Status report on the Survey and Alignment activities at CERN

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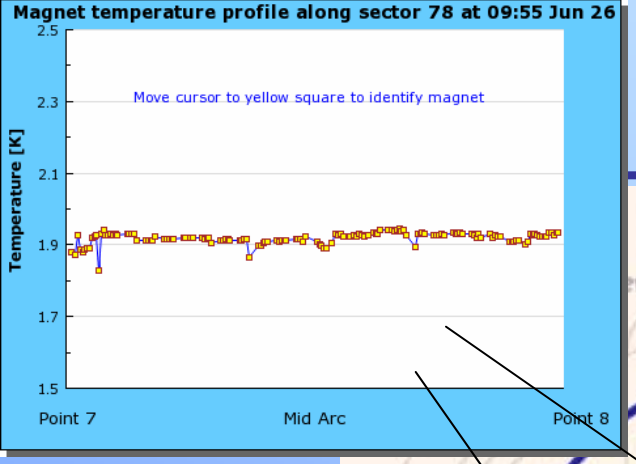
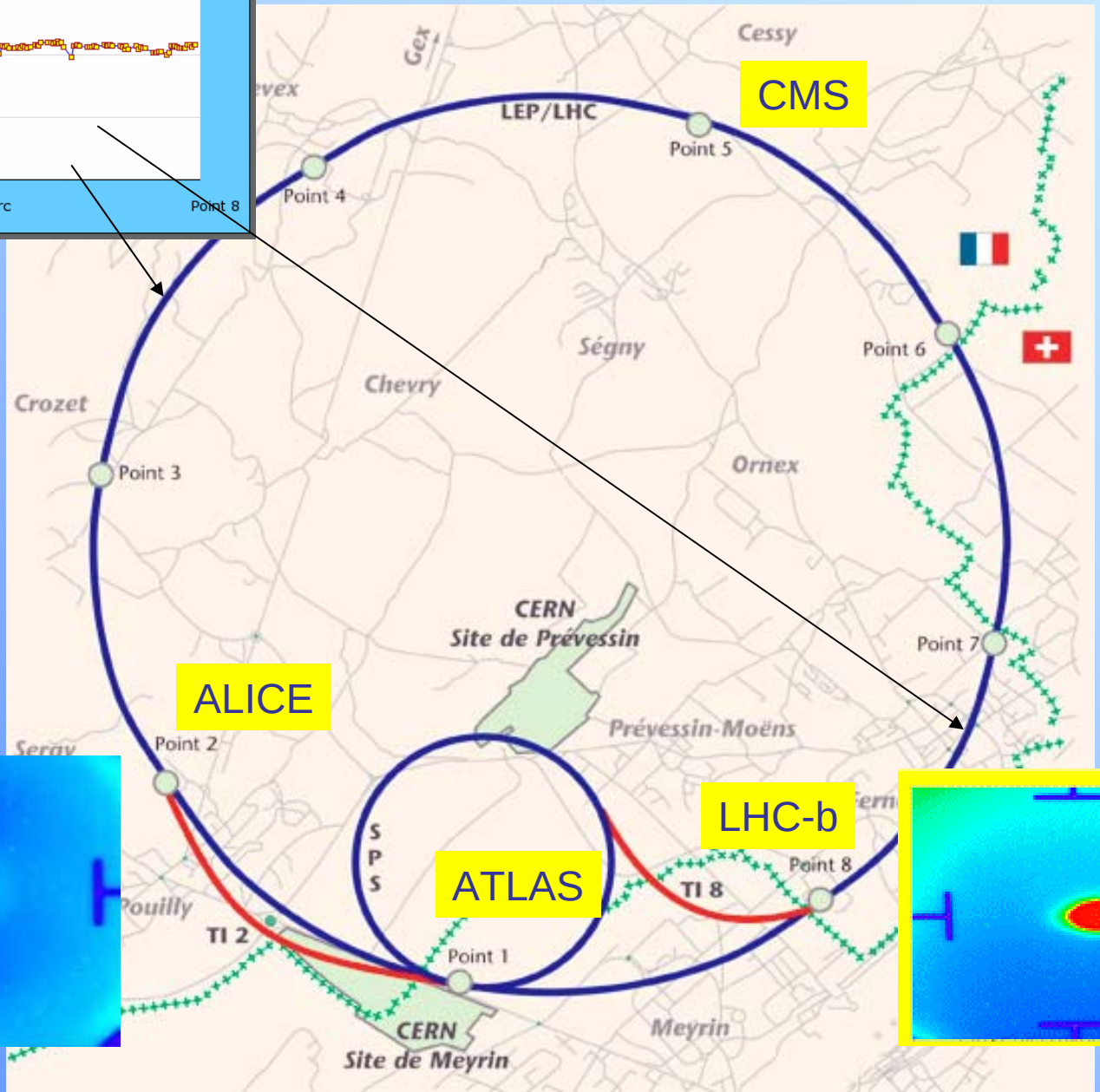
The LHC: the machine and its detectors

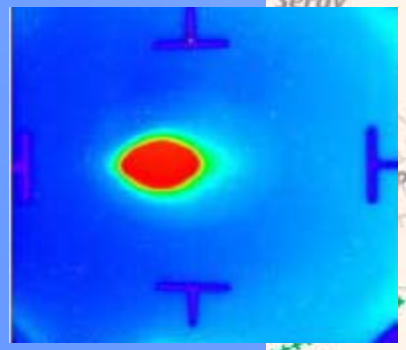
Linac 4 / SPL, PS2

The CLIC project

Status of LHC







LHC

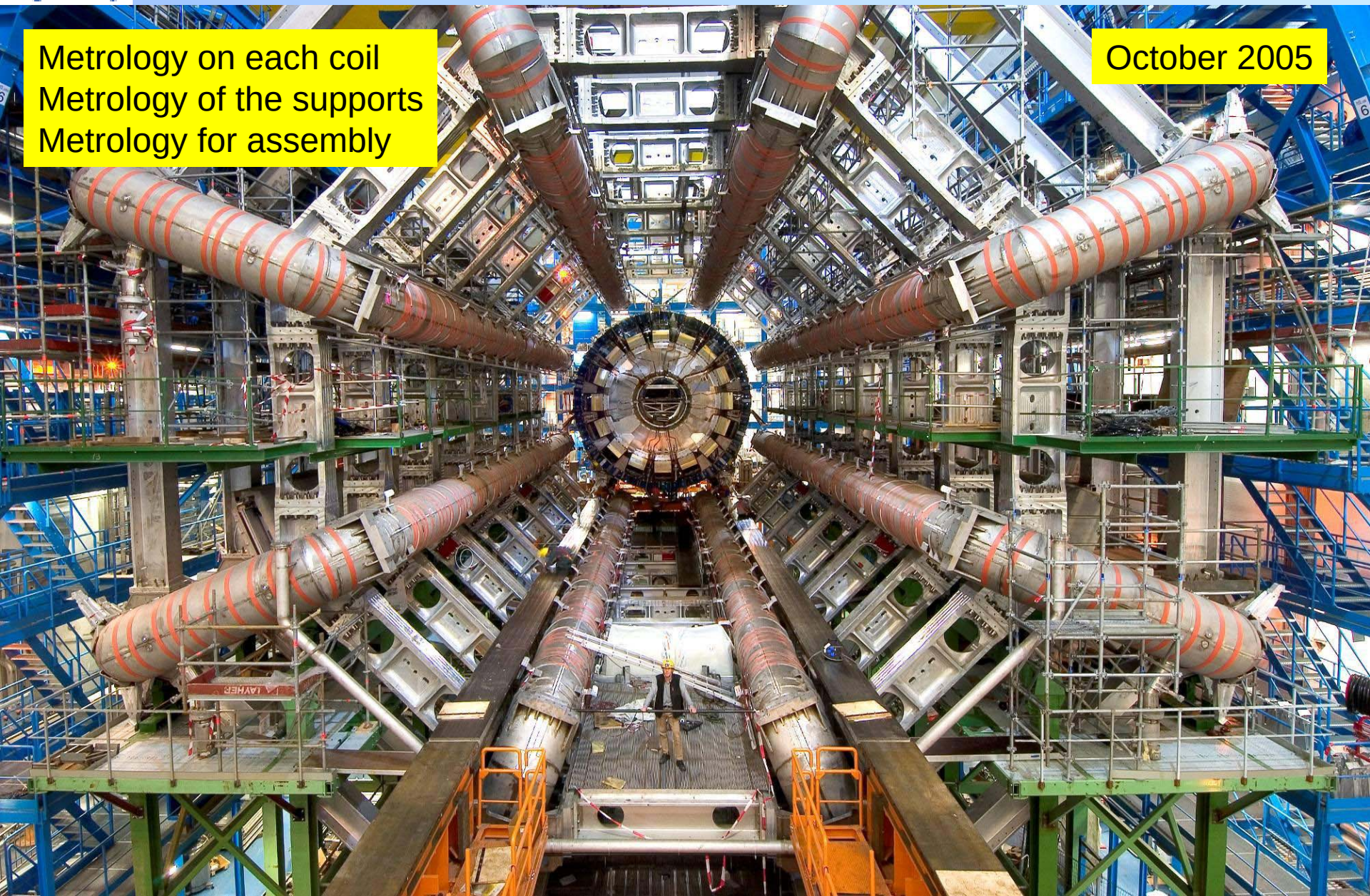
- The two 2 km long injection lines have been successfully tested
- All the elements are installed in the ring
- The final vertical alignment of all the ring has been performed.
- The sector 7-8 has been cooled down, and the final alignment has been performed
- The sector 4-5 is cooled down and tested electrically up to >10 KA.
- The other sectors are ready to be cooled down.
- It is planed to have beams mid 2008 in the rings.

Barrel toroïd system
8 25m long-100 tons superconducting coils

ATLAS

Metrology on each coil
Metrology of the supports
Metrology for assembly

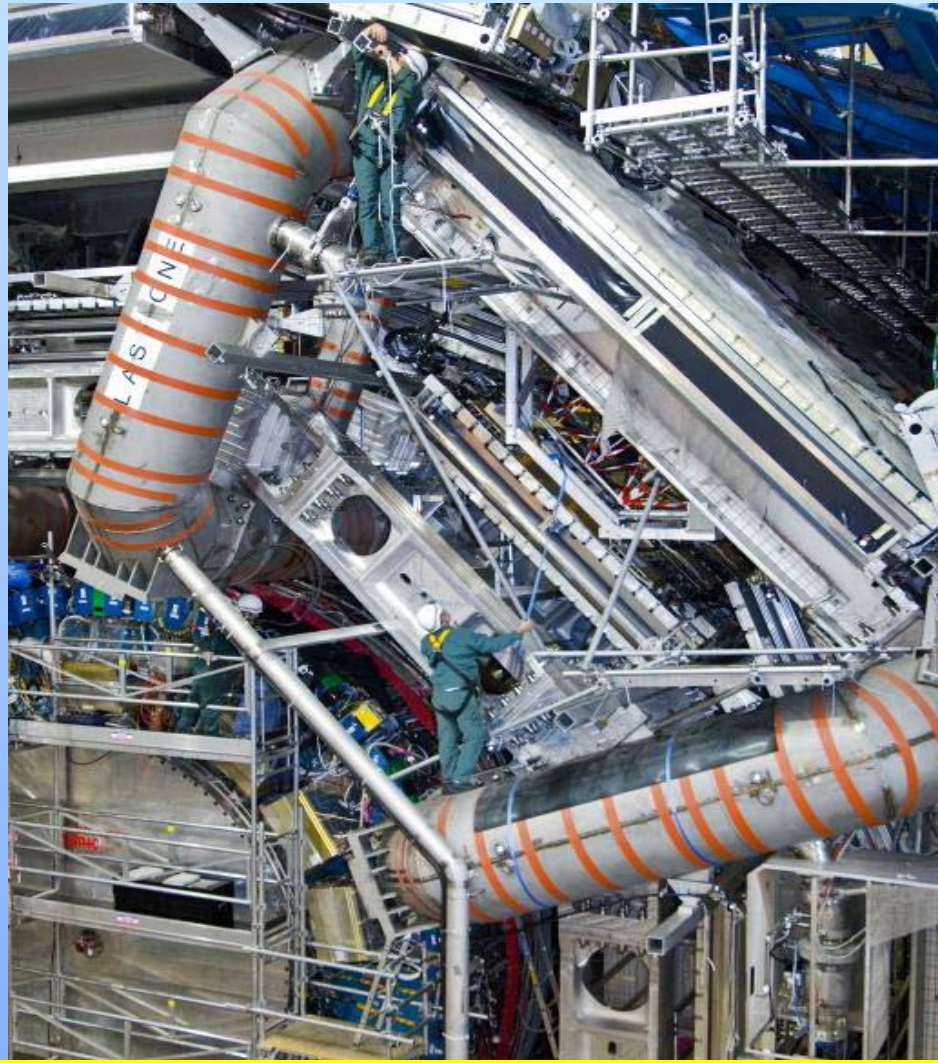
October 2005



Barrel toroïd system
8 25m long-100 tons superconducting coils

ATLAS

October 2004
The installation



Installation of barrel muon chambers (700)
Access is difficult
Alignment of the rail supports (~2 km)

ATLAS

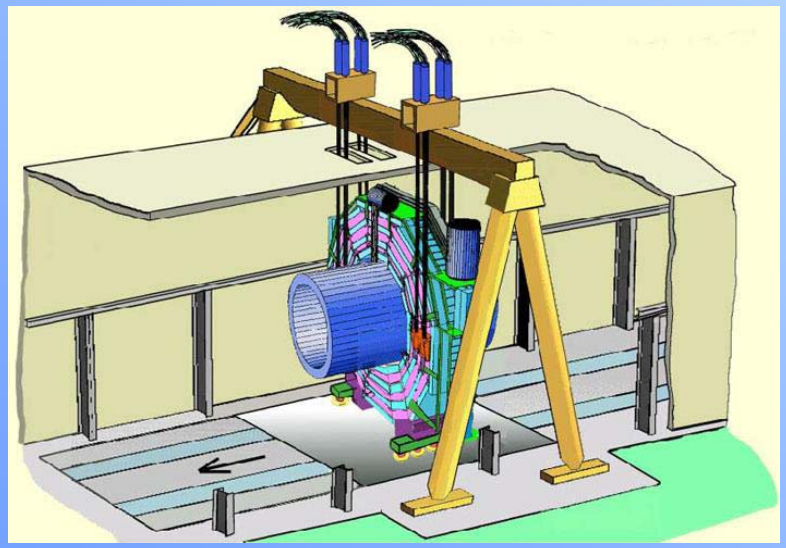
Muon big wheels
In ATLAS.
Diameter: 25 m.
Measured by photogrammetry.
(~300 photos + some additional distance and angular measurements
r.m.s. 0.3 mm at 1σ)

CMS assembly

- Assembly of the equipment in the surface hall.
- All the metrology of the assembly done in the surface hall
- Transfer of the elements to the cavern
- In the cavern, only metrology for the assembly of the very big elements
- Weight of this element = 1430 T
- Depth of the pit ~100m

CMS

The central heaviest slice (2000 tons !) including the solenoid magnet lowered in the underground cavern in Feb. 2007

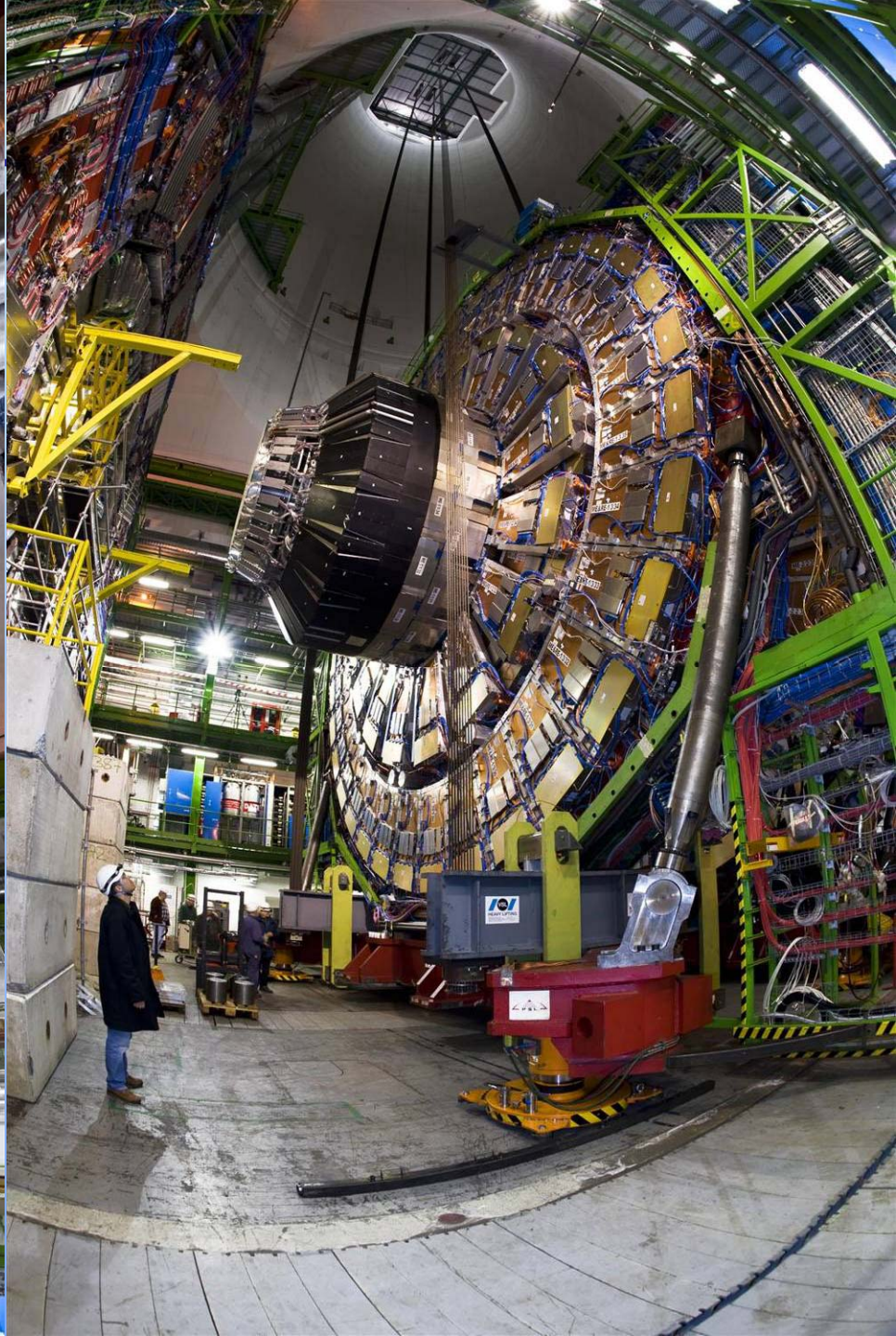


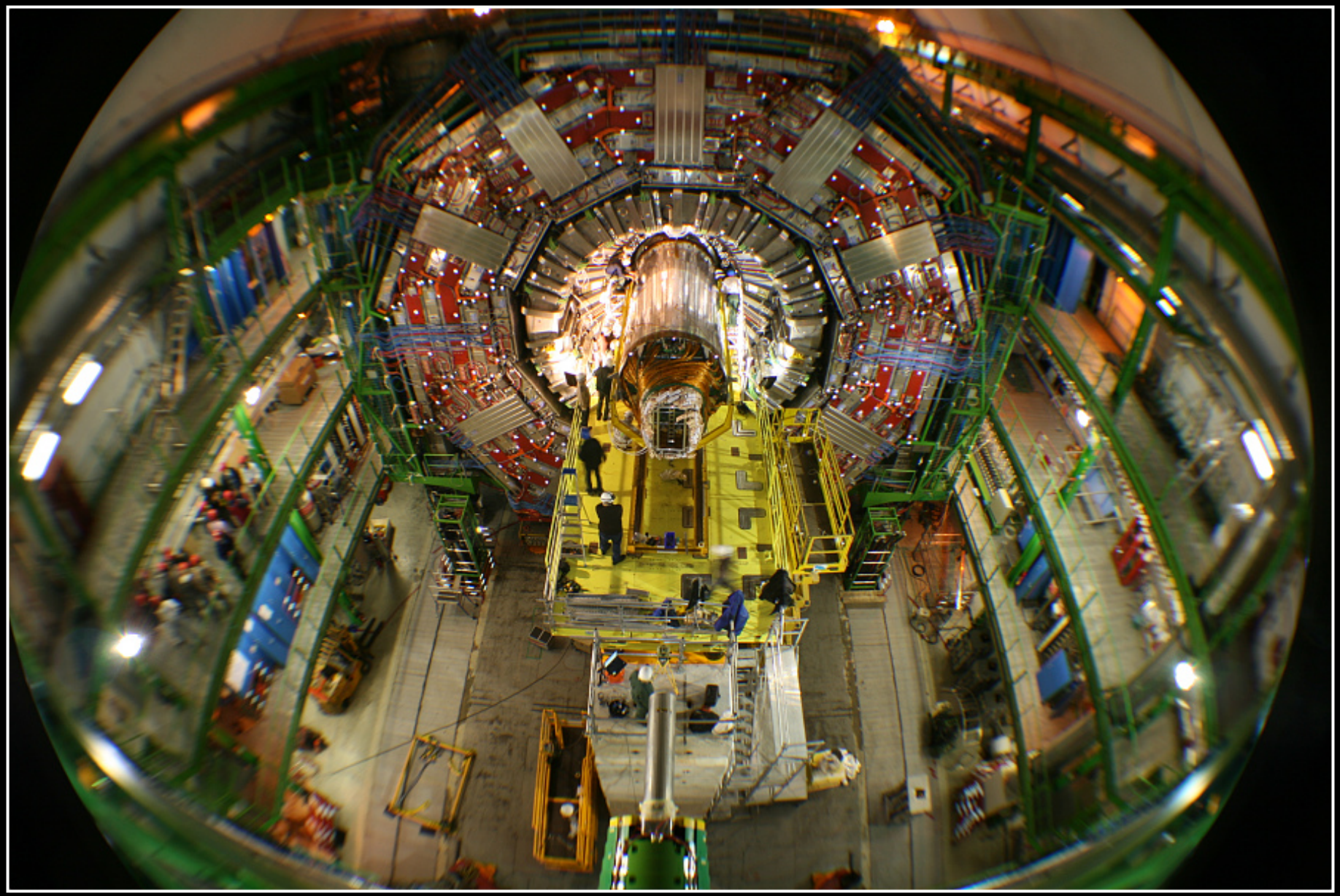
CMS solenoid:

Magnetic length	12.5 m
Diameter	6 m
Magnetic field	4 T
Nominal current	20 kA
Stored energy	2.7 GJ

Tested at full current in Summer 2006


ME-2/2/18
ME-2/2/17



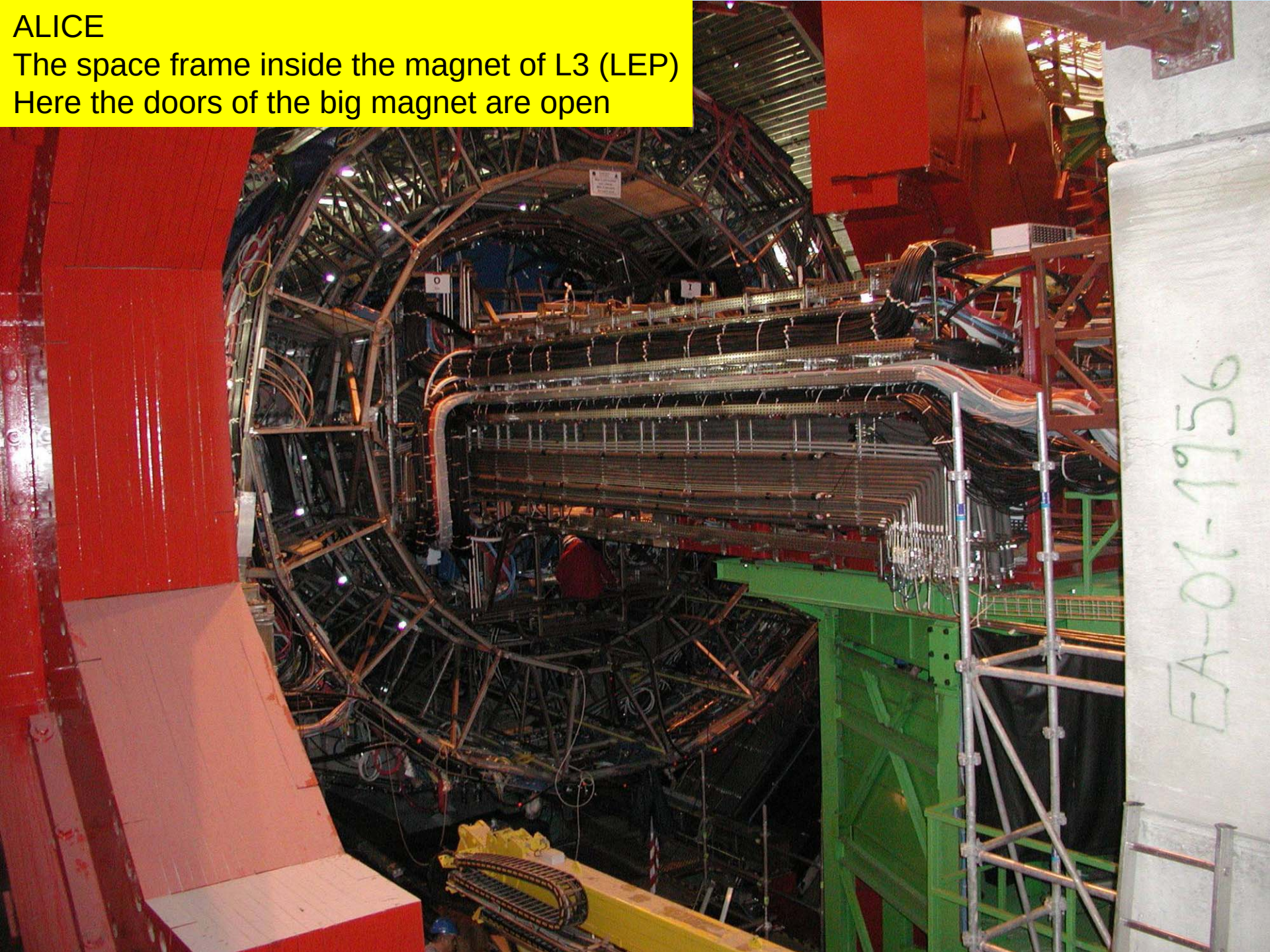


SAMEDI 15 DÉCEMBRE 2007

CMS

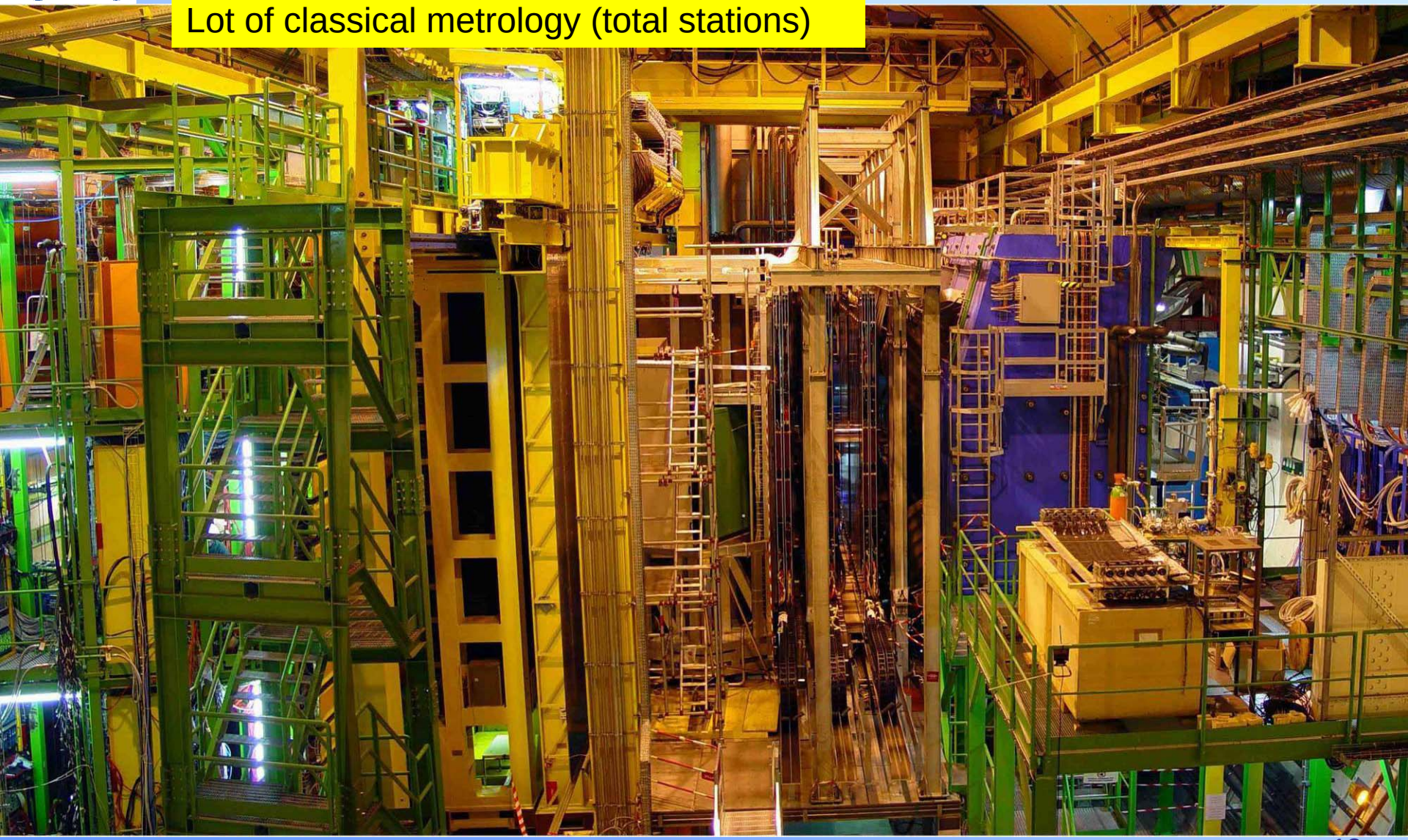
- Photogrammetry for assembly
- Bcams for remote control

ALICE
The space frame inside the magnet of L3 (LEP)
Here the doors of the big magnet are open



LHC-b

Looks like an experiment for fixed target
Very difficult to access to the detectors
A detector is in the vacuum of the machine
Lot of classical metrology (total stations)

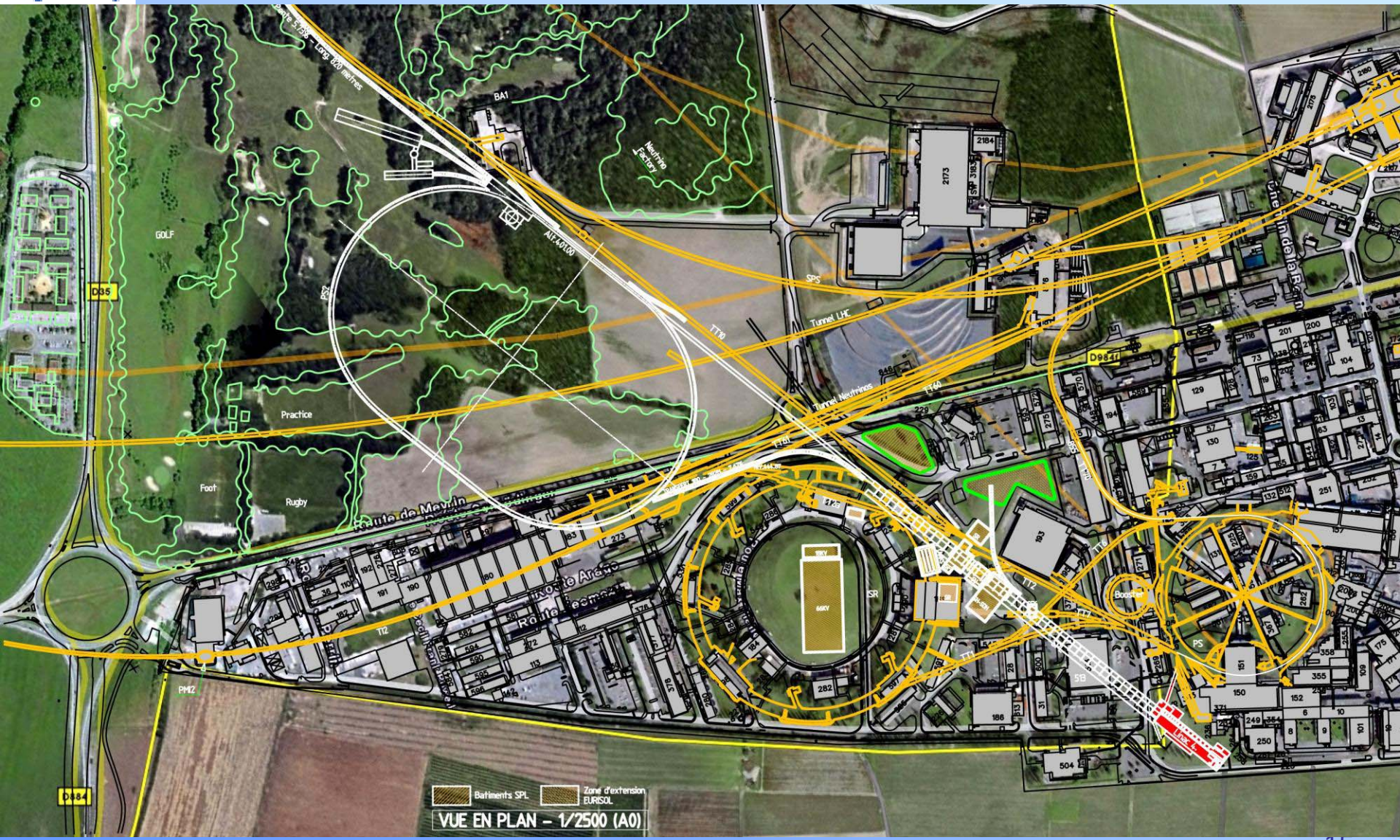


Linac 4

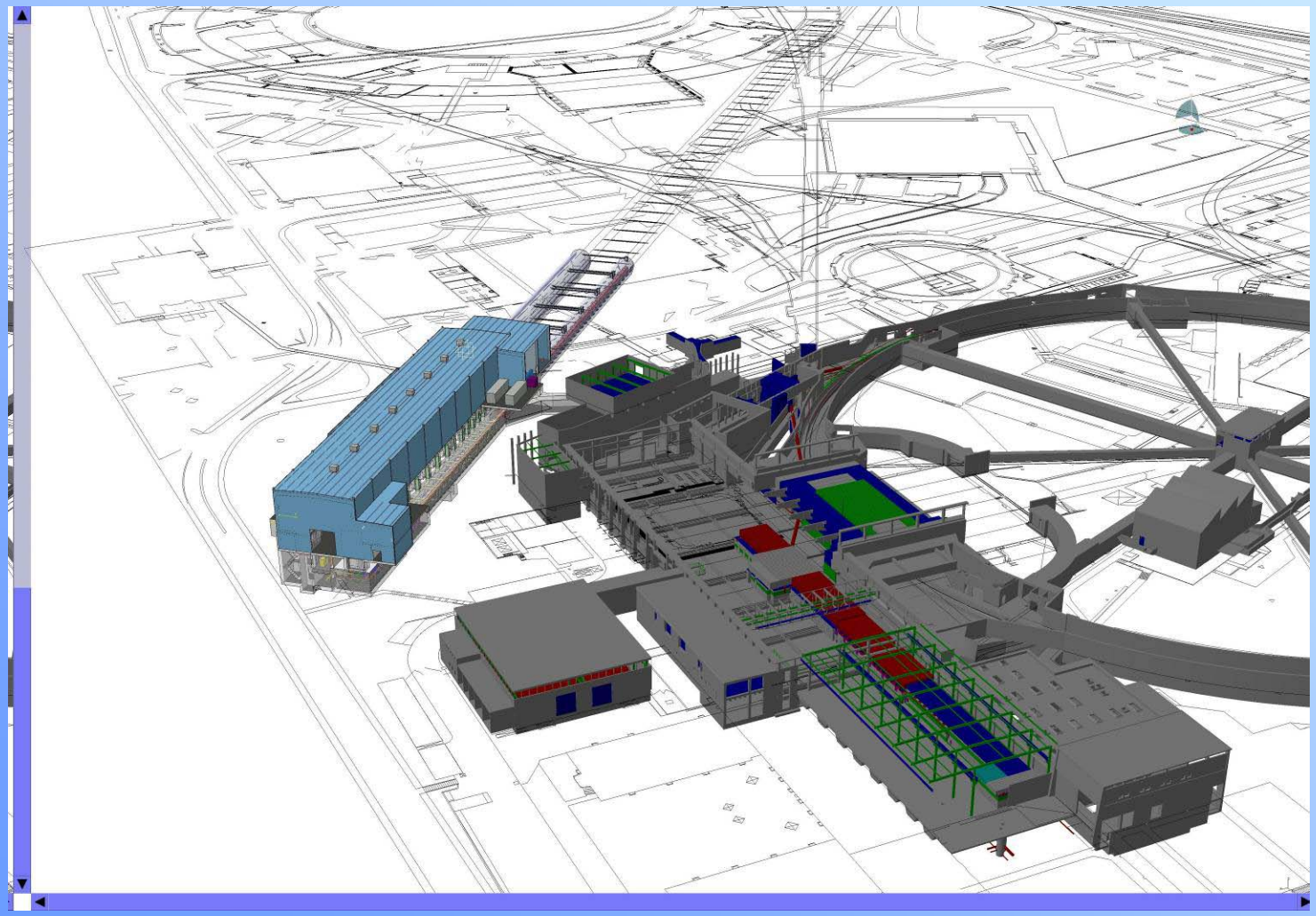
- CERN will built a new 140 MeV linac to replace the 50 MeV proton linac. Length 90m.
  - Start of the civil engineering works in January 2008, end in 2010.
  - Installation of the linac elements in 2011.

- Design studies for a 4 GeV superconducting proton linac (SPL), and a 50 GeV synchrotron (PS2), are under way, to replace the PS Booster and the PS.

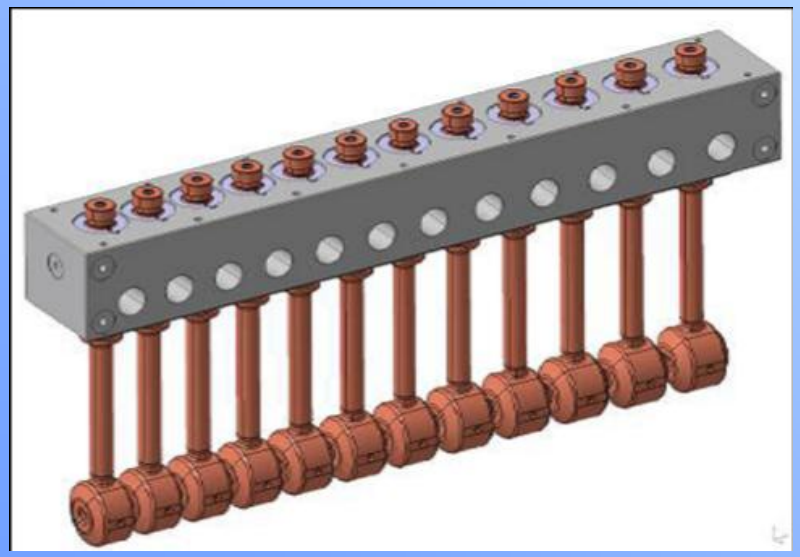
A new injector for LHC

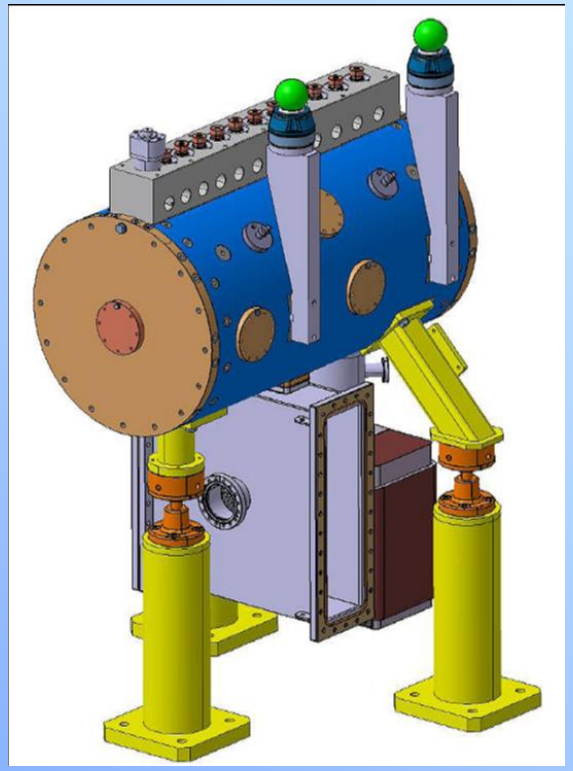


Linac 4



- DTL prototype





CLIC

- Objective: To demonstrate the faisability of the project.
- Report to be written in 2010
- For Survey team:
  - To be able to pre-align in real-time the components of the main beam within a tolerance (max.) of 10 microns over a 200 m long window.

Collaborating Institutes
4 in 1999
23 in 2007

WORLD WIDE CLIC & CTF3 COLLABORATION

Ankara University (Turkey)
Berlin Tech. Univ. (Germany)
BINP (Russia)
CERN
CIEMAT (Spain)
DAPNIA/Saclay (France)
RRCAT-Indore (India)
Finnish Industry (Finland)
Gazi Universities (Turkey)
Helsinki Institute of Physics (Finland)
IAP (Russia)
Instituto de Fisica Corpuscular (Spain)
INFN / LNF (Italy)
JASRI (Japan)
JINR (Russia)
KEK (Japan)
LAL/Orsay (France)
LAPP/ESIA (France)
LLBL/LBL (USA)
NCP (Pakistan)
PSI (Switzerland),
North-West. Univ. Illinois (USA)
Polytech. University of Catalonia (Spain)
RAL (England)
SLAC (USA)
Svedberg Laboratory (Sweden)
Uppsala University (Sweden)

Present status

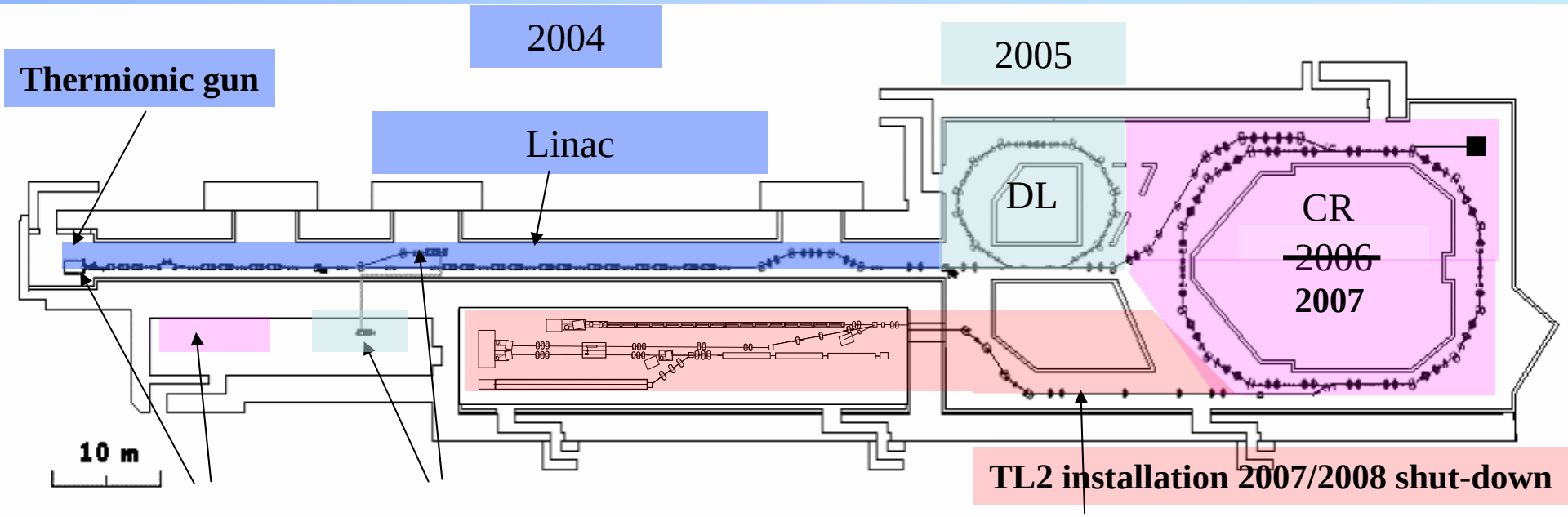


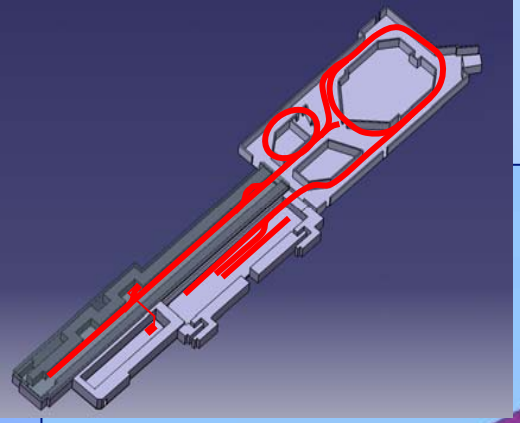
Photo injector / laser
Hardware ready end 2007
tests in 2008
Laser ?

30 GHz production (PETS line) and test stand

CLEX 2007-2009 building ready

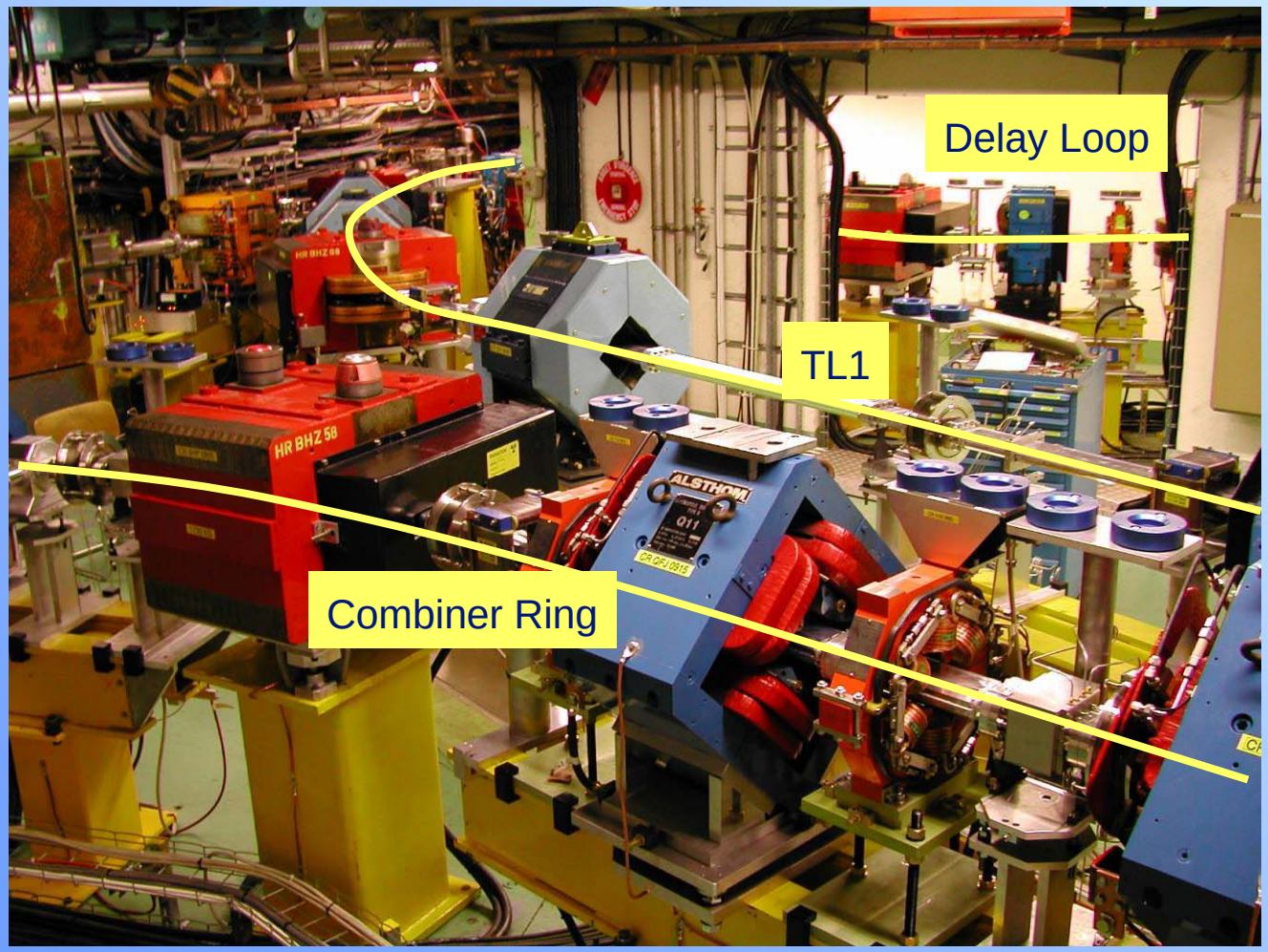
Beam into CLEX in 2008

Combiner Ring being commissioned

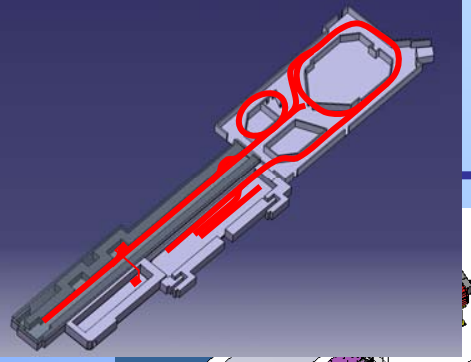


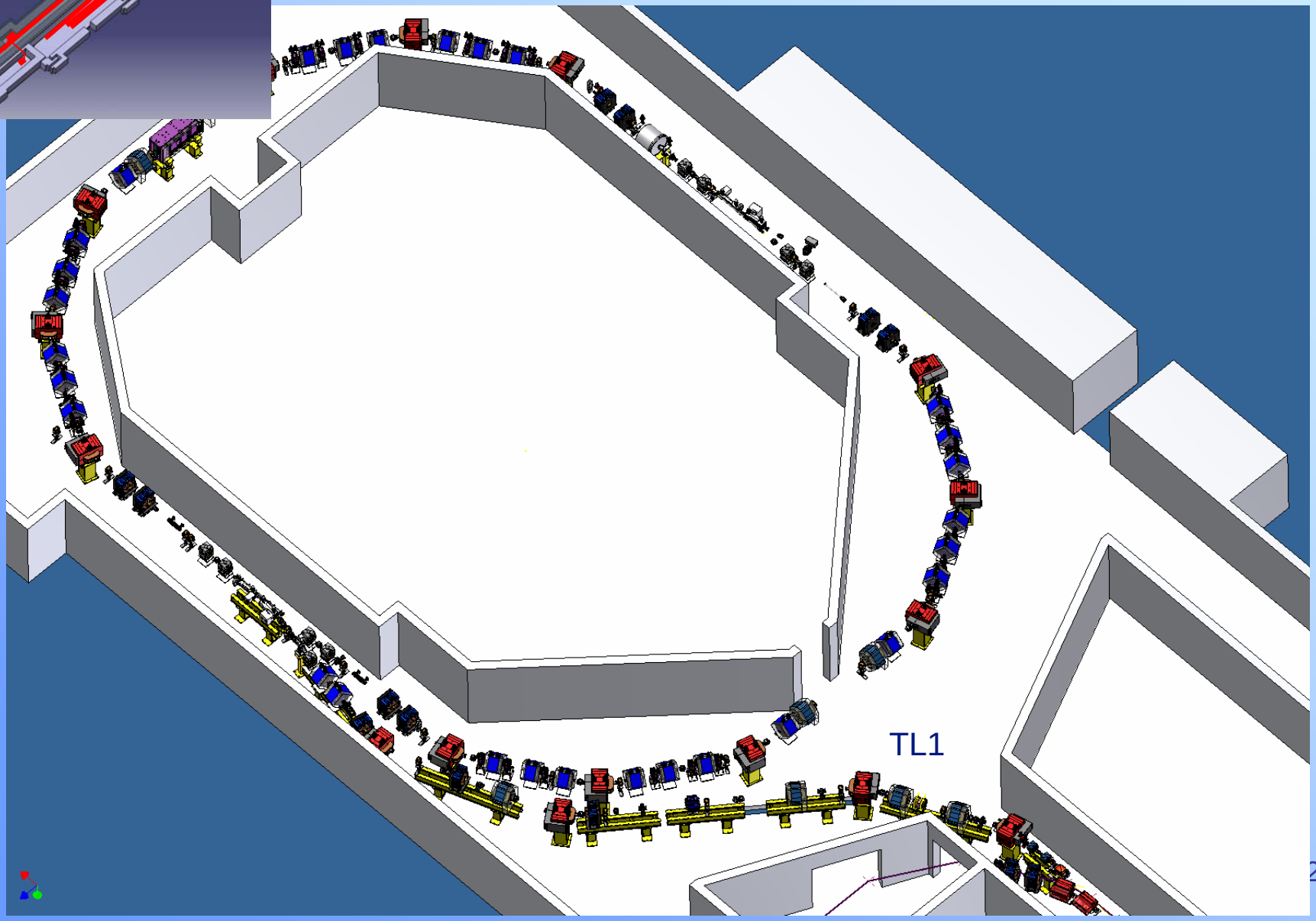
Beam recombination in the Delay Loop (factor 2)

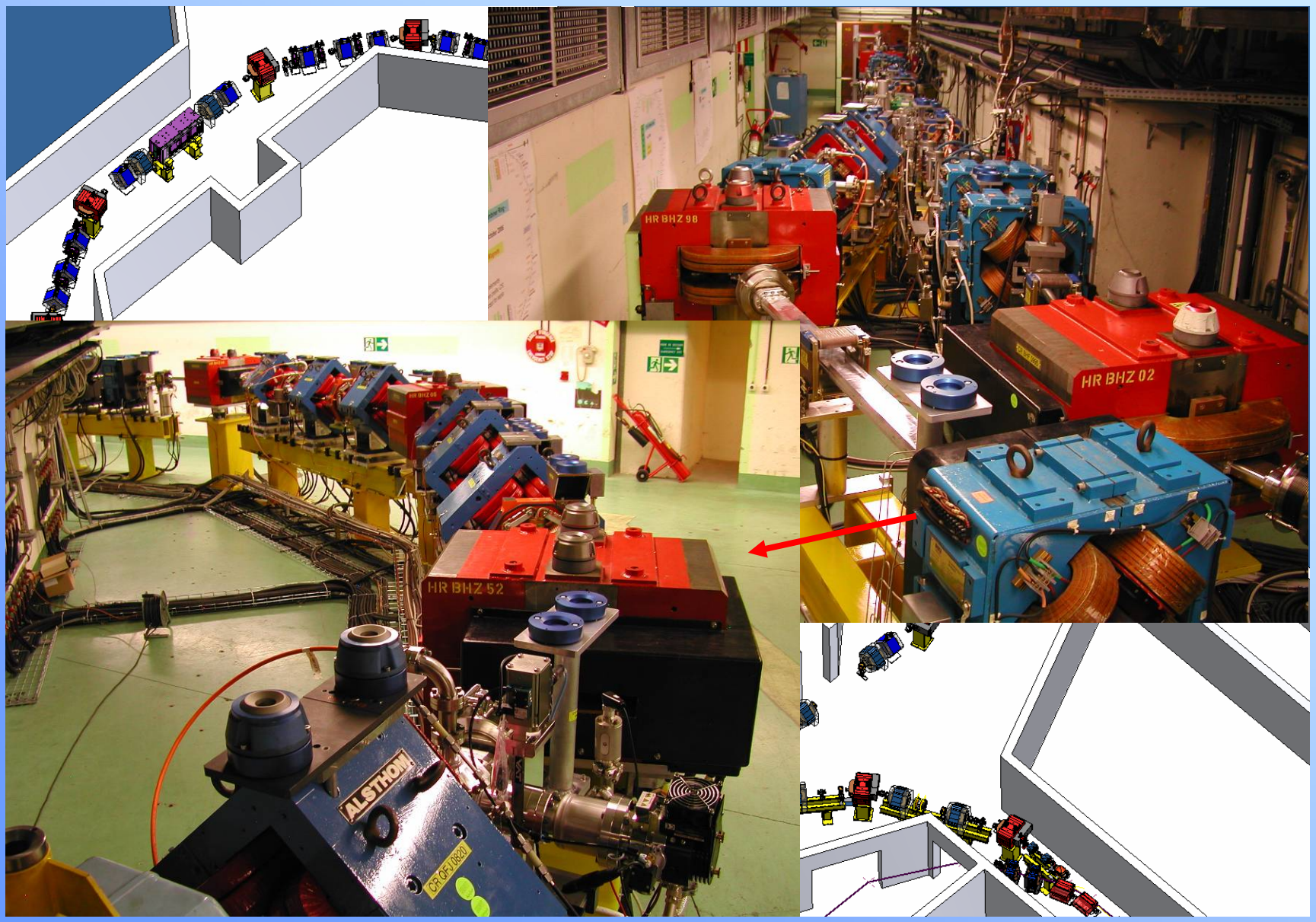
View of DL, TL1, CR



Combiner Ring

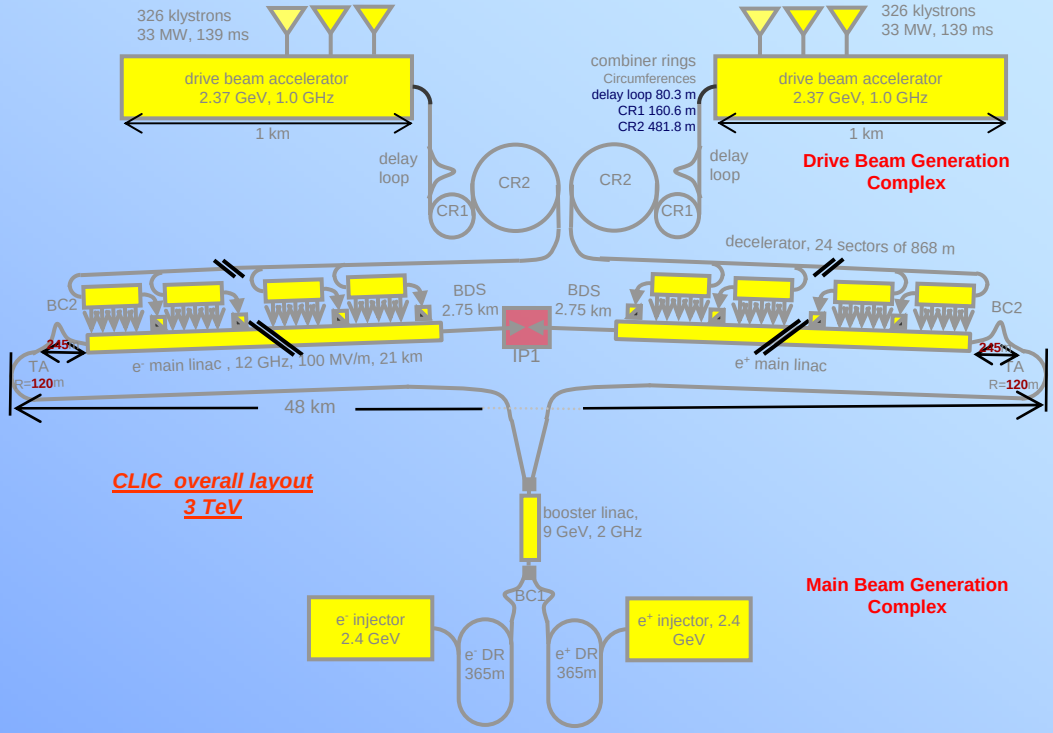





HR BHZ 98
HR BHZ 02
HR BHZ 52
ALSTHOM

CLIC

- The principle is based on a two beams acceleration concept.
- Main beam is accelerated by 12 GHz accelerating structures (accelerating field 100 MV/m)
- RF power comes from other RF structures (PETS) installed on a “drive beam”.
- For 3 TeV, the length of CLIC is ~50 km.



CLIC – Geodetical aspects under study

- Correction of the effect of the tides on the HLS (for LHC and CLIC)
- Influence of the geoid and gravity on the measurements. Corrections to be applied to the HLS measurements and the wires's sag.
- The best possible accuracy of the determination of the geoid shape, in collaboration with ETHZurich
  - Theoretical study (OFT Bern)
  - Astrozenithal camera measurements
  - Absolute gravimetry measurements

CLIC – Alignment techniques

- Comparison between optics (Rasclic), stretched wire and HLS. (140 m long test bench)
- Study on a 500 m long stretched wire
  - Technique for stretching the wire
  - Shape and stability of the wire
- Quality of the wire
  - No elasticity, Creep…etc
  - Axial shape
  - Material
- New optical 2D wireless sensor based on CCD camera
- Calibrations for absolute measurements

3D calibration bench for sensors

- We bought an « old » Trioptic from SIP. The 3 axis are controlled by laser interferometry.
- Used for the calibration of the sensors

CLIC – alignment and mechanical aspects

- Optimisation of the methodology of alignment. Cost versus accuracy
- Simulations for the alignment network
- Integration
  - Fiducialisation of the structures (within few microns)
  - permanent reference line (optical or wire)
- Actuators for the remote real-time pre-alignment
- Stabilisation (in collaboration) of the quadrupoles of the main beam.