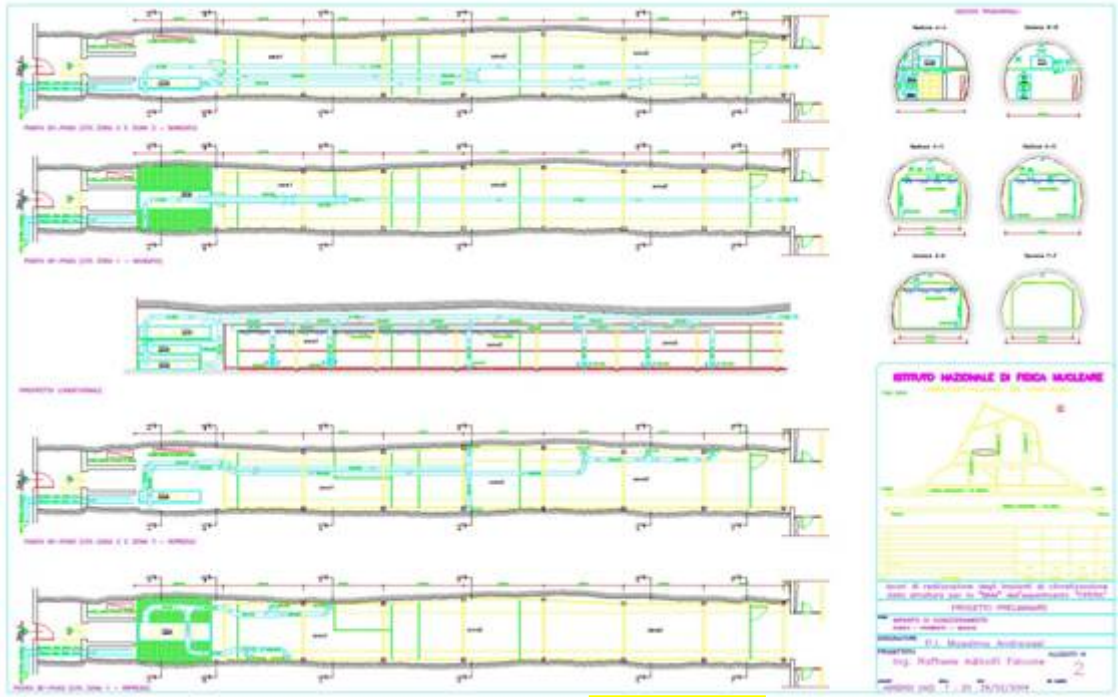
Further studies are needed on:
- vacuum sucking device
- photographic effects







The BAM site at LNGS



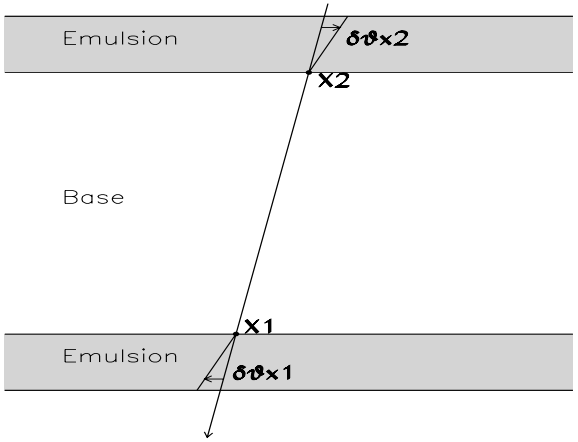
Preparation of the by-pass site has started in March ’04
Main civil engineer done in May-June ’04
Tender for air conditioning system closed in March ’04, to be delivered by Sept ’04
Electrical network and safety systems to be delivered in July ’04
Monthly meeting with BAM and LNGS engineers to monitor the status of the work in progress.

BAM schedule

✓ **Final specifications:**	**December 2002**
✓ **End of market search:**	**March 2003**
✓ **Technical audit:**	**April 2003**
✓ **Call for tenders:**	**May to October 2003**
✓ **Firm selection:**	**November 2003**
✓ **Ordering:**	**December-January 2004**
✓ **Design, Construction and Tests in the firm:**	**February 2004 to March 2005**
Delivery at Gran Sasso laboratory:	**April 2005**
Assembly, installation:	**May 2005**
Production acceptance tests at Gran Sasso:	**June to August 2005**
Brick mass production:	**September 2005 to September 2006**

Changeable sheet

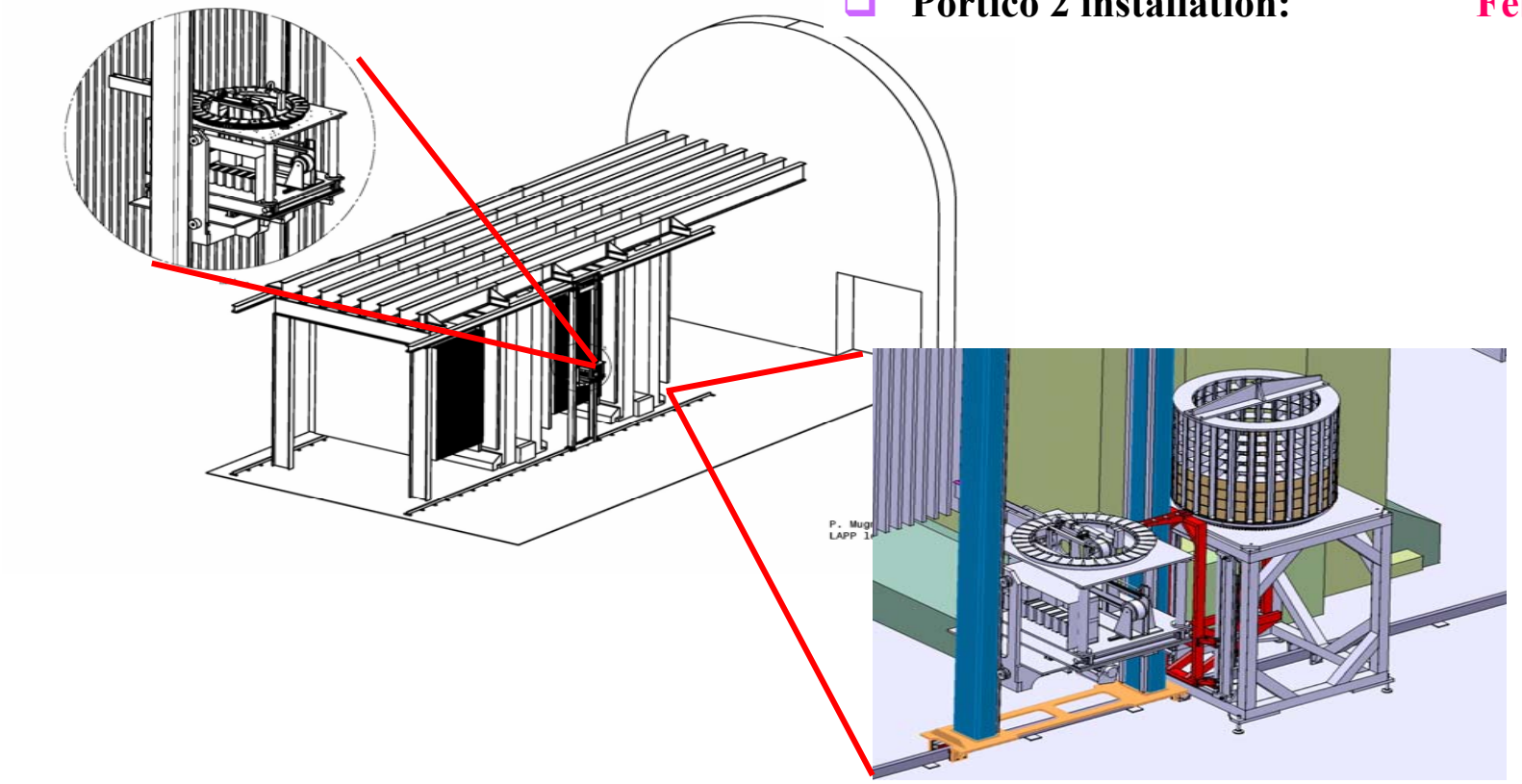
- R&D ~2004-Oct
  - BG rejection
    - Distortion : distortion itself, precise measurement, packing
    - Self-Refresh : parameter study
  - Aging test at high humidity
    - sensitivity , fog , etc.
- CS packing machine development ~2004-May
- Production 2005-May ~ 1000CS/day
  - Humid packing at Nagoya.
  - Initialization at Gran Sasso (self-refresh acceleration, 30degC 1month etc)



- **By tuning the development procedure the distortion is removed intrinsically.**
  - **at the level of $\sigma_\theta < 2$mrad.**
  - **Now observed distortion is dominated by the stage accuracy and measurement.**

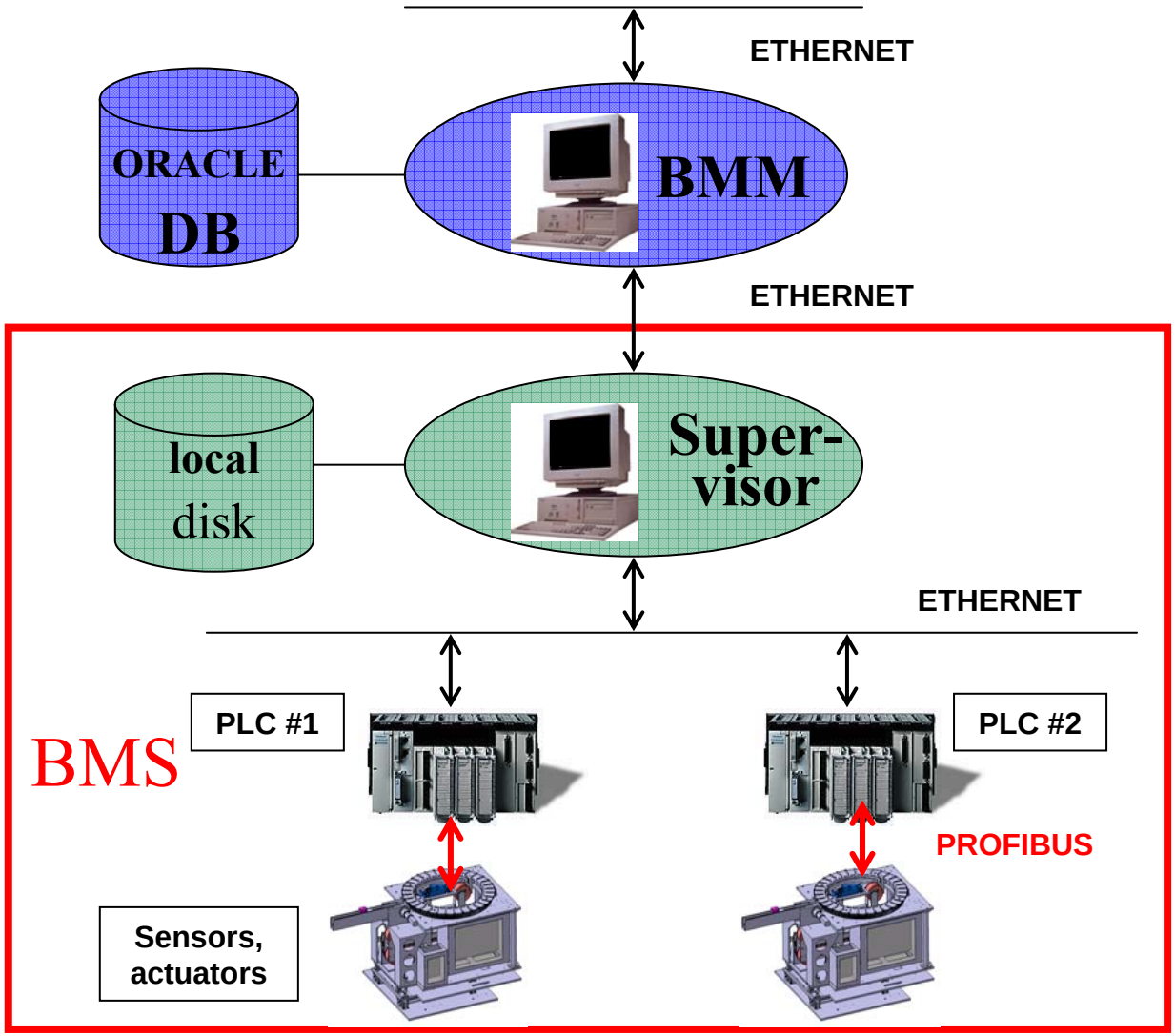
Brick Manipulator System

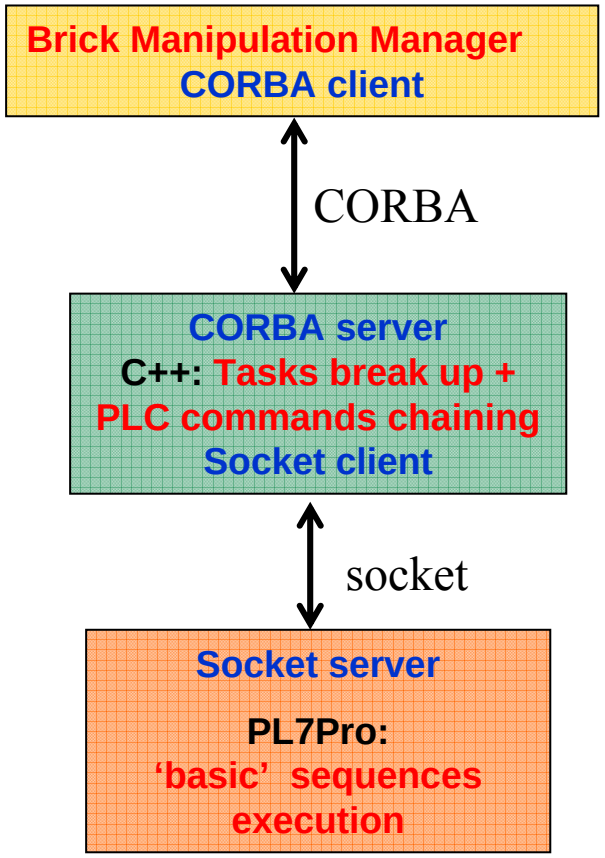
- Portico ready for tests DZ & DY: June 04
- Platforms complete: September 04
- Loading station 1 constructed: June 04
- Loading station fully equipped: mid-October 04
- First basket: July 04
- VV final vehicles: October 04
- Loading station 2: December 04
- Portico 2 installation: February 05



BMS : first system constructed in Annecy

BMS Supervisor





Emulsion processing @ LNGS

The new building

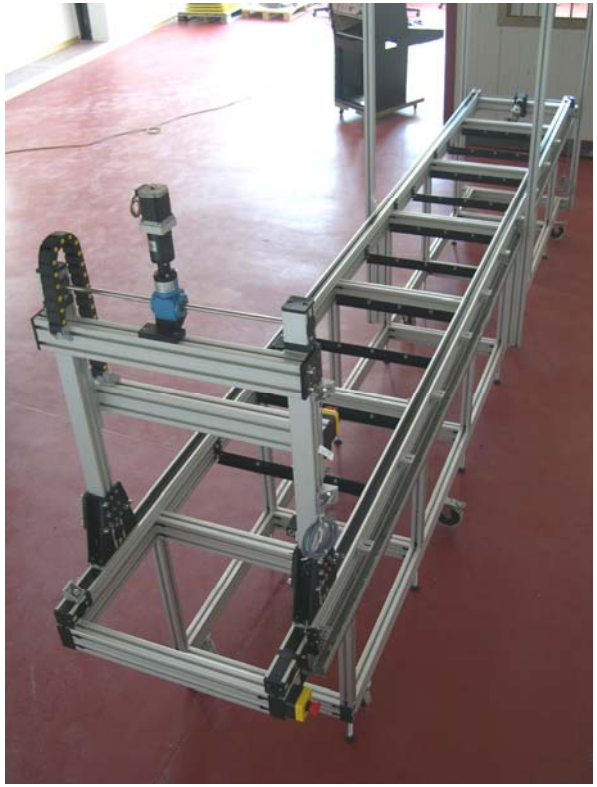
- Meetings between Company's management and GS staff to fully define the project
- 'Work delivery' (*consegna dei lavori*) on May, 18th

  ➔ formal delivery date is 15 months since this date!
- Area cleared and delimited (also our Cosmic-ray hut displaced...)
- Excavation expected to start this week
- We are expected to provide Fe for Cosmic-ray pit shielding by summer

The prototype chain

- Test site hall assigned and prepared for OPERA
- Main structure assembled, several details defined

➔ Ready and equipped for full scale tests by July, then "automation" program will start



Status of the European Scanning System

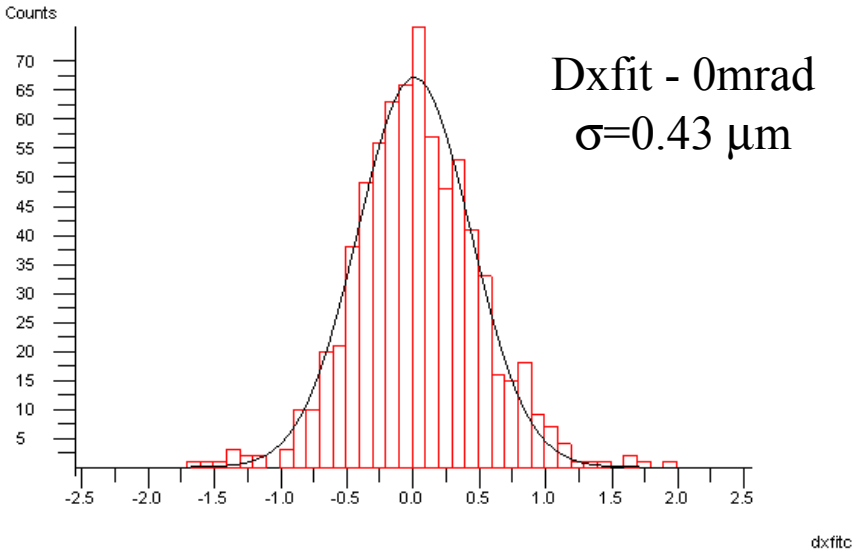
(Bari, Bern, Bologna, Lyon, Napoli, Neuchâtel, Roma, Salerno)

- New CMOS camera up to 500 fps
- New Image processor Matrox Odyssey and more powerful PCI-X workstation
- Same Optics (Nikon)
  and Mechanics (Micos)
  now as industrial productions
- New asyncronous DAQ software

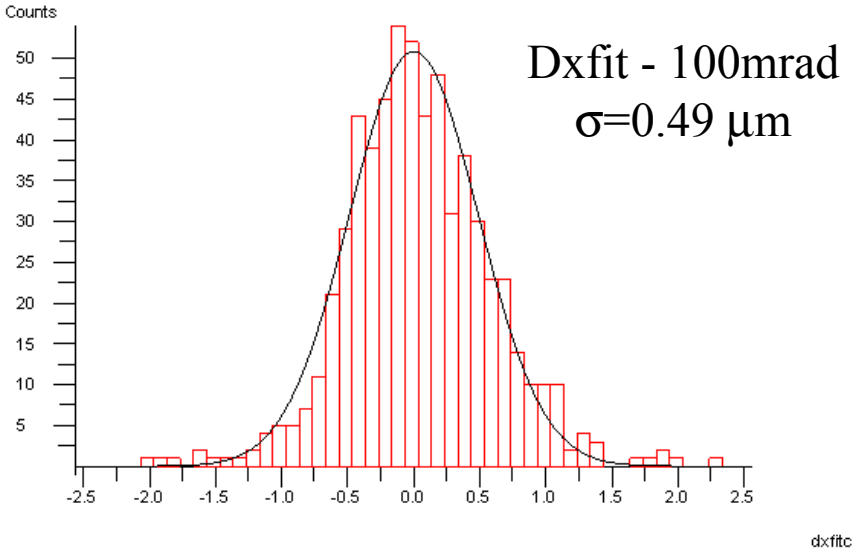
Scanning lab being installed @LNGS

- **Scanning speed ~ 20 cm²/h/side**
- **Single side microtrack finding efficiency ~ 95%**
- **Sheet-to-sheet alignment precision (8 GeV/c πs) ~ 0.5 μm**
- **Angular resolution ~ 2mrad**

Scanning Performances

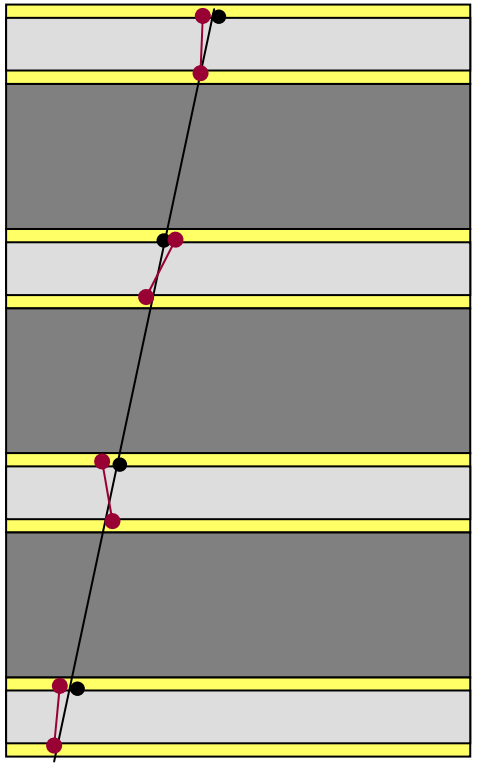


Dxfit - 0mrad
σ=0.43 μm



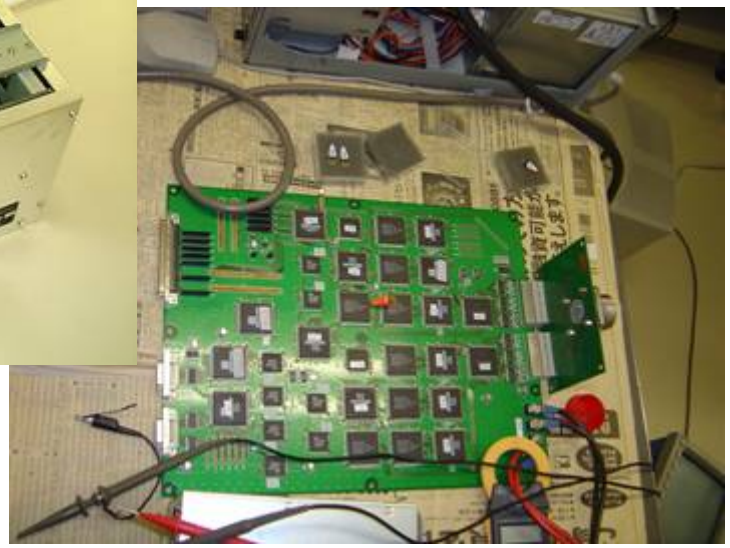
Dxfit - 100mrad
σ=0.49 μm

Aligned beam volume-tracks having at least 5 base-tracks. Correcting residual sistematic errors.



Japanese Scanning System: image processing

Camera Head + CCU

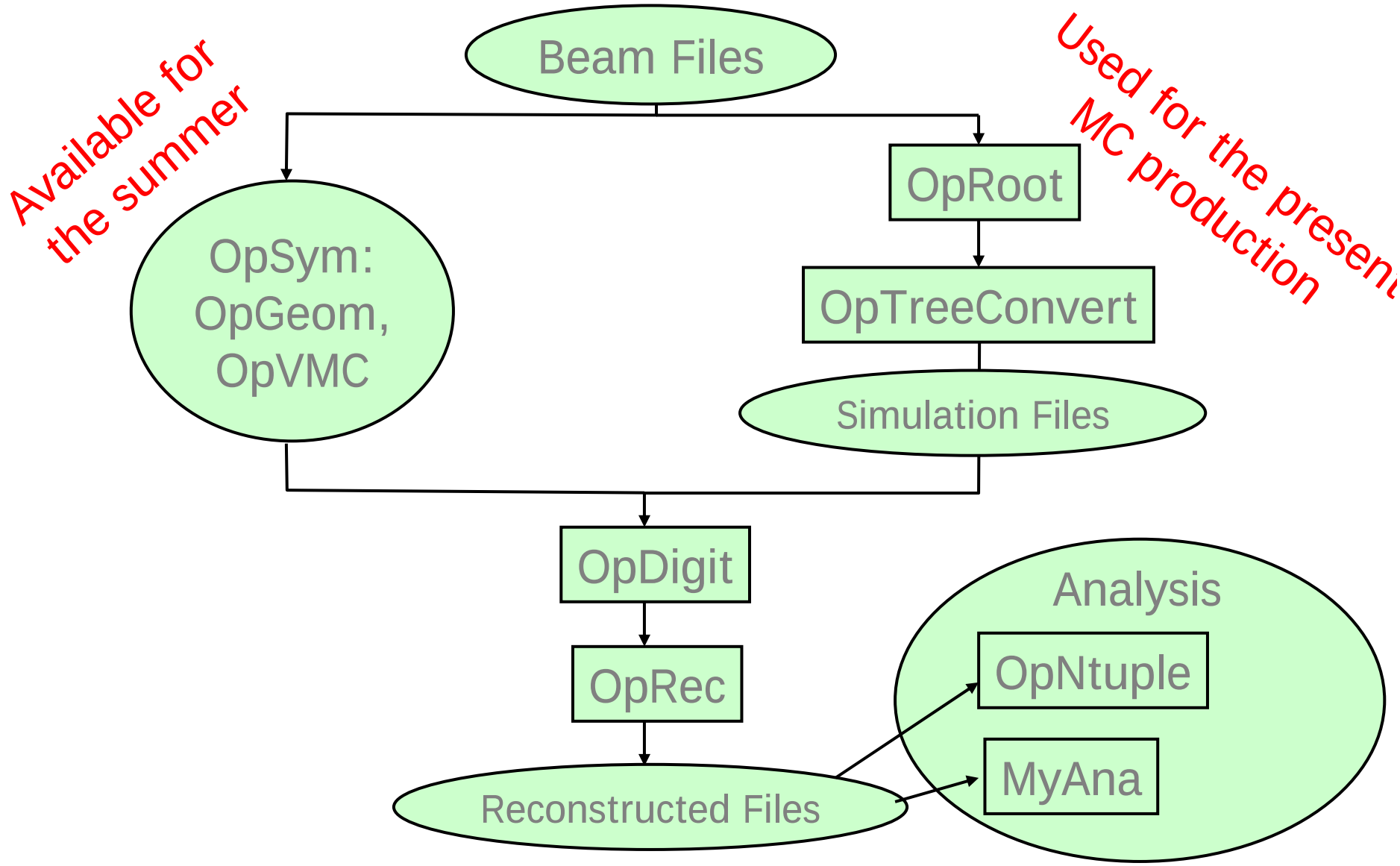


Ultra High Speed CCD Camera for S-UTS

- 512(H)×504(V) pixels
- 3k frames/sec
- Digital output via LVDS, 1.3Gbyte/sec

New Front-End FPGA boards
(under debug)

OPERA Software Chain



OPERA Software

- General framework : ROOT/VMC

- Still a lot of work to complete :
  - the integration of analysis tools
  - the common (Japanese and European) format for data coming out from scanning systems (micro tracks and pulse height)
  - the convergence between different emulsion reconstruction algorithms
  - the central database
  - the documentation, presently very incomplete

- No serious worry for the schedule, but limited manpower
- Better access to CERN computing ressources

τ detection efficiencies *(in % and including BR)*

Channels considered at the time of the CNGS approval in 1999 :

$\tau \rightarrow e$ (DIS+QE, long)	3.0
$\tau \rightarrow \mu$ (DIS+QE, long)	2.6
Overall efficiency	$\varepsilon = \underline{5.6}$

	DIS long	*QE long*	*DIS short*	*Overall**
$\tau \rightarrow e$	2.7	2.3	1.3	3.4
$\tau \rightarrow \mu$	2.4	2.5	0.7	2.8
$\tau \rightarrow h$	2.8	3.5	-	2.9
Total	8.0	8.3	1.3	**9.1 %** Eff * BR

* weighted sum on DIS and QE events

Improvements under study:

- use of a changeable sheet on the back side of the brick
- Brick finding strategy : +10%
- channel τ→3 prongs (1.0% eff, including BR 15%) : +10%

Improvements in the brick location analysis

➢ Integration in the algorithm of all the informations provided by the detector:
Energy flow, Tracking + vertexing, Muon identification

➢ Classification of the events in categories:
with muon (small/large hadronic energy)
without muon (dominantly/not dom. electromagnetic shower)

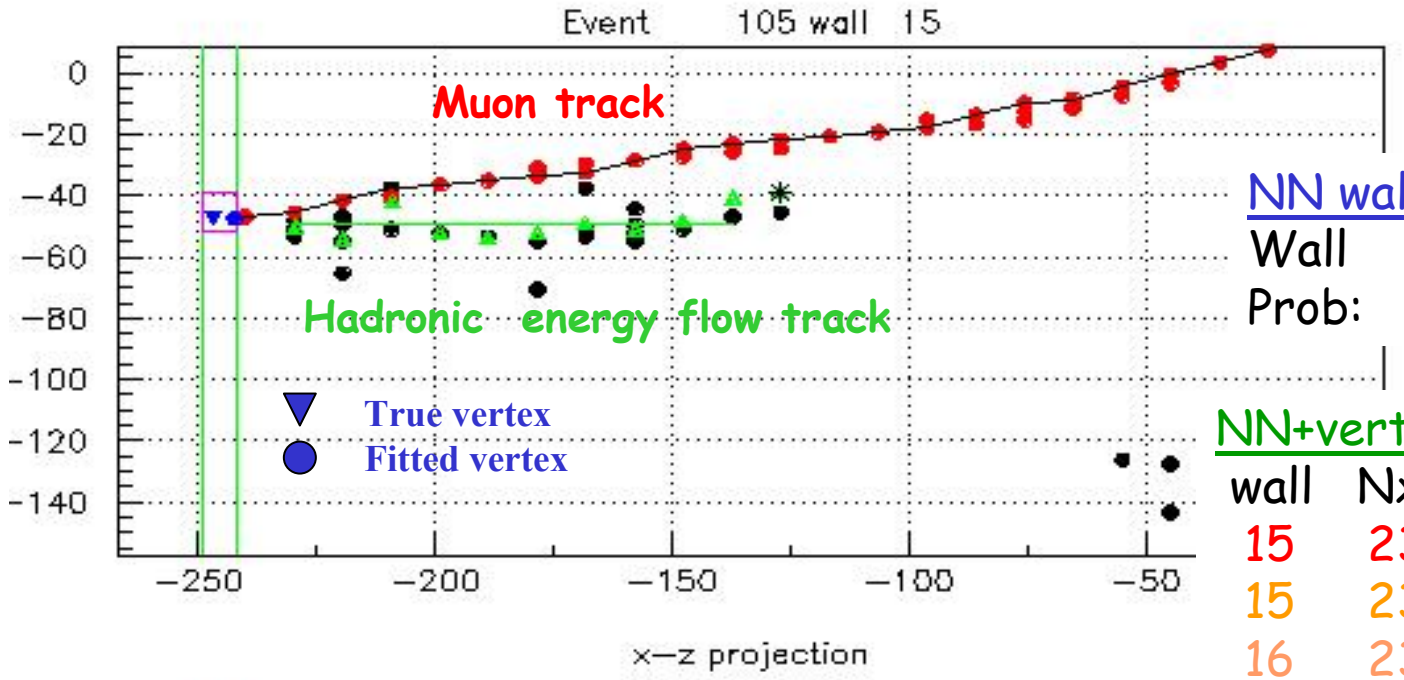
In order to optimize both the NN energy flow analysis and the tracking analysis

➢ Combination of the wall probabilities from the NN energy flow analysis with the 3D vertex probabilities in order to produce a 3D brick probability chart

➢ Sequential extraction and analysis of the bricks following the order of the probability chart

Efficiency improved with minimal losses of the target mass

Combined NN + tracking probability chart for a typical τ–>μ event

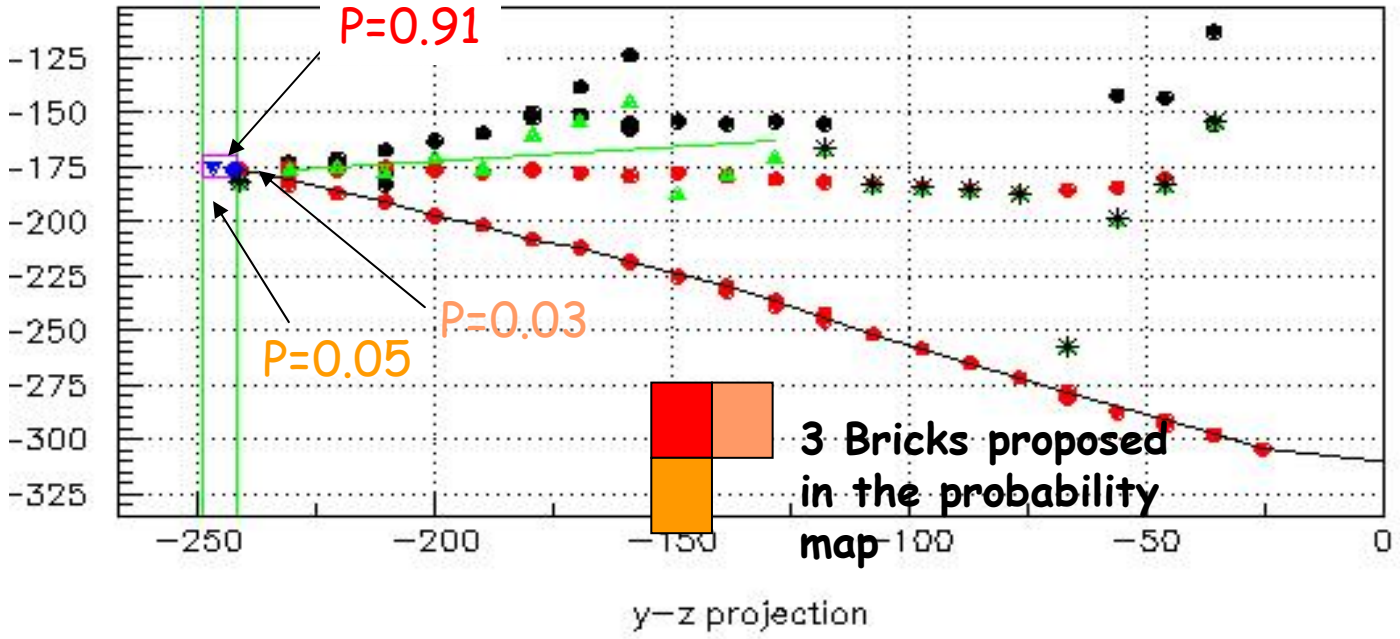


NN wall probabilities:

Wall	15	16	17
Prob:	0.79	0.21	-

NN+vertex Brick Prob. (P>1%)

wall	Nx	Ny	P
15	23	16	0.91
15	23	15	0.05
16	23	16	0.03



Increased precision in the determination of the brick also along Z

Efficiency for the: τ→μ channel

BR	Evt long	ε Localization	Kink+ kinematics	Id μ + ECC connection	Others
0.176	0.39	0.73	0.73	0.80	0.96 → 2.8%

6.8%

Application of the 3D chart

Additional fraction of extracted bricks

Extraction strategy:	τ→μ	τ→e	τ→h	
Only the Highest Prob. Brick (HPB)	73.5%	75.4%	64.2%	
HPB + second most probable brick (SMPB) if P1-P2<0.1	+1.0%	+3.0%	+4.7%	→ 0.3%
HPB + SMPB if P1-P2<0.2	+2.0%	+5.0%	+6.9%	→ 0.4%
HPB + SMPB if P1-P2<0.3	+2.8%	+5.8%	+8.2%	→ 0.5%
HPB + SMPB (P2> 1%)	+8.1%	+9.7%	+12.0%	→ 1.2%
Sequential extraction of all the bricks in the list (with P>1%)	+9.6%	+12.0%	+16.1%	→ 1.9%
Net efficiency gain →	+7.7%	+ 10.1	+14.2%	

Minimal reduction of the target mass

Historical summary of Brick finding efficiencies

OPERA proposal (2000)

Inclusion of nuclear effects (-10% avg. eff. loss) and analysis retuning (2002)

Sequential, probability ordered, extraction of all the bricks in the 3D chart (P>1%) until the vertex is found (2004)

$\tau \to \mu$	$\tau \to e$	$\tau \to h$
73.0%	80.1%	69.8%
65.1%	74.0%	63.2%
81.2%	85.5%	78.4%

The last numbers are corrected for the target mass reduction due to the multi-brick extraction

- Single brick extraction efficiencies recovered the losses due to the inclusion of nuclear effects and came back to the Proposal values
- The application of the 3D probability chart allows to increase by 10% the number of τ events (weighted effect)

Expected number of background events

(5 years run, nominal intensity)

(in red : possible improvements)	$\tau \to e$	$\tau \to \mu$	$\tau \to h$	total
Charm background	.210 .117	.010 .007	.162 .160	.382 .284
Large angle μ scattering		.116 .023		.116 .023
Hadronic background		.093 .093	.116 .116	.209 .209
Total per channel	.210 .117	.219 .123	.278 .276	.707 .516

30% possible background reduction

1. **Charm background :**
   - **Being revaluated using new CHORUS data: cross section increased by 40%**
   - **πμ id by dE/dx would reduce this background by 40%**
     ⇒ being tested at KEK and this autumn at PSI (pure beam of π or μ stop)
2. **Large angle μ scattering :**
   - **Upper limit from past measurements used so far**
   - **Calculations including nuclear form factors give a factor 5 less**
     ⇒ will be measured in 2004 in X5 beam with Si detectors
3. **Hadronic background :**
   - **Estimates based on Fluka standalone : 50% uncertainty**
   - **Extensive comparison of FLUKA with CHORUS data and GEANT4 would reduce this uncertainty to ~15%**

$\nu_\mu \rightarrow \nu_\tau$ sensitivity

full mixing, 5 years run @ 4.5 x10^{19} pot / year

	signal ($\Delta m^2 = 1.9 \times 10^{-3}$ eV^2)	signal ($\Delta m^2 = 2.4 \times 10^{-3}$ eV^2)	signal ($\Delta m^2 = 3.0 \times 10^{-3}$ eV^2)	BKGD
OPERA 1.8 kton fiducial	6.6(10)	10.5(15.8)	16.4(24.6)	0.7(1.1)
+ brick finding + 3 prong decay	8.0(12.1)	12.8(19.2)	19.9(29.9)	1.0(1.5)
Background reduction	8.0(12.1)	12.8(19.2)	19.9(29.9)	0.8(1.2)

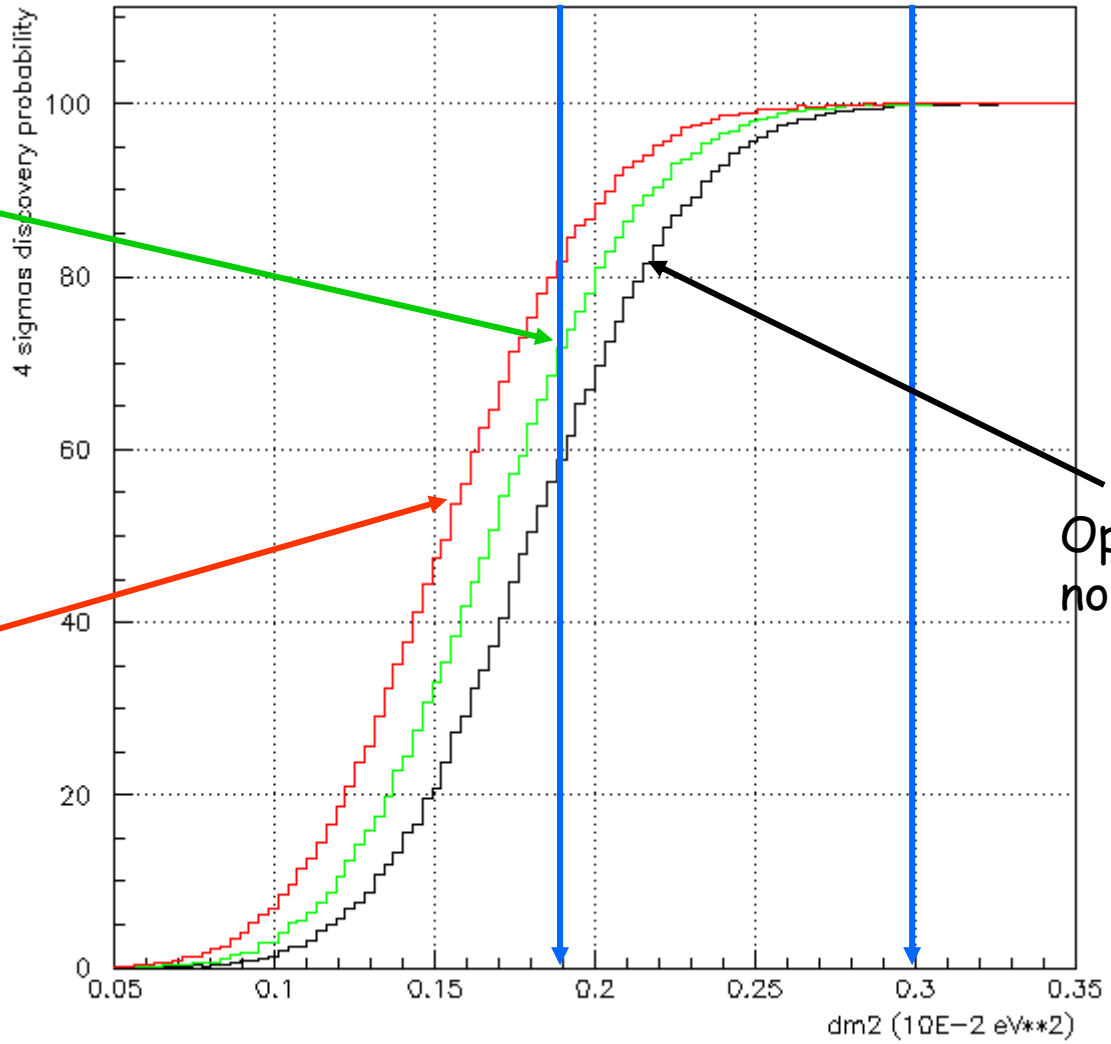
(...) with CNGS beam upgrade (X 1.5)

Sensitivity versus Background

Opera with expected background improvements

-30%

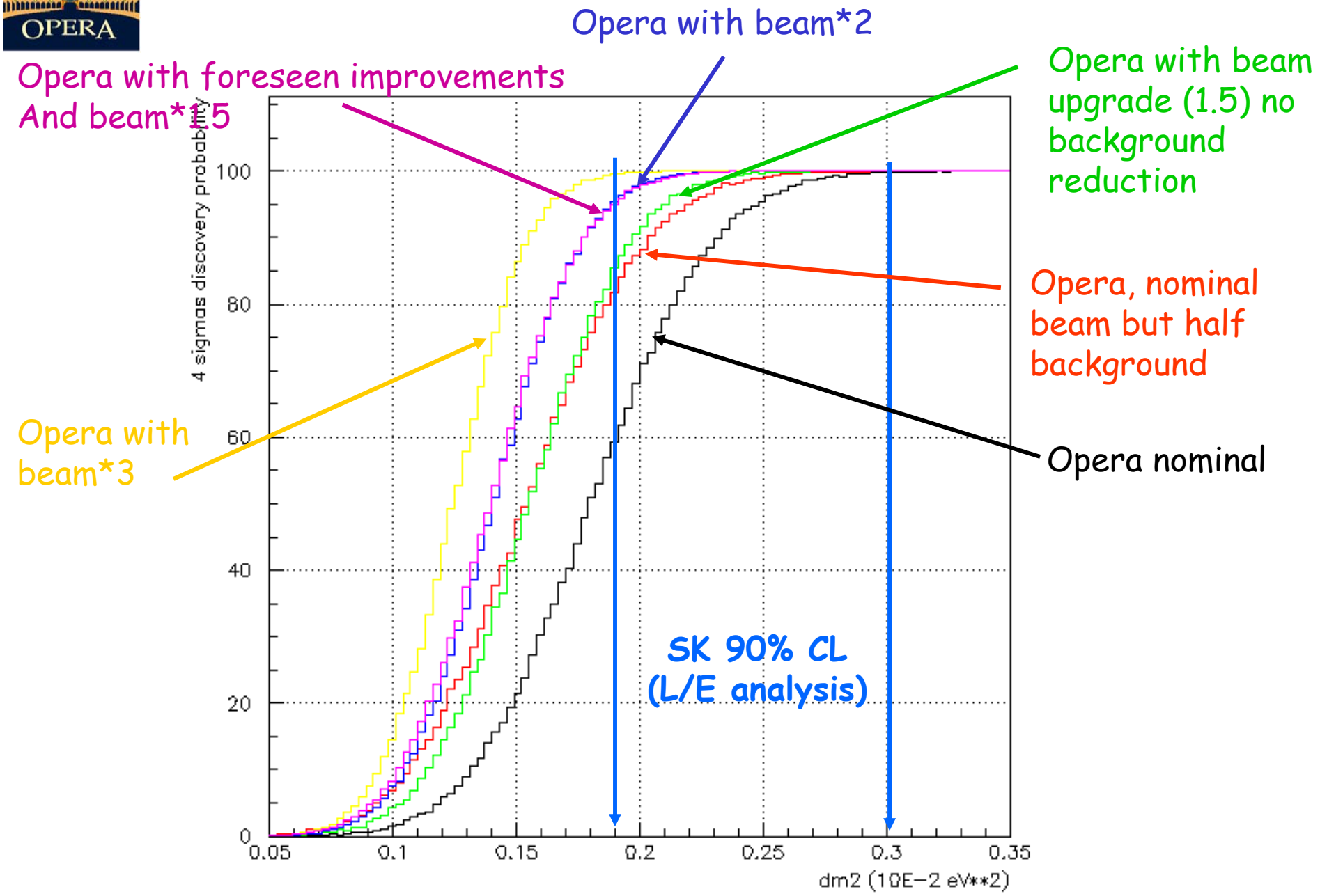
Opera, half background



Opera nominal

SK 90% CL (L/E analysis)

Sensitivity versus Beam Intensity



Conclusions

- despite the difficulties @ LNGS and the limited support in Home Institutions
  the installation of the OPERA experiment is following the expected schedule

- the completion of the first SuperModule is foreseen in feb 06
  and the second in september 06
  → we need a physics run in 2006 to start the physics program

- to cover the allowed range of Δm^2 from SuperK analysis
  → better efficiency and background reduction for OPERA are needed : in progress
  → more protons onto the CNGS target are needed:
  either by increasing the number of CNGS cycles
  or (and) increasing the proton intensity in the SPS as soon as possible