Status of ALBA

Dieter Einfeld / CELLS

Big Milestones in 2009

1.) Installation of the booster Synchrotron

2.) Movement from the University to the final building.

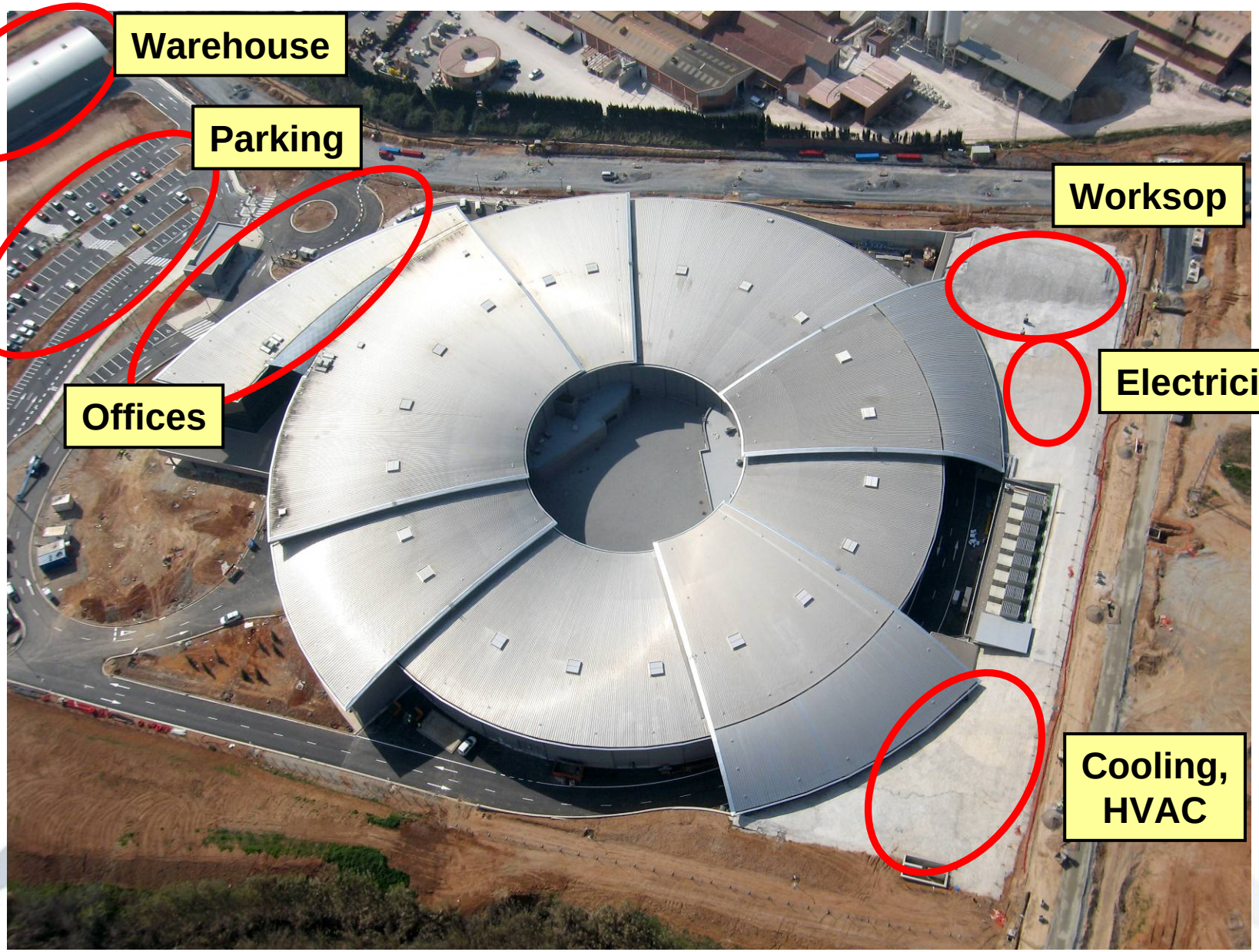
3.) Mechanical Installation of the storage ring

4.) Commissioning of the subsystems

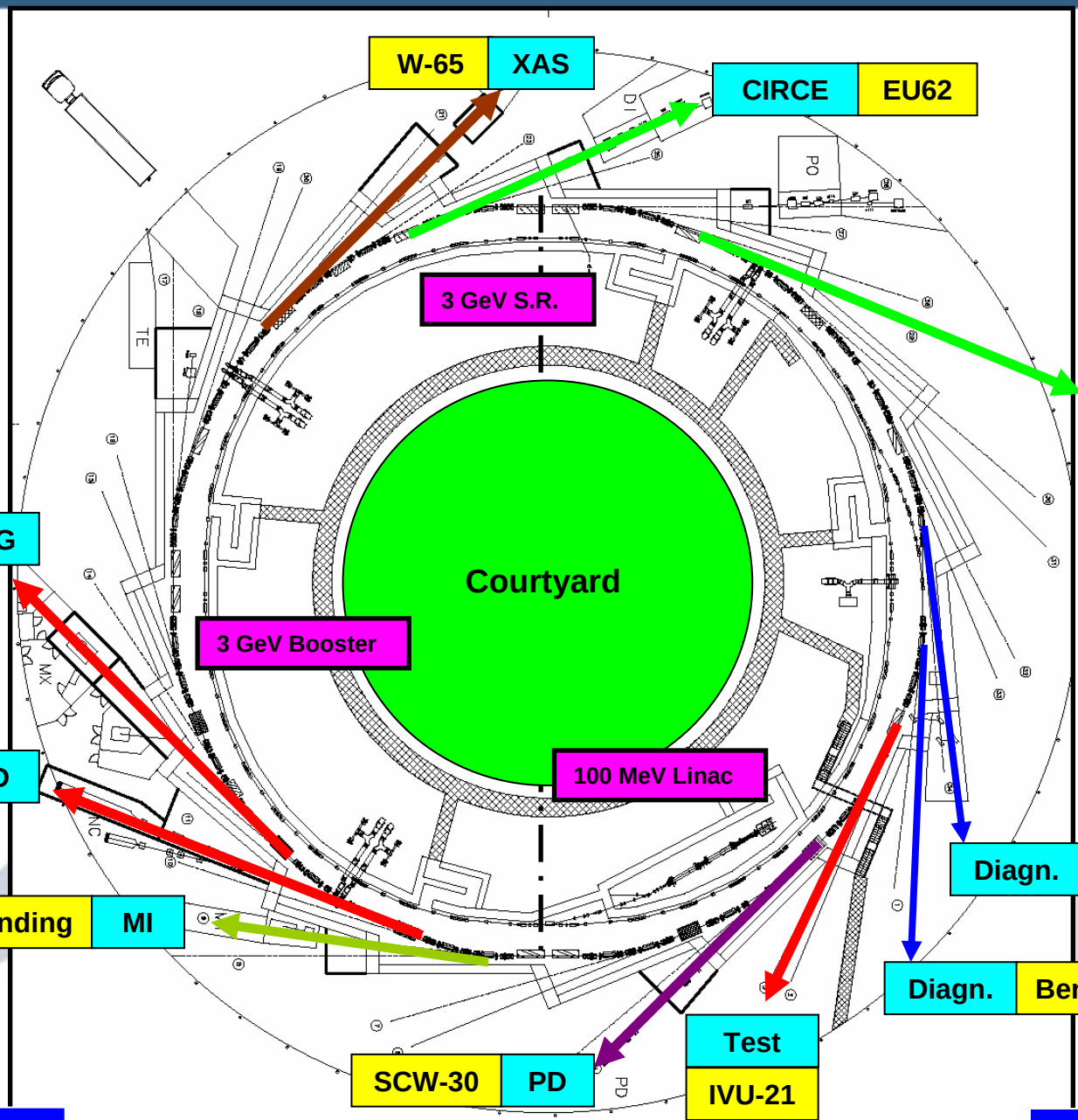
5.) Restart of the Linac

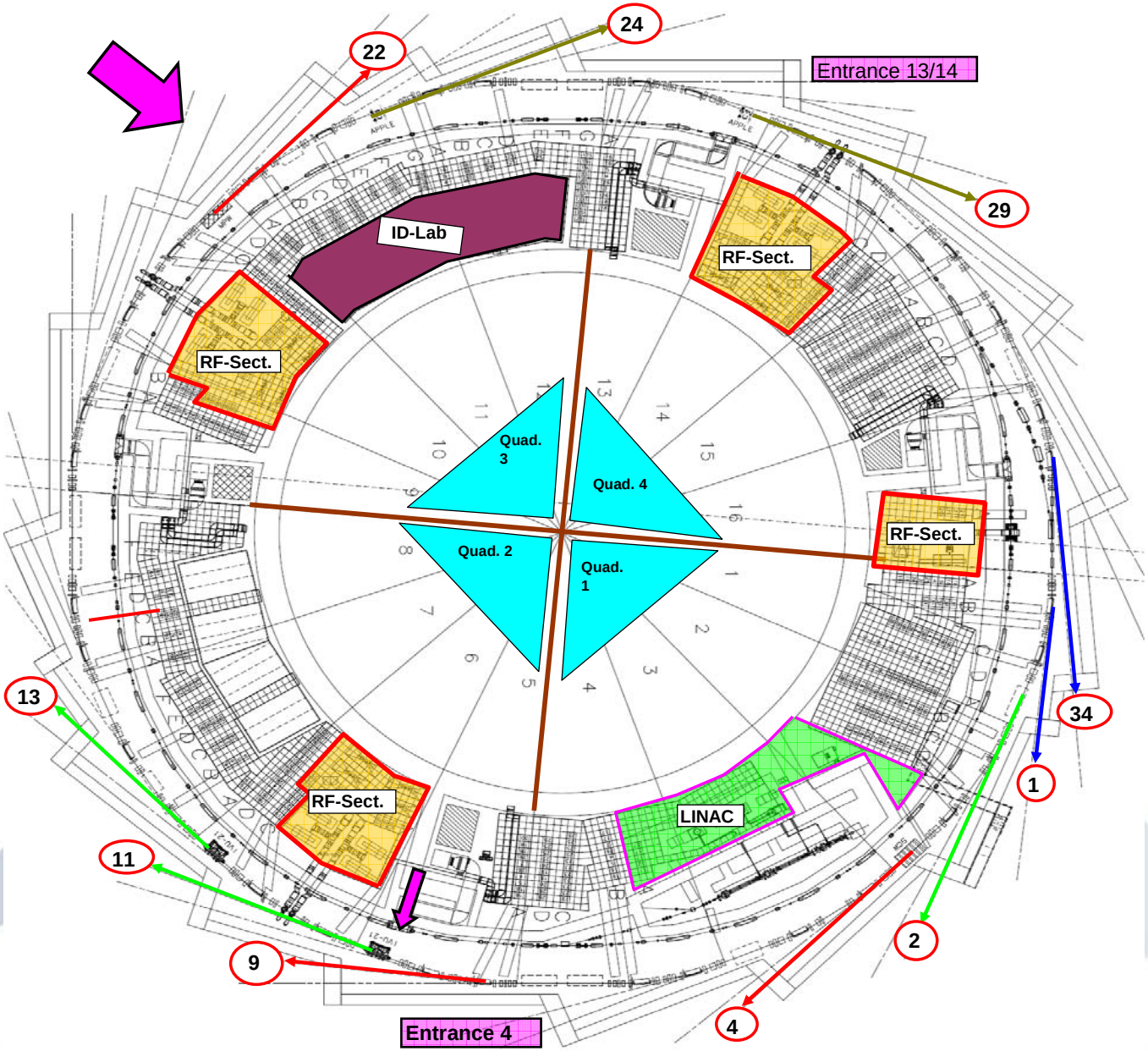
and upcoming in 2009

6.) Start of the booster commissioning

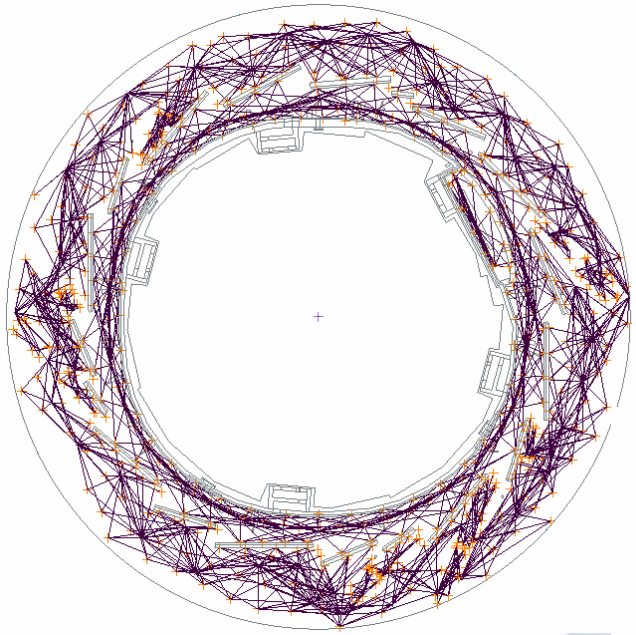

Warehouse
Parking
Offices
Worksop
Electricity
Cooling, HVAC


Tunnel Q1
Tunnel Q2
Tunnel Q3
Tunnel Q4
Temperature °C
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
3.11.09
4.11.09
5.11.09
6.11.09
W
9.11.09
10.11.09
11.11.09
12.11.09
13.11.09
W
16.11.09
17.11.09
18.11.09
19.11.09
20.11.09


W-65
XAS
CIRCE
EU62
3 GeV S.R.
XMCD
EU-71
IVU-21
XALOG
Courtyard
3 GeV Booster
IVU-21
NCD
100 MeV Linac
Diagn.
Bending
Bending
MI
Diagn.
Bending
Test
IVU-21
SCW-30
PD
PO
TE
MX
NC
PD


24
22
Entrance 13/14
29
ID-Lab
RF-Sect.
RF-Sect.
Quad. 3
Quad. 4
RF-Sect.
Quad. 2
Quad. 1
34
1
13
RF-Sect.
LINAC
11
2
9
4
Entrance 4

Network Measurement

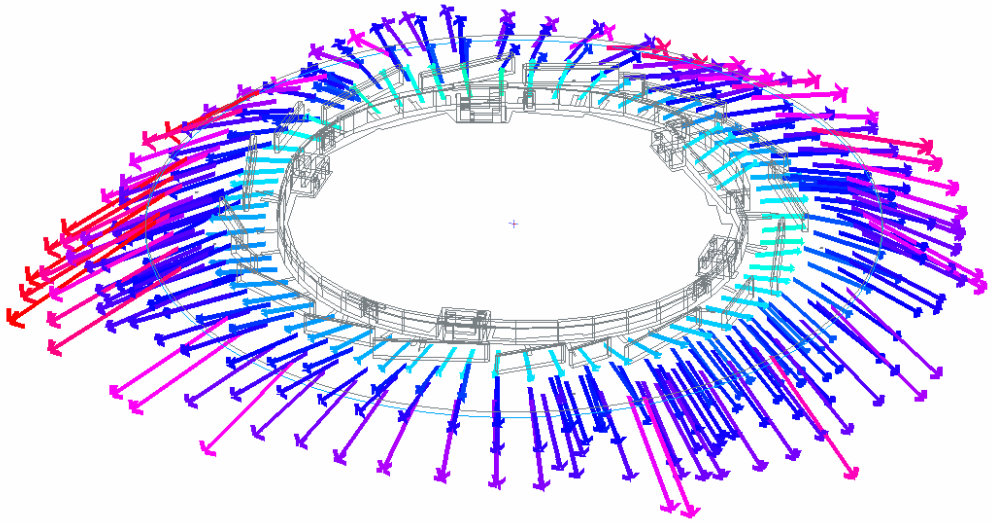


564 Al References
123 Laser Tracker setup
52 Digital level setup
2148 Observations

Point Error:
Overall RMS: ± 0.020 mm
Average: 0.014 mm
Max: 0.105 mm

Uncertainty Magnitude
Average: 0.082 mm
Max: 0.201 (Front Wall Windows)

Network Evolution along the year



Statistic	dX	dY	dZ	Magnitude
Min	-2.9801	-2.6451	-2.4036	0.7889
Max	2.4055	2.6276	0.4250	3.8130
Average	0.0373	0.0070	-0.5868	1.9360
StdDev	1.3533	1.2972	0.5784	0.6593
RMS	1.3515	1.2950	0.8233	2.0448

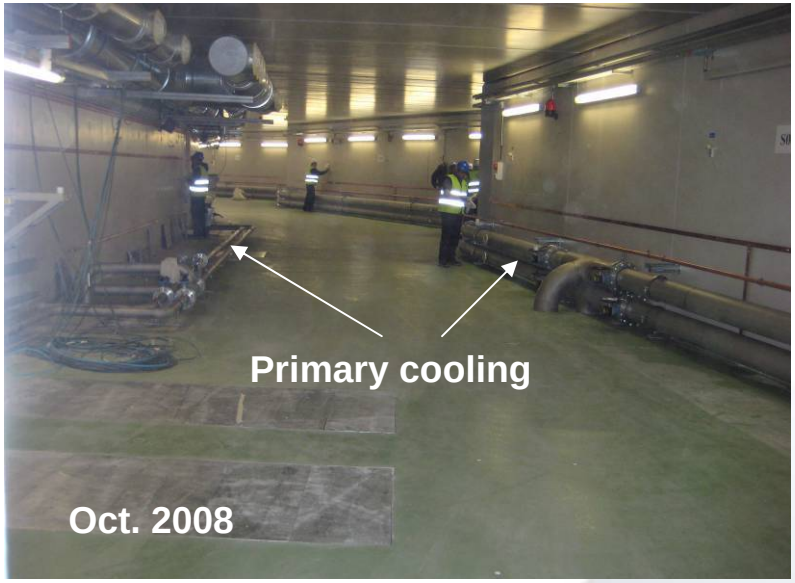
The installation of the 7 beam lines is in progress and within the time schedule

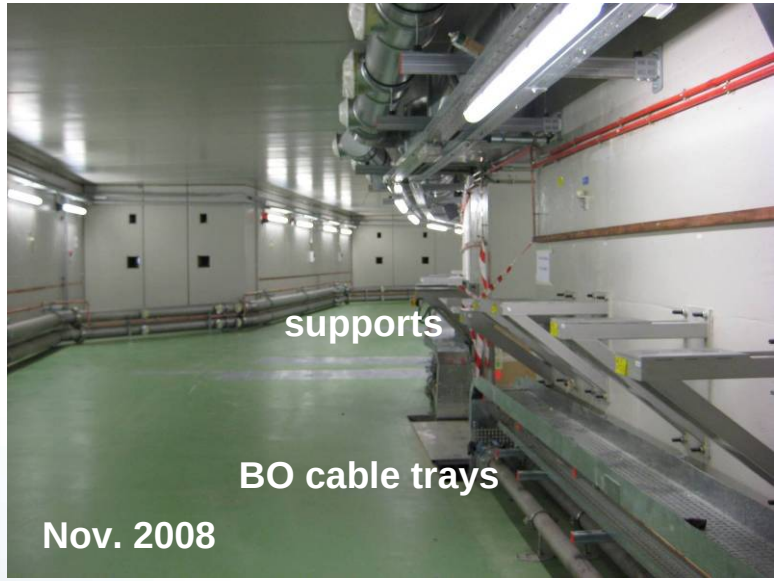
The racks for the RF-system. Timing system, network, power supplies, etc have been installed

Booster Mechanical Installation

- Unit cell installation test done on 18.01.09 already at the tunnel
- Vacuum chamber assembled and baked in the laboratory

- Started magnet installation on 15.01.09
- Finished mechanical installation on 26.03.09


Primary cooling
Oct. 2008


supports
BO cable trays
Nov. 2008


Jan – March 2009


Jan – March 2009

Booster and LTB vacuum installation

- The preparation for the installation inside the vacuum lab started on Sep 2008.
  1. The booster was divided into 43 parts.
  2. Each part was assembled and tested on assembly tables.
  3. then moved to the oven and baked.
  4. then vented with dry nitrogen and stored.
- The mechanical installation started end of Jan. 09 and finished mid. Mar. 09.
- Once the magnets are aligned and open the chambers were placed and connected to each other under laminar flow tent.

Chambers assembled on the assembly tables

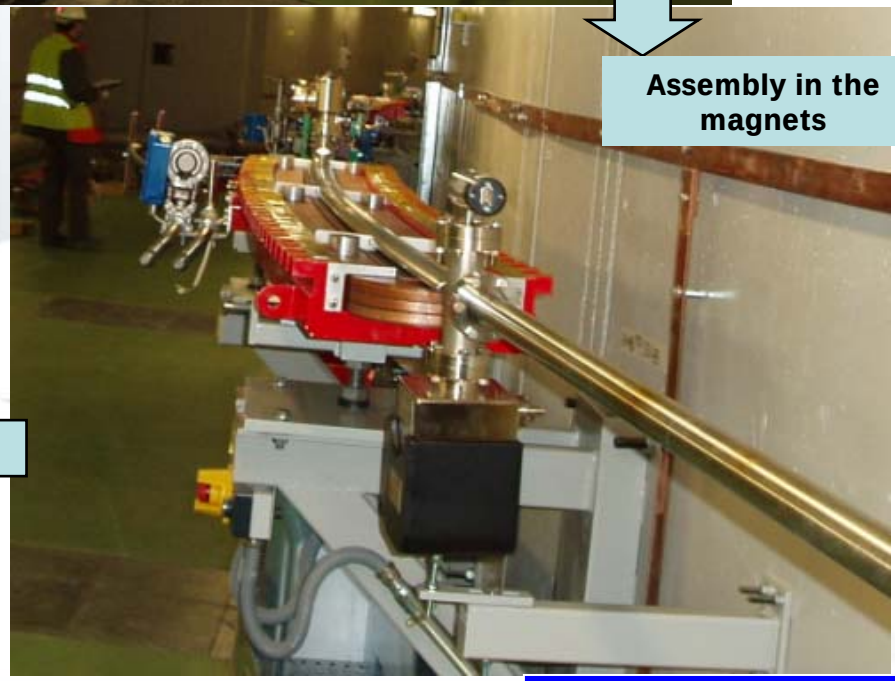
Chambers assembled and under testing.

Chambers under bakeout in the oven

Movement to the tunnel

Each section is moved under nitrogen to the tunnel.

Magnets are open and assembly is ready to be placed.



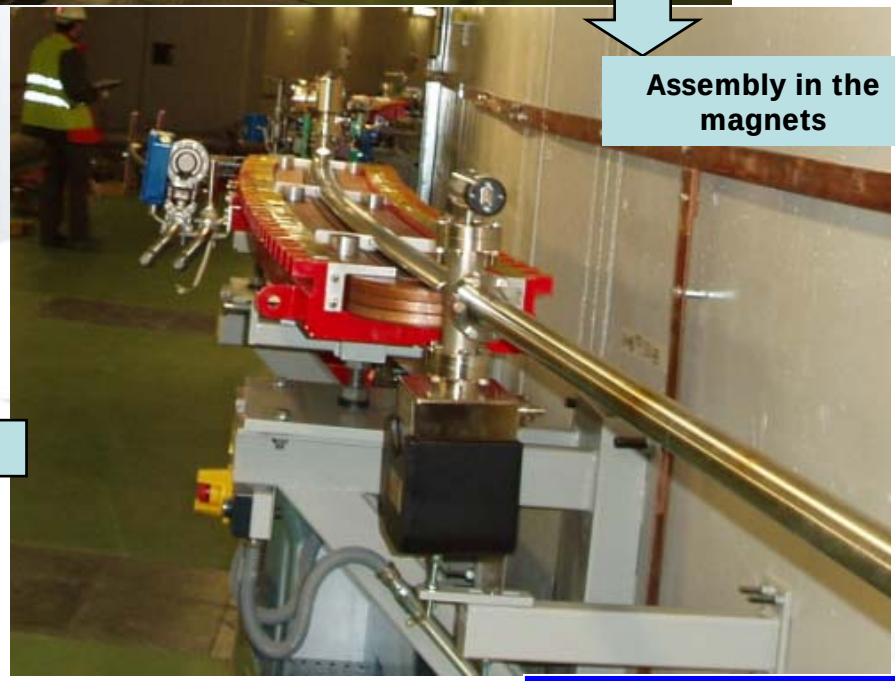
Assembly in the magnets

Connection to each assembly done under laminar flow tent.

Movement to the tunnel

Each section is moved under nitrogen to the tunnel.

Magnets are open and assembly is ready to be placed.

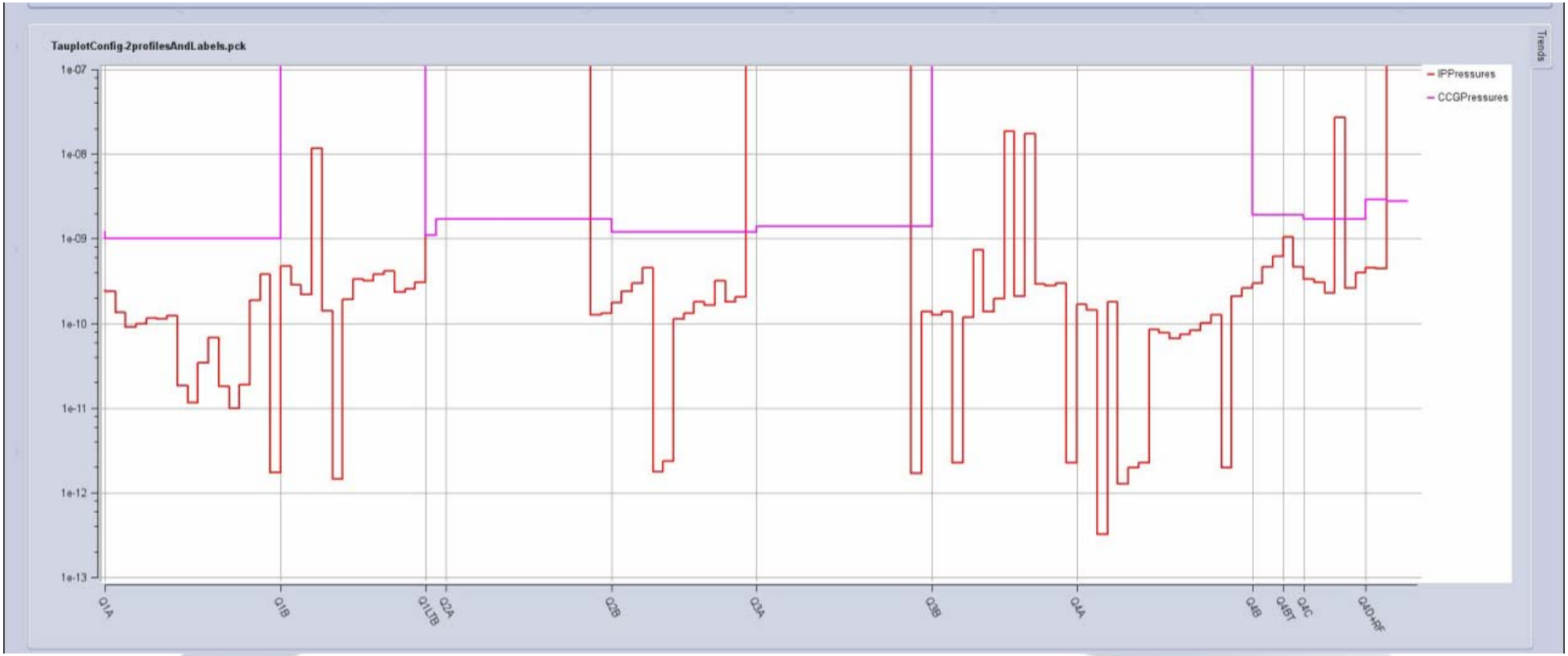


Assembly in the magnets

Connection to each assembly done under laminar flow tent.

Pressure profile of the booster (23rd Nov. 2009)

The average pressure from the ion pumps is 7.7×10^{-10} mbar.
And from the gauges is 1.9×10^{-9} mbar.



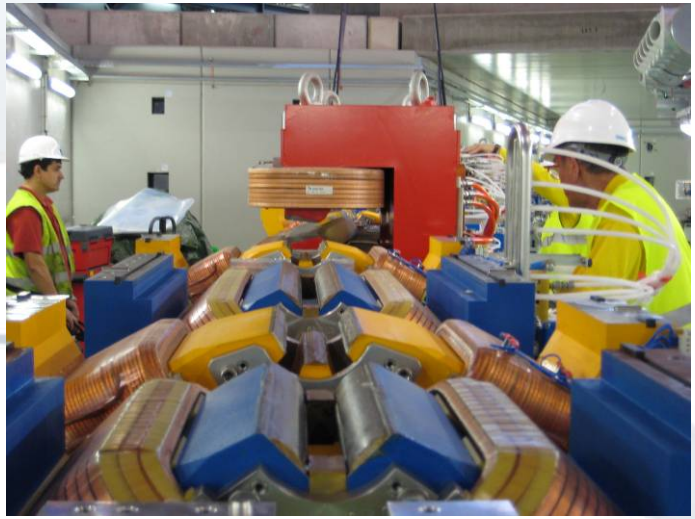
Storage Ring Mechanical Installation

- Objective: 1 sector (2 girders) per week.
- No straights
- Vacuum chamber assembled in the Lab
- Baking oven in the Experimental Hall
- Magnets onto the girders in the Experimental Hall
- Moving girders into tunnel, but without the dipole
- Open magnets

- First sector into tunnel: 28.04.09
- Last sector into tunnel: 01.09.09

(completed on time, after the summer break)

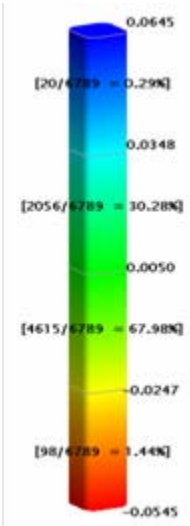
Storage Ring Mechanical Installation

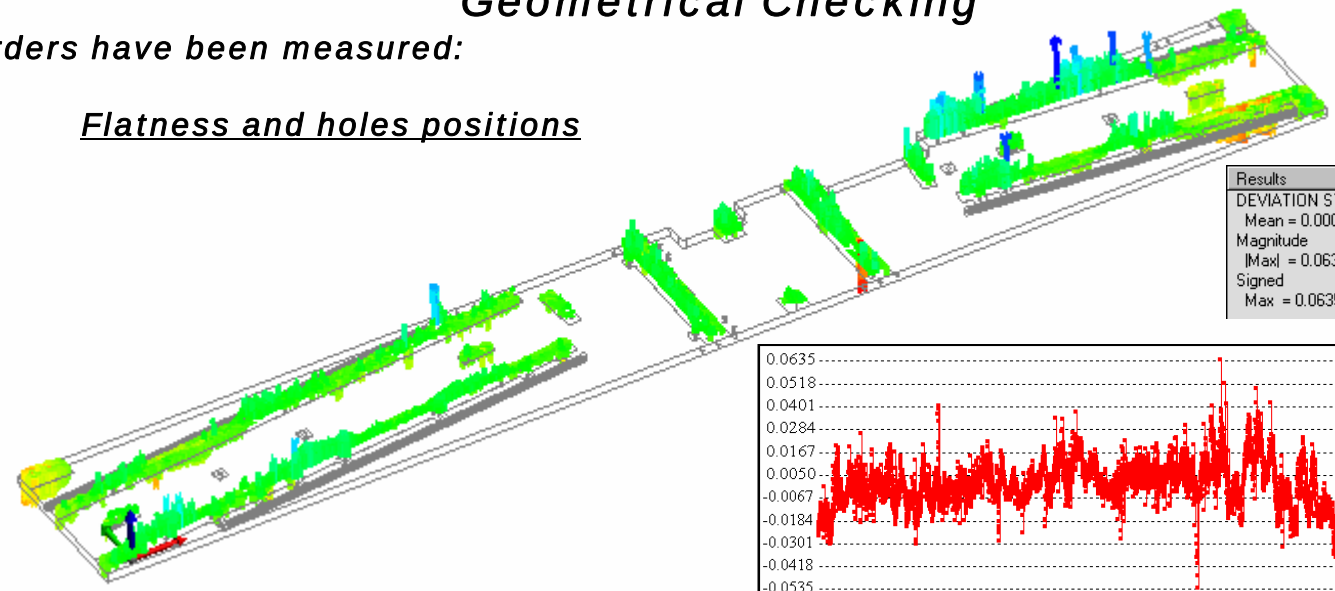


Geometrical Checking

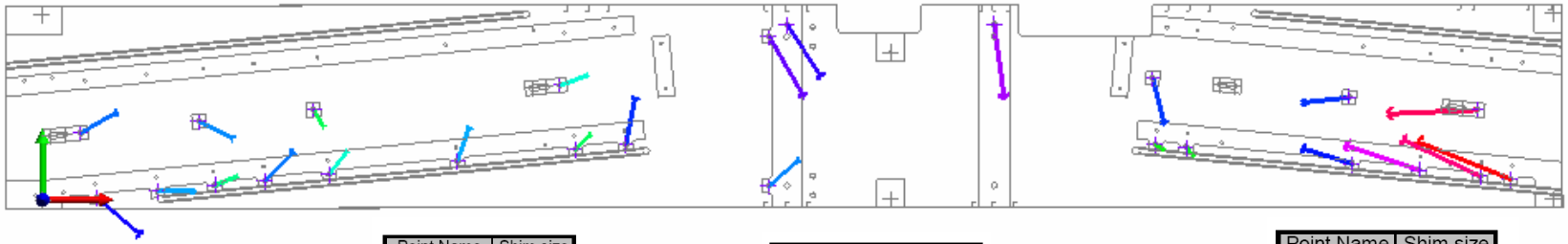
All 32 SR Girders have been measured:

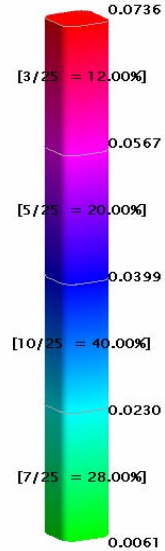
Flatness and holes positions





Results
DEVIATION STATS
Mean = 0.000000 RMS = 0.010998 Millimeters
Magnitude
|Max| = 0.063520 |Min| = 0.000000 Millimeters
Signed
Max = 0.063520 Min = -0.053475 Millimeters





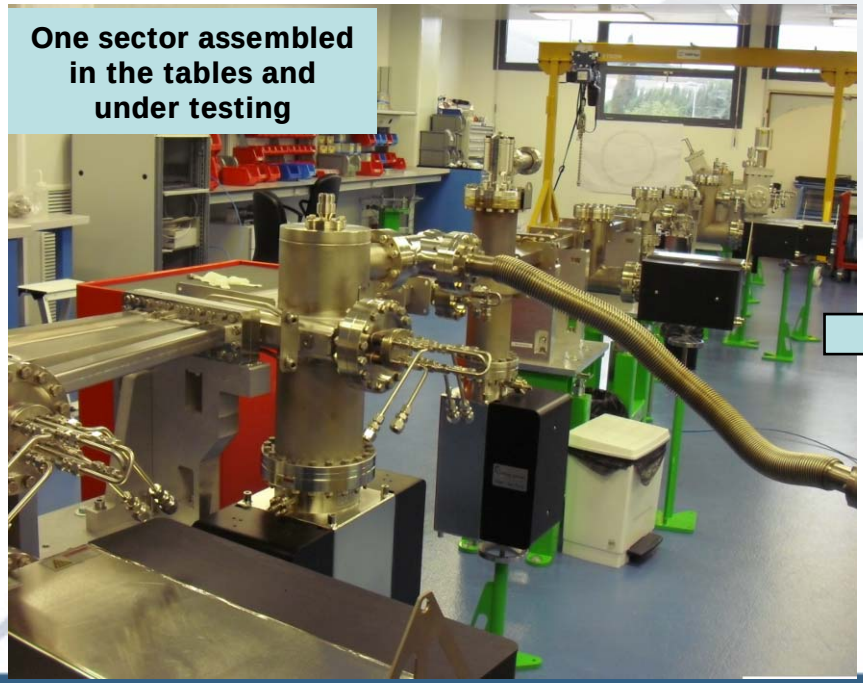
Point Name	Shim size
2M	0.030
3M	0.003
5M	-0.005
6M	-0.019
8M	-0.015
9M	-0.024
11M	-0.009
12M	-0.033

Point Name	Shim size
13M	-0.053
14M	-0.040

Point Name	Shim size
18M	0.003
19M	0.006
21M	-0.007
22M	-0.013
24M	-0.021
25M	-0.020

Storage ring.

- The assembly was done in a clean room.
- Assembly tables were used and were aligned up to 50um.
- The chambers were assembled with all the components (gauges, pumps, valves…etc) and tested in the vacuum lab.
- The sector (13m) is connected to a frame and moved to the oven where it is baked to 220C for at least 48 hours.
- then cooled and moved under vacuum to the tunnel.
- The average pressure in the tunnel is mid 10^{-10} mbar range.
- The process (from assembly to movement to tunnel) for each sector is one week.
- The last sector was placed on the 1st of Sep. 2009.



One sector assembled in the tables and under testing

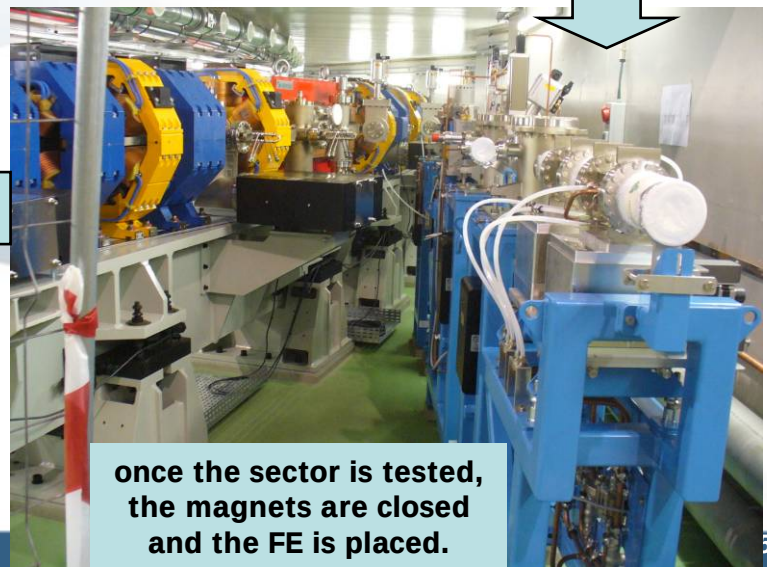
Sector connected to the frame

Storage ring.

Sector inside the oven and ready for bakeout

Sector moved to the tunnel to be placed in the girder.

When two adjacent sectors are placed the straight in between is assembled and baked in-situ



once the sector is tested, the magnets are closed and the FE is placed.

Storage Ring Mechanical Installation

After installation of the vacuum sector:

- **Alignment of vacuum chamber @ BPM's**
- **Vacuum leak test**
- **Connecting ion pumps**
- **Closing of magnets**

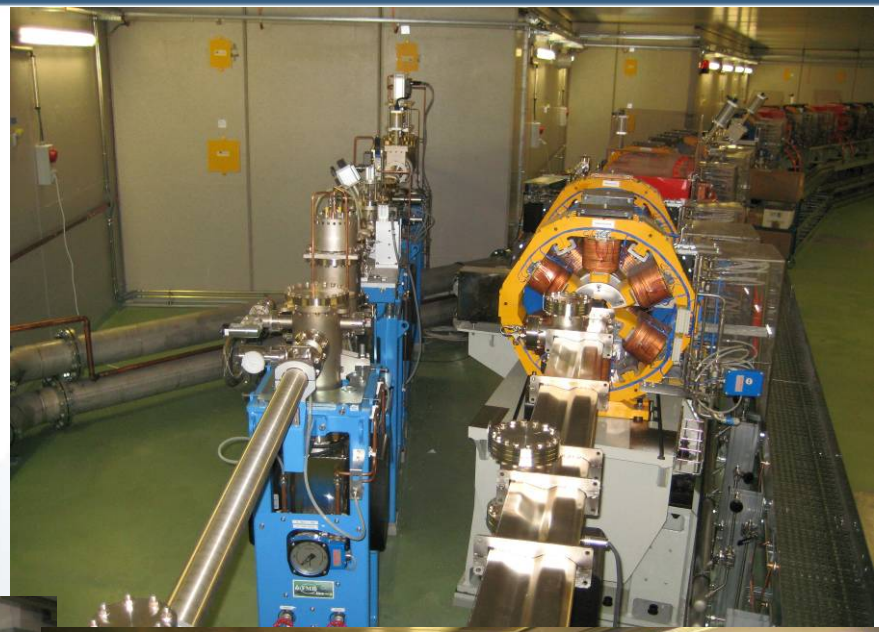
Celebrations!

Finishing the booster

...and the storage ring!

Situation in the tunnel

Situation in the tunnel




ALBA
INSERTION DEVICES


EXIT

BO & SR SEPTA

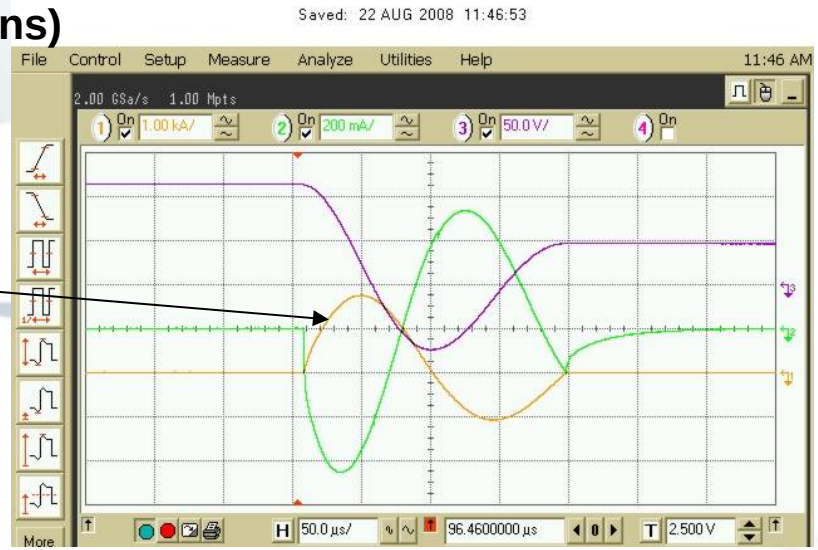
Main characteristics

- ✓ Full sinus
- ✓ 180 μs pulse length BO-INJ
- ✓ 300 μs pulse length BO-EXT
- ✓ I_{max}= 1755 A BO-INJ (nom. 1550 A)
- ✓ I_{max}= 9600 A BO-EXT (nom. 6800 A)
- ✓ 0.2% p-p current stability (spec ±0.2 %)
- ✓ 5 ns p-p time jitter (spec ±5 ns)

BO septa: installed and running

SR septa: ready for installation

Current pulse



BO KICKERS

Main characteristics:

- ✓ fall time 150 ns (from 10 to 90%) (specs 200 ns)
- ✓ flat top 350 ns (specs 300 ns)
- ✓ 1.3 ns p-p time jitter (specs ± 5 ns)
- ✓ 0.08% @ Imax A current stability (specs 0.1 %)
- ✓ ±1% variation in flat top (specs ± 1%)

BO kickers: installed and running

SR KICKERS

Main characteristics

- ✓ half sinus
- ✓ 6 μs pulse length
- ✓ I_{nom} = 4750 A
- ✓ 0.5% p-p current stability
- ✓ 0.7 ns p-p time jitter

SR kickers: Ti coating under production

2 KI mounted on one girder

HAZEMEYER POWER CONVERTERS

DIPOLE

- SR-BEND (750V/600A)

QUADRUPOLES (16 cabinets/112un)

- SR-QUAD-1 (25V/225A)
- SR-QUAD-2 (15V/200A)

SEXTUPOLES (9 units)

- SR-SEXT-1 (100V/215A)
- SR-SEXT-2 (125V/215A)
- SR-SEXT-3 (190V/215A)
- SR-SEXT-4 (350V/215A)

FAT finished and approved.

All power supplies delivered.

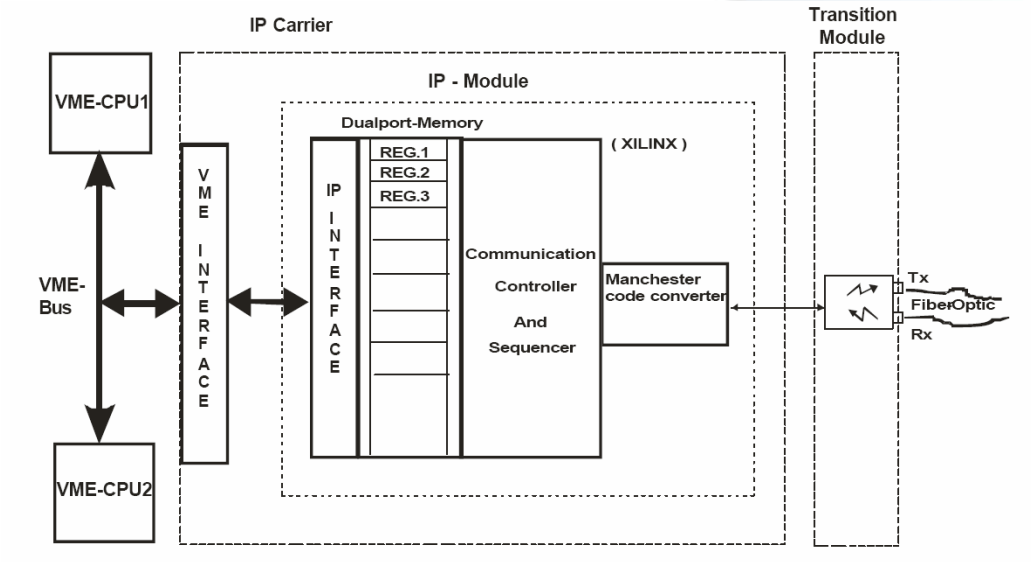
In house tests on all power supplies, except the dipole

Installation completed

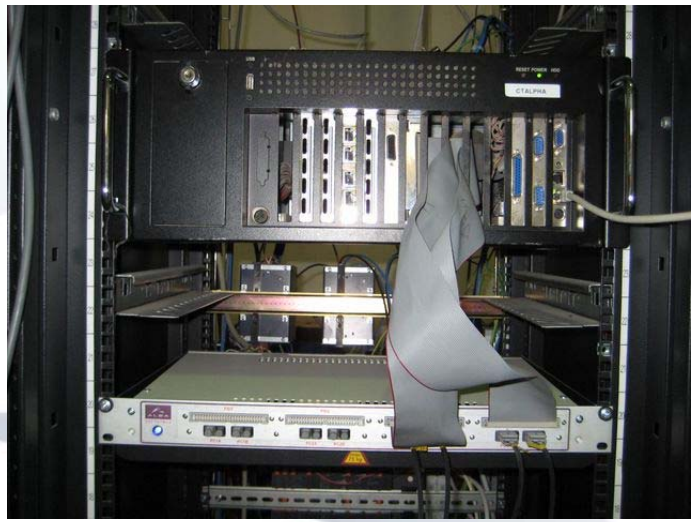
Connection in progress

SR CORRECTORS FROM OCEM

- cPCI bus used for the communication and control of PSI regulation cards
- Transition board design and prototype completed by CELLS Computing Div.
- Tests have been successful
- FAT to be completed, Jan 2010



PSI VME communication link



ALBA's transition board connected to cPCI crate

BRUKER POWER CONVERTERS

LT TRANSFERLINE

- LT-BEND-1(30V/200A)
- LT-BEND-2 (12V/12A)
- LT-QUAD (20V/15A)
- LT-CORR (2V/2A)

BT TRANSFERLINE

- BT-BEND (60V/180A)
- BT-QUAD (15V/170A)
- BT-CORR (10V/6A)

BOOSTER

- BO-BEND (1000V/750A)
- BO-QUAD(100,200,750V/180A)
- BO-SEXT(60V/8A)
- BO-CORR (12V/6A)

All power supplies delivered.

Installation completed

LT&BO PS connected

LT is running

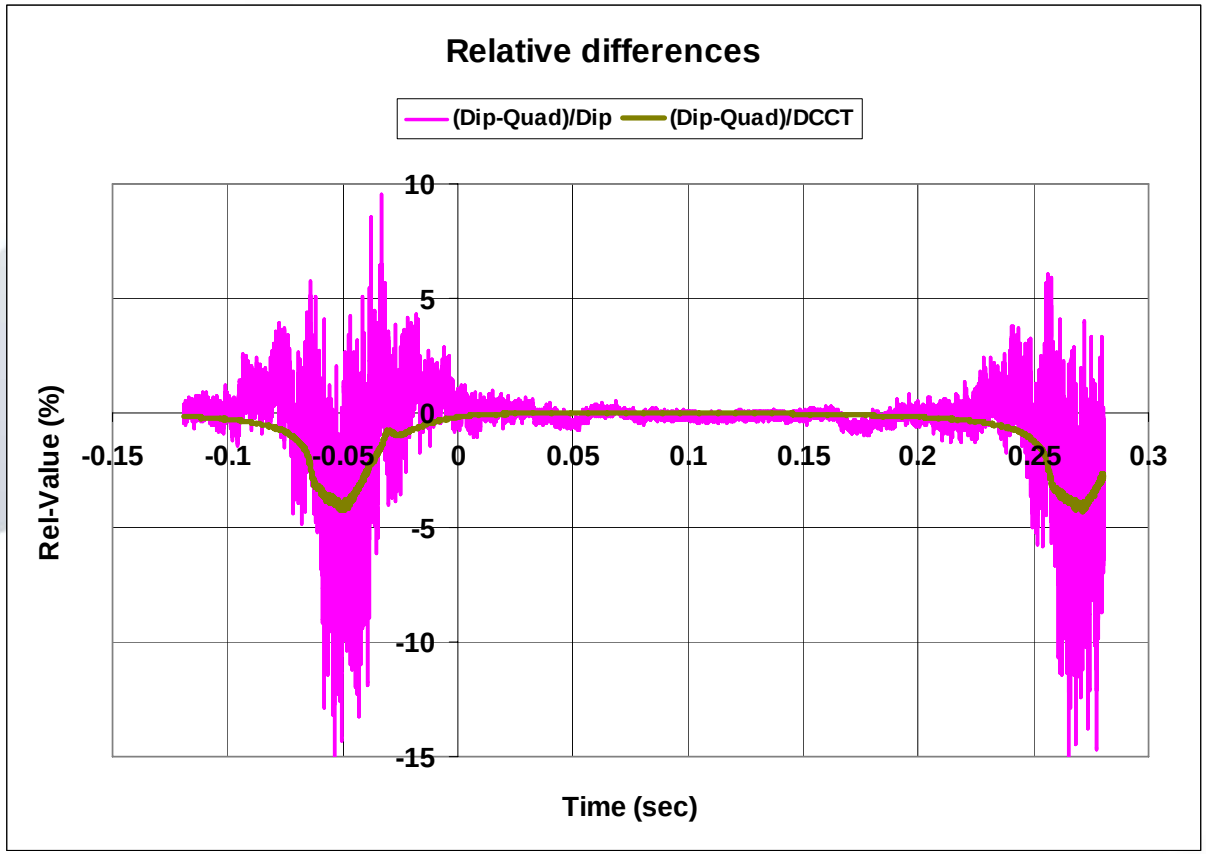
BO is running, but

- adjusting the tracking
- working on controls

BRUKER POWER CONVERTERS

BOOSTER

- **BO-BEND (1000V/750A)**
- **BO-QUAD(100,200,750V/180A)**
- **BO-SEXT(60V/8A)**
- **BO-CORR (12V/6A)**



RF Cavities

RF Booster 5-cell cavity:

- ✓ Cavity installed and aligned
- ✓ Conditioned up to 40 kW inside the tunnel

RF SR DAMPY cavities:

- ✓ DAMPY_01 to 04 conditioned and ready to be installed
- ✓ DAMPY_05 and 06 still to be conditioned in the RF High power Lab

RF Transmitters and WG elements

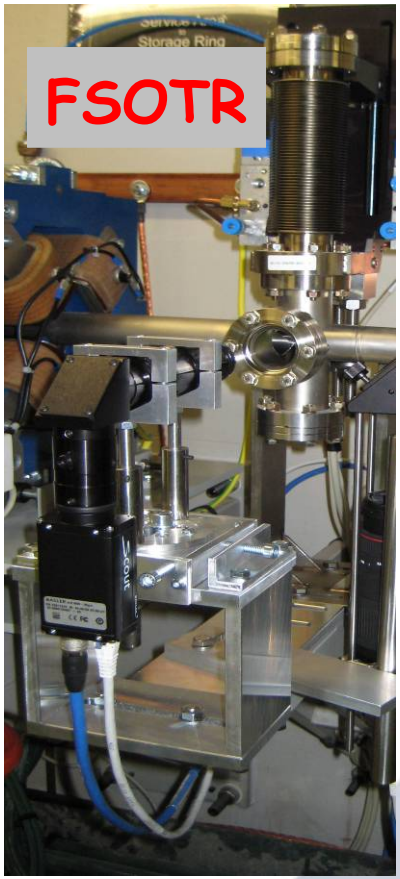
RF Booster operational

RF SR status

- ✓ Transmitters installed (2 x 12) and DC commissioned
- ✓ IOTs commissioning waiting for water collectors installation
- ✓ CaCos, Circulators & Loads installed

BOOSTER + LTB DIAGNOSTICS: hardware installed

FSOTR

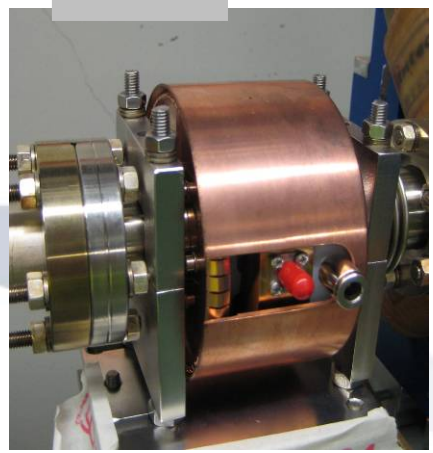


BPM

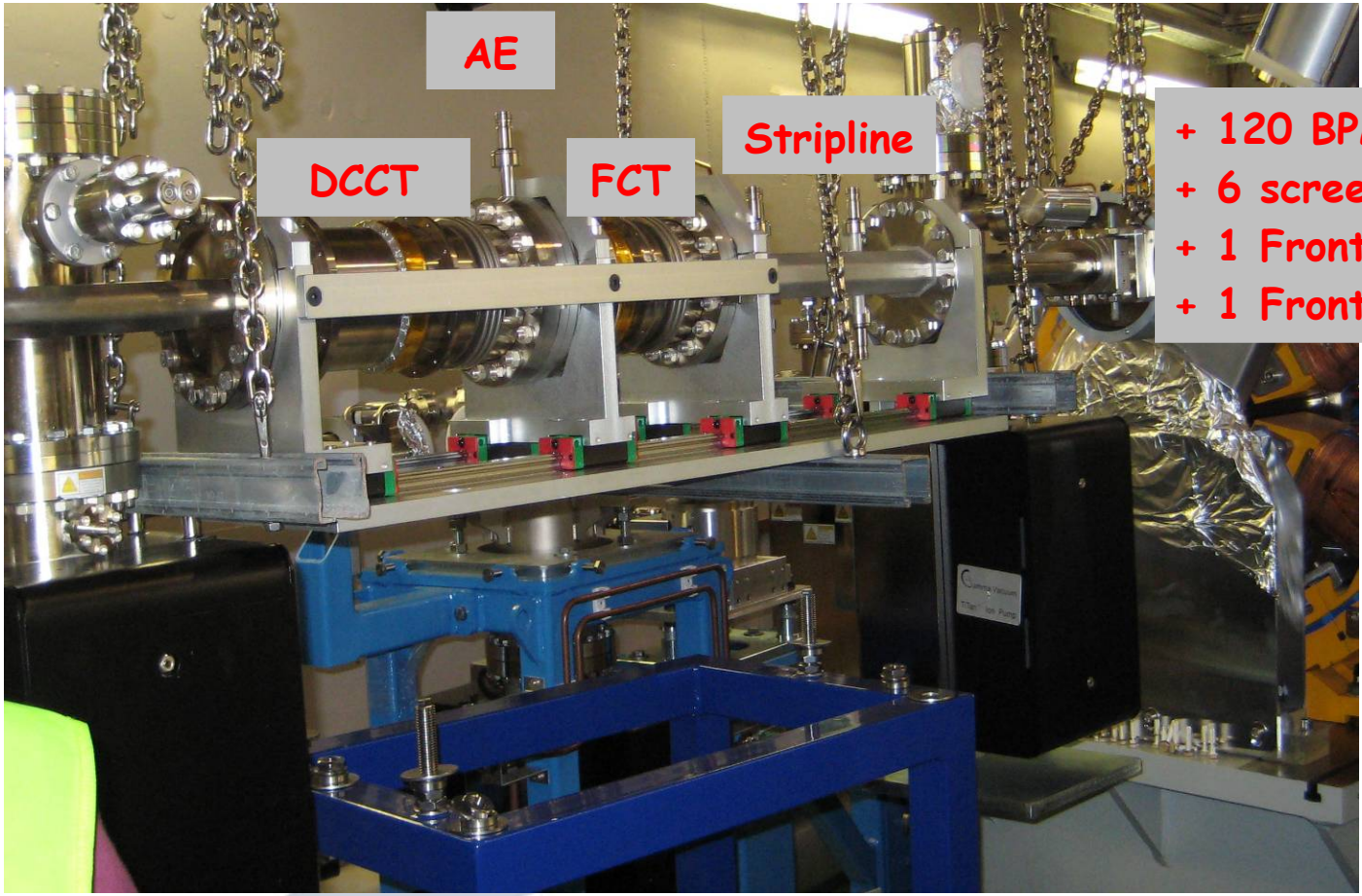
Stripline

DCCT

FCT



SR DIAGNOSTICS: hardware installed



+ 120 BPMs installed
+ 6 screen monitors
+ 1 Front End for Pinhole
+ 1 Front End Streak Camera

Control Software will profit BO+LTB Software

ID time schedule

	Company	FAT done	FAT expected	Date of delivery	Expected delivery	SAT
EU61	Elettra	wk 12 (March 2009)		27/04/2009		Finished
EU71			wk 35 (August 2009)	07/09/2009		December 2009
SC-W31	BINP		wk 4 (January 2010)		28/02/2010	March 2010
IVU-21	ACCEL		wk 48 (December 2009)		7/12/2009	January 2010
IVU-21			wk 3 (January 2010)		25/01/2010	February 2010
MPW-80	ADC	wk 23 (June 2009)		29/06/2009		In process

	Company	Delay	Comments on current situation
EU61	Elettra	- 1 month	ID fully fulfills specs
EU71		1.5 months	According FAT, it fulfills specifications
SC-W31	BINP	14.5 months	FAT delayed due to manufacturing problems
IVU-21	ACCEL	13 months	Magnetic optimization finished on 20/11/2009
IVU-21		12 months	Mechanical acceptance test passed on 23/07/2010
MPW-80	ADC	7 months	Up to now it fulfills specifications

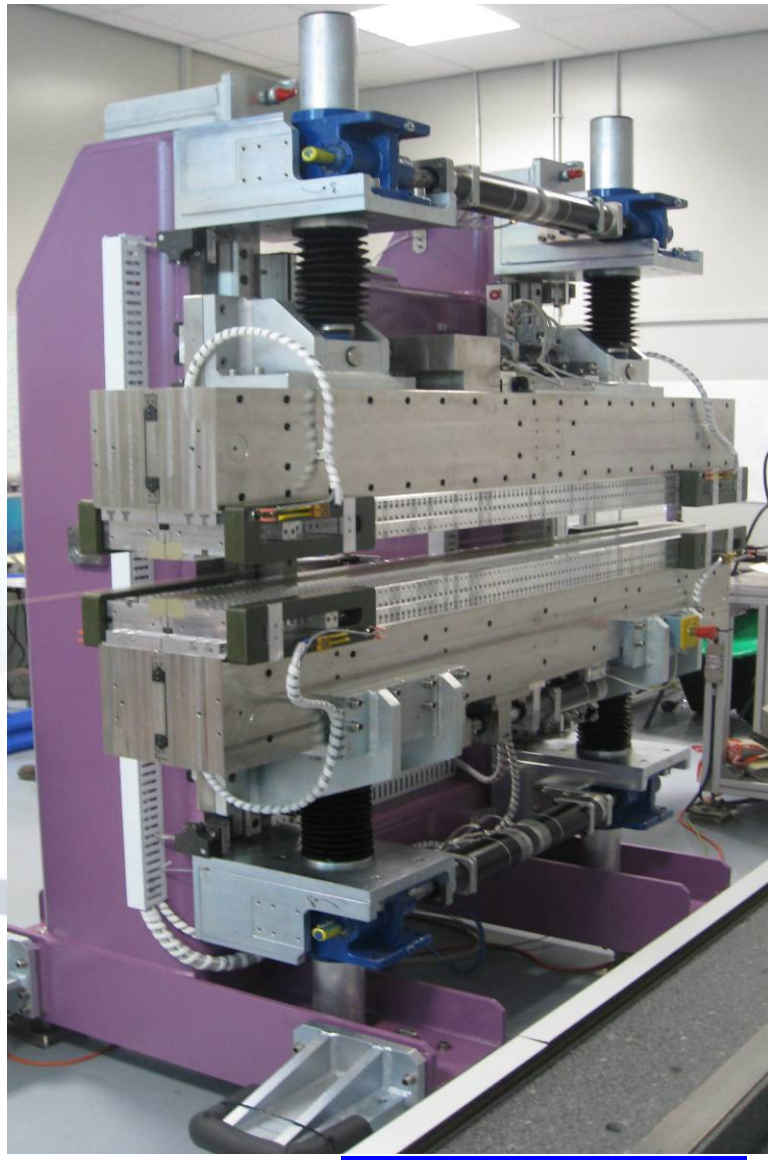
Apple-II undulators EU62, EU71

EU62 for CIRCE

Magnitude	Simplex
Period [mm]	62.76
W x H [mm x mm]	32 x 32
L [mm]	1769
Full period blocks	108
Bmax , K (V)	0.86 , 5.02
Bmax , K (H)	0.61 , 3.60
Bmax , K (C)	0.50 , 2.94

EU71 for XMCD

Magnitude	Simplex
Period [mm]	71.36
W x H [mm x mm]	32 x 32
L [mm]	1655
Full period blocks	89
Bmax , K (H)	0.92 , 6.14
Bmax , K (V)	0.73 , 4.69
Bmax , K (C)	0.56 , 3.76



Status

- Production on time
- 1st undulator measured at CELLS - OK
- 2nd undulator received - FAT OK

- Mechanical errors within tolerances
- Field and phase errors within tolerances

Conventional wiggler W80

Main characteristics

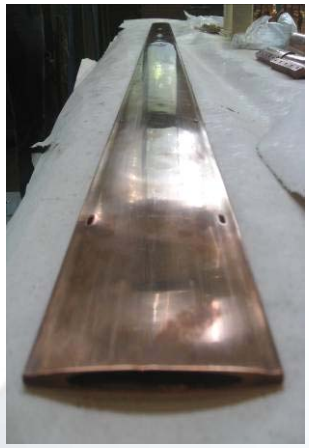
- Hybrid structure, NdFeB magnet blocks
- 12,5 mm minimum gap
- Block size: 90 x 70 mm. Pole size: 55 x 55 mm
- Num. periods full size: 25
- Length: 1.070 m
- Bmax: 1.782 T
- K: 13.32
- Ripple @ low energies ~6%

Status

- Currently at CELLS
- SAT ongoing
- Results show it fulfils specifications

Superconducting wiggler SC-W31

Cryostat shield



Liner

Main characteristics

- Superconducting wiggler
- 12,6 mm magnetic gap
- Period: 30,16 mm
- Num. poles full field: 117
- Length: 1.764 m
- Bmax: 2.16 T
- K: 6.08

Support

Cryostat

Status

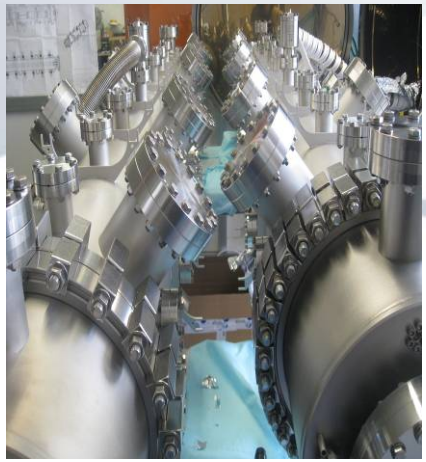
- 14.5 monts delay
- Assembly ongoing

Problems with vacuum chamber discovered on July 2009. New manufacturing needed.

In-vacuum undulators IVU-21

Main characteristics

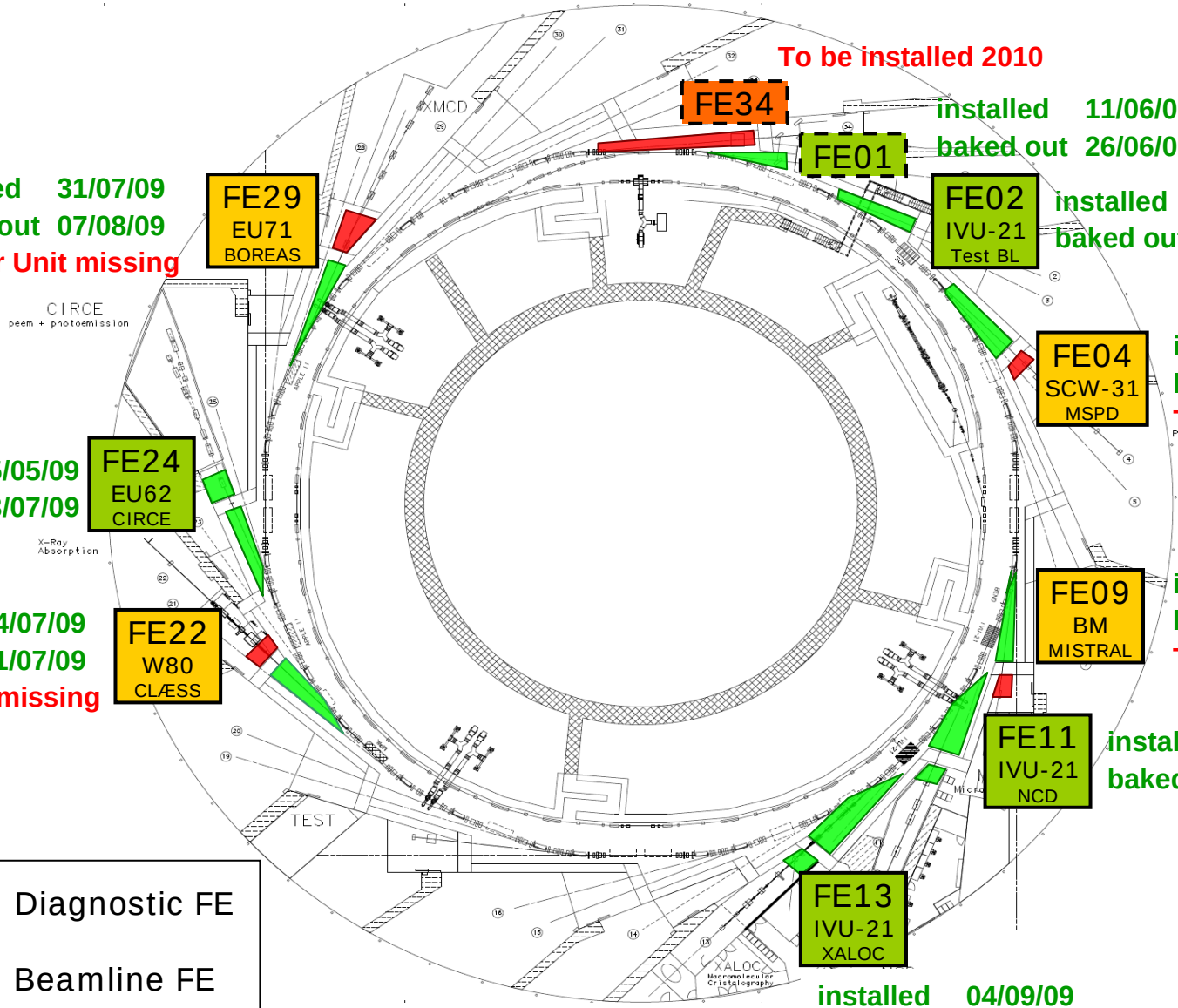
- PPM undulator
- SmCo magnet blocks.
- 5,7 mm minimum gap
- Block size: 50 x 16 mm
- Period length: 21.8 mm
- Num. Periods full size: 92
- Length: 2.1 m
- Beff: 0.797 T
- K: 1.62



Status

- 12-13 monts delay
- Shimming of IVU-1 done
- Final magnetic tests IVU-1, wk 48
- Assembly foreseen for wk 49

Status of ALBA



To be installed 2010

FE34

installed 11/06/09
baked out 26/06/09

FE01

FE02
IVU-21
Test BL

installed 20/07/09
baked out 06/10/09

Installed 31/07/09
baked out 07/08/09
Trigger Unit missing

FE29
EU71
BOREAS

FE04
SCW-31
MSPD

installed 31/08/09
baked out 04/09/09
Trigger unit missing

installed 15/05/09
baked out 03/07/09

FE24
EU62
CIRCE

FE09
BM
MISTRAL

installed 18/06/09
baked out 03/07/09
Trigger unit missing

installed 24/07/09
baked out 31/07/09
Trigger Unit missing

FE22
W80
CLÆSS

FE11
IVU-21
NCD

installed 17/07/09
baked out 24/07/09

FE13
IVU-21
XALOC

installed 04/09/09
baked out 14/09/09

Diagnostic FE

Beamline FE

Status of ALBA

Testing in FEs lab

Installation in tunnel

Alignment & vacuum assembly

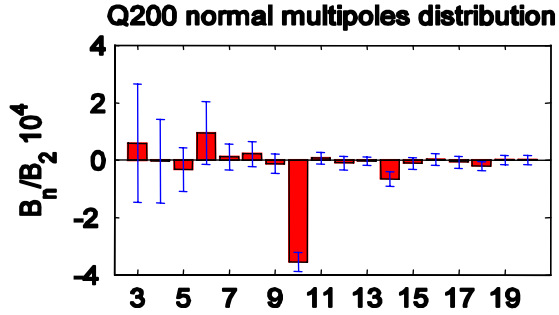
Bake-out

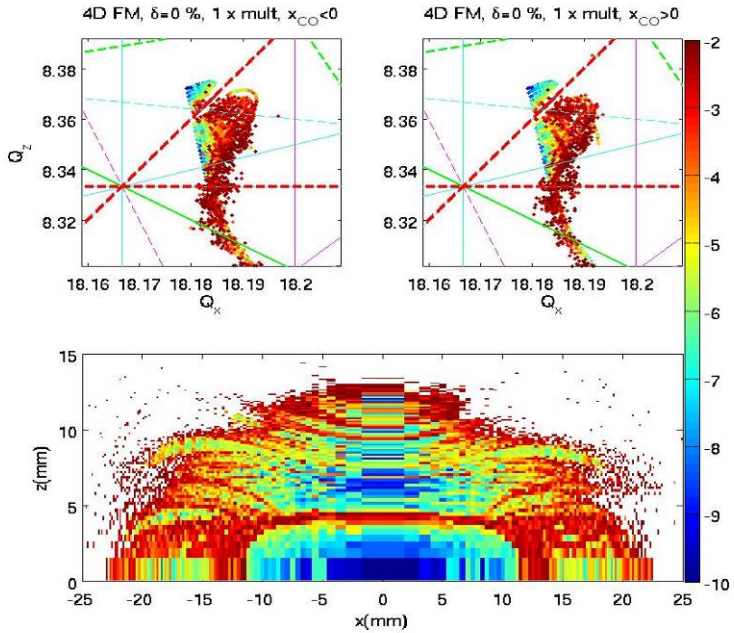
Situation Control Room

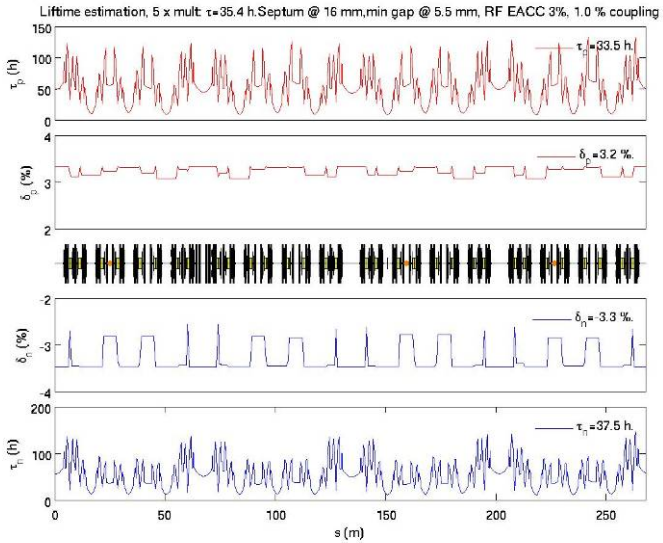

THALES


Sun

- Multipole components of ALL quadrupoles and sextupoles measured in BINP. Results cross checked at Soleil and ALBA.
- Simulations with AT, including the measured HOM.
- DA, FMAP and energy acceptance.
- No impact in predicted performance.
- See 2nd NLBD workshop presentation.







- Effect of the Ids modelled with different techniques: hard edge model, multipoles, kicks maps.
- All models agrees in the results for the Radia models.
- Developing a model based in the real measures.
- Detected reduction of lifetime due to the superconducting wiggler, can be compensated by moving slightly the working poing.
- For more details, see the Ids presentation.

Resistive wall Impedance and Instability

Among SLSources ALBA has one of the smallest standard vacuum chambers: 28(V)x72(H)mm^2 of stainless steel

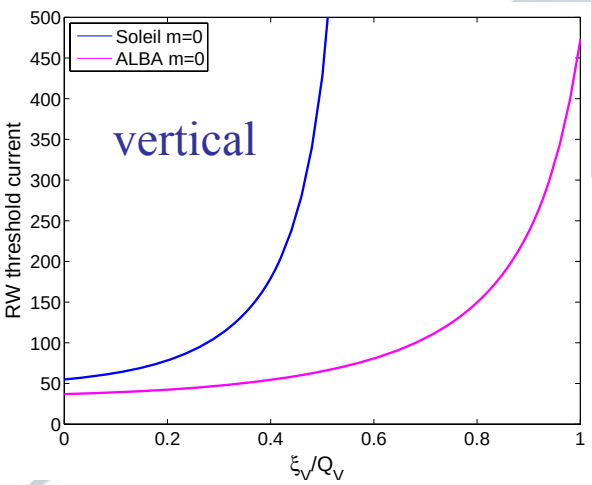
Furthermore due to the slanted form the dipole chamber is in fact slimmer than the standard vacuum chamber

→ Resistive wall impedance(RW) will be large right from the beginning

The installation of 7 low-gap chambers (phase I : 3 in-vac's + 3 NEG-coated Al-chambers+1 SS-chamber of 9mm gap) changes the transverse RW budget vertically only by 10% and horizontally by only 22%.

RW-thresholds: 37mA $\xrightarrow{\text{phase I}}$ 33.7mA (vertical) 164.5mA $\xrightarrow{\text{phase I}}$ 134.8mA (horizontal)

Without transverse feedback the maximum current will be quite limited since the first aid cure: ***increase of chromaticity*** ξ does not help much neither.

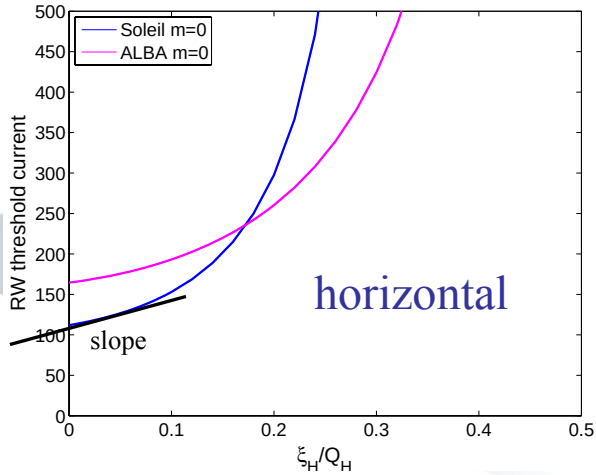


Demonstration:

the RW-thresholds of SOLEIL are more sensitive to increase of chromaticity than those of ALBA

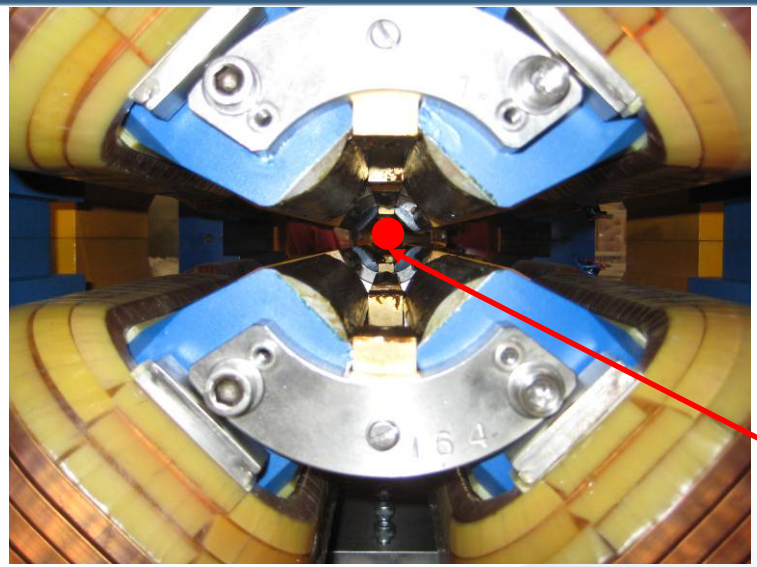
the slope of the threshold I vs. $\xi|_{\xi=0}$ ~K

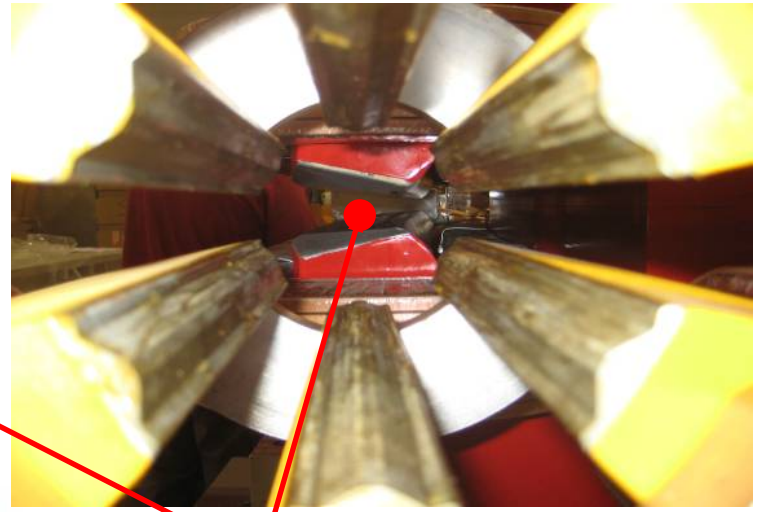
Key parameter: $K := \frac{1}{h}\sqrt{\frac{(1-[Q_\perp])\delta}{\alpha \cdot \nu_s}}Q_\perp$



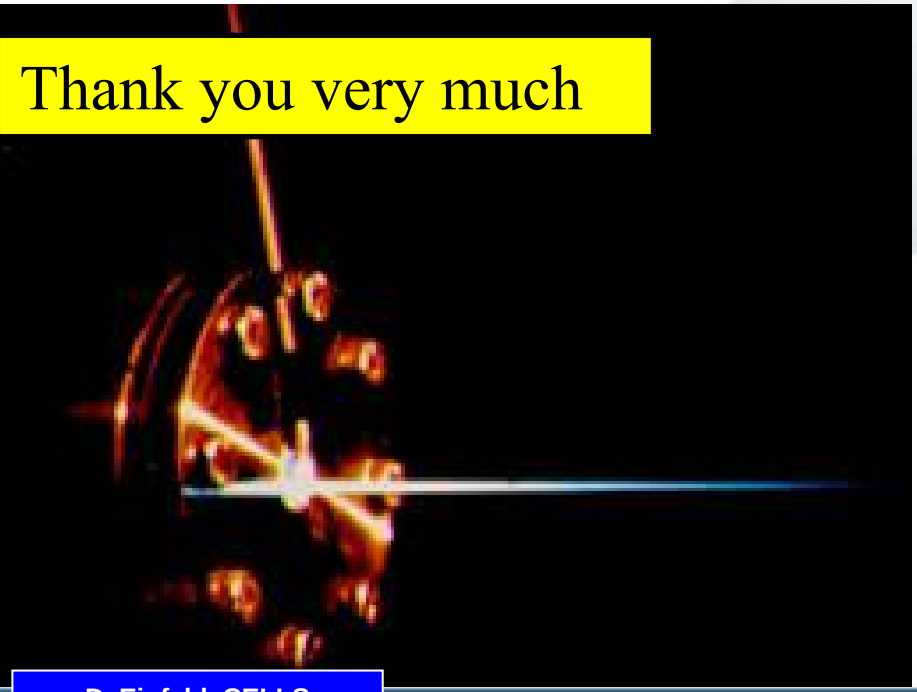
K of ALBA is ~2.3 times smaller than the K of SOLEIL(resp. smaller than most other SLSources)

Status of ALBA





Thank you very much



Hopefully pretty soon the electron beam will make it around ALBA through the middle of the magnets under good vacuum conditions