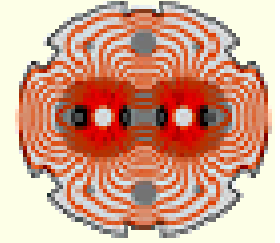




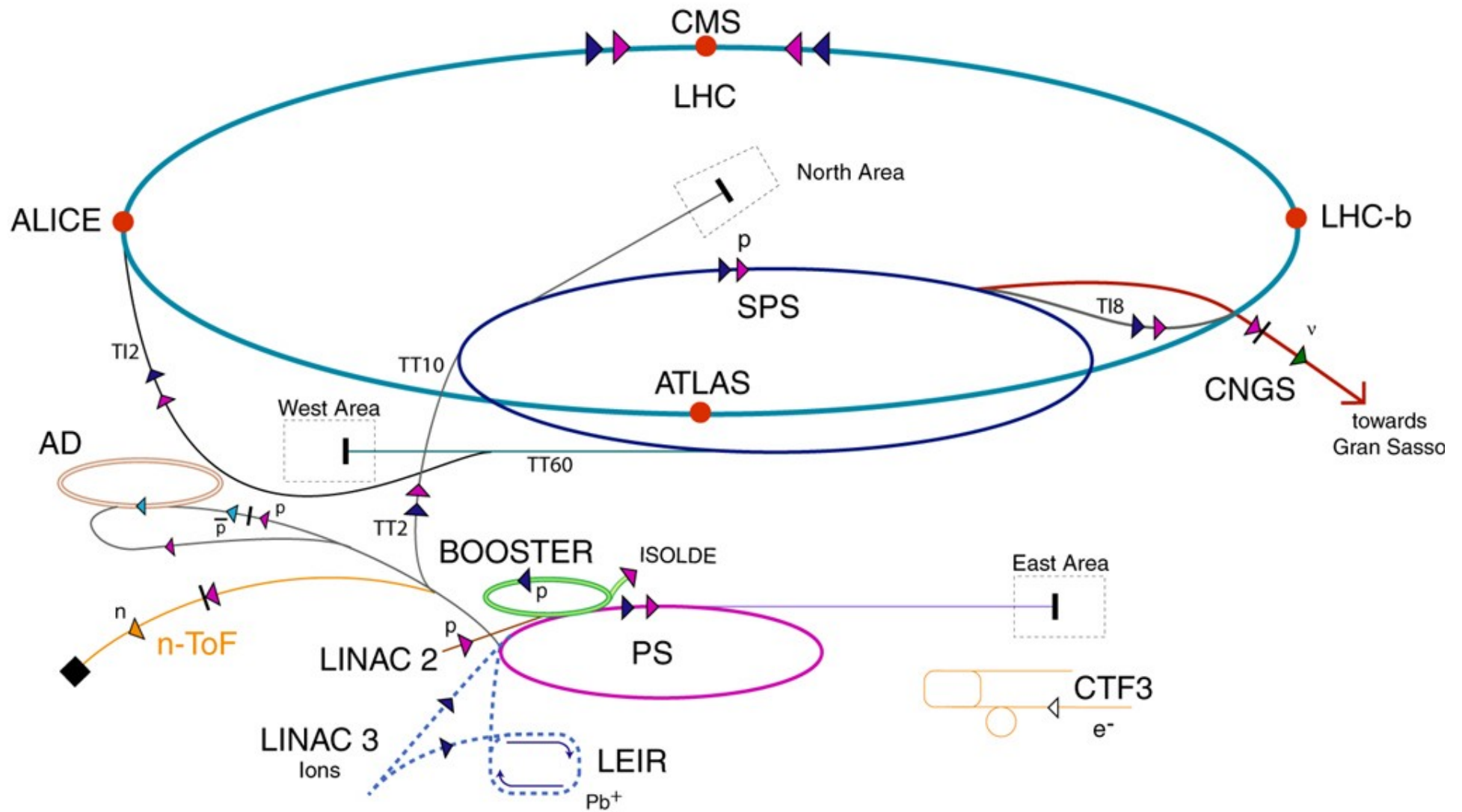
Frontier Science 2005



STATUS OF THE LHC

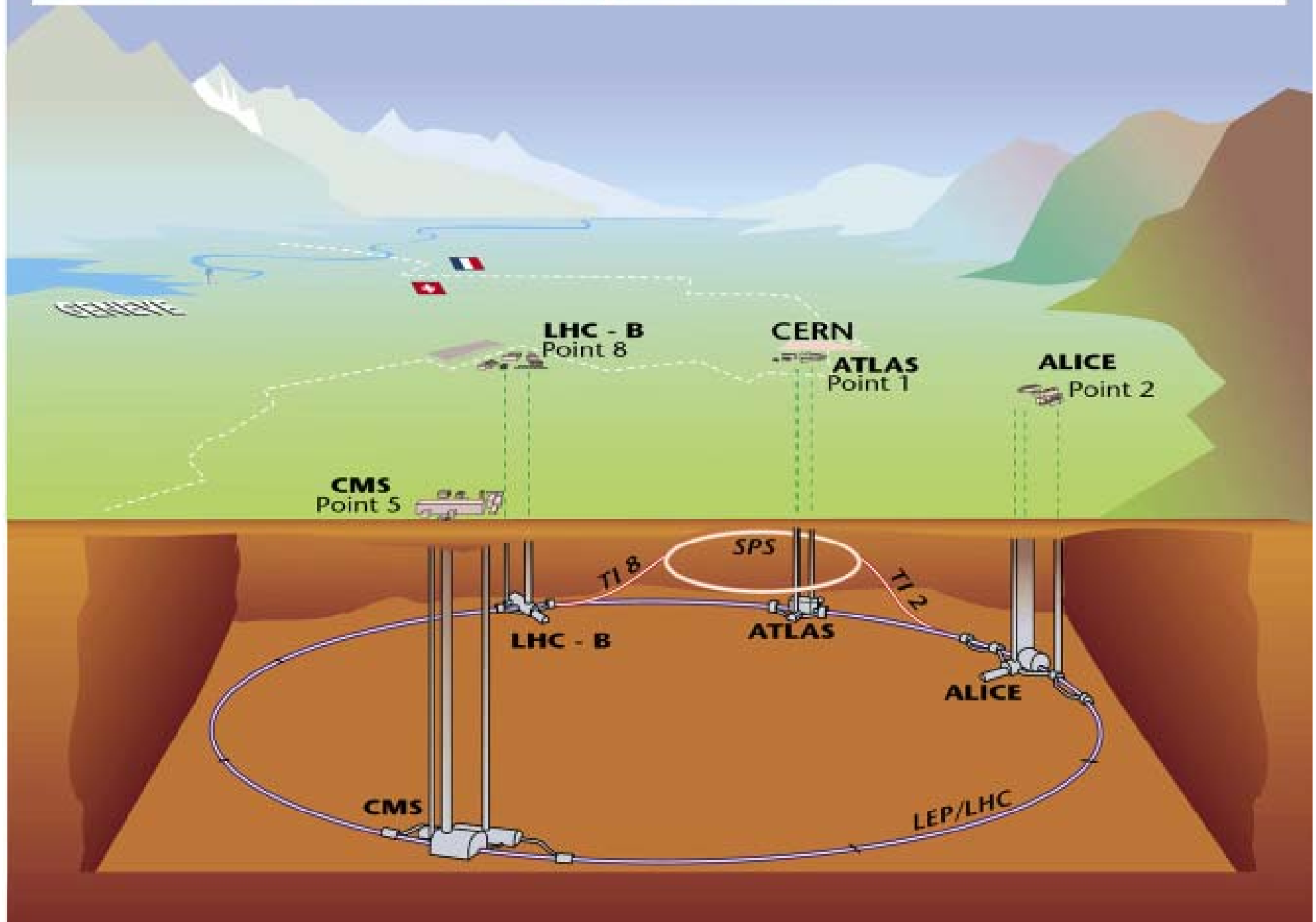
Daide Tommasini



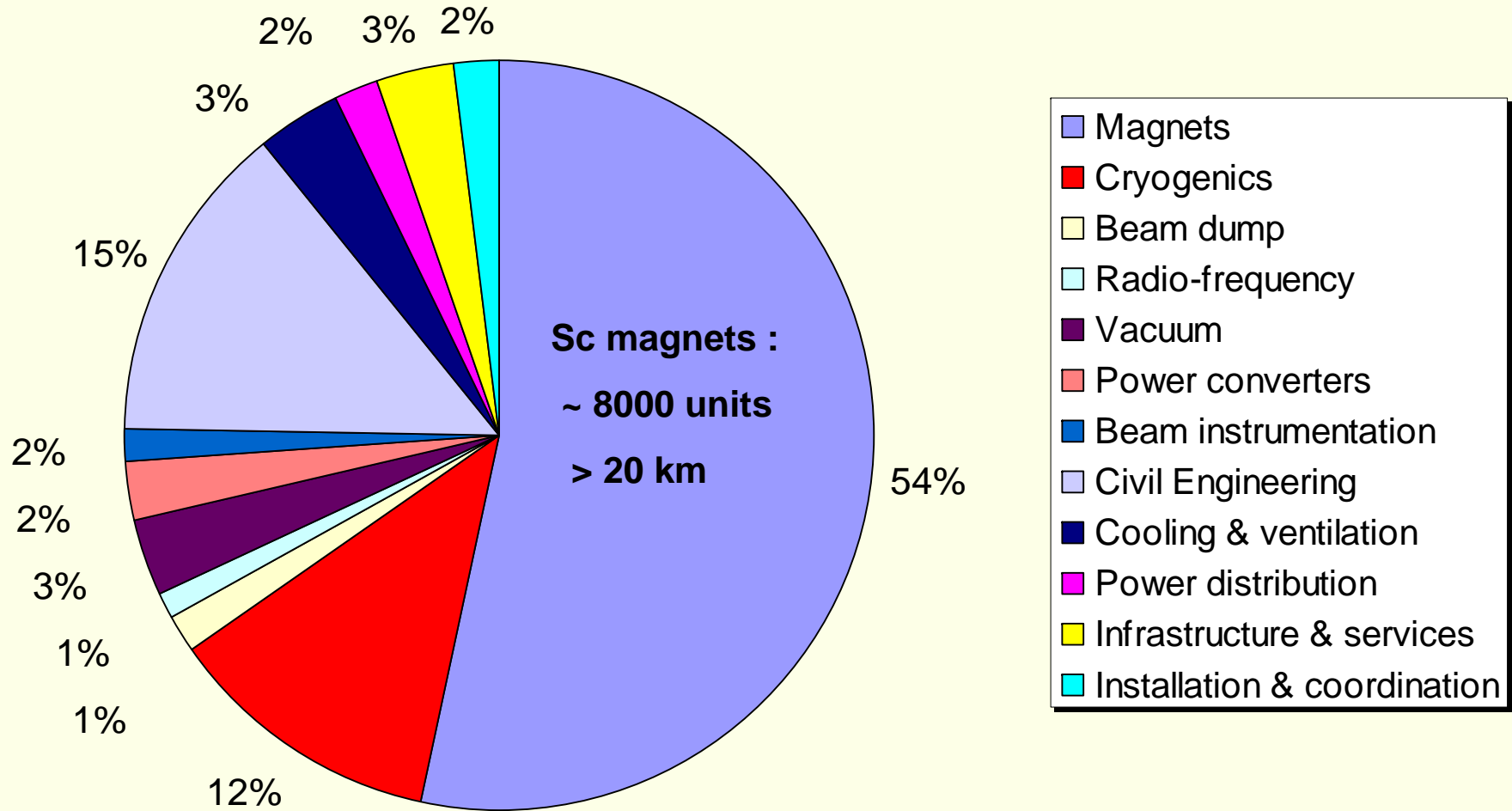


- | | | | |
|------------|---------------|------------------------------|--------------------------------|
| ▶ protons | ▶ antiprotons | AD Antiproton Decelerator | LHC Large Hadron Collider |
| ▶ ions | ▶ electrons | PS Proton Synchrotron | n-ToF Neutron Time of Flight |
| ▶ neutrons | ▶ neutrinos | SPS Super Proton Synchrotron | CNGS CERN Neutrinos Gran Sasso |
| | | | CTF3 CLIC Test Facility 3 |

Overall view of the LHC experiments.



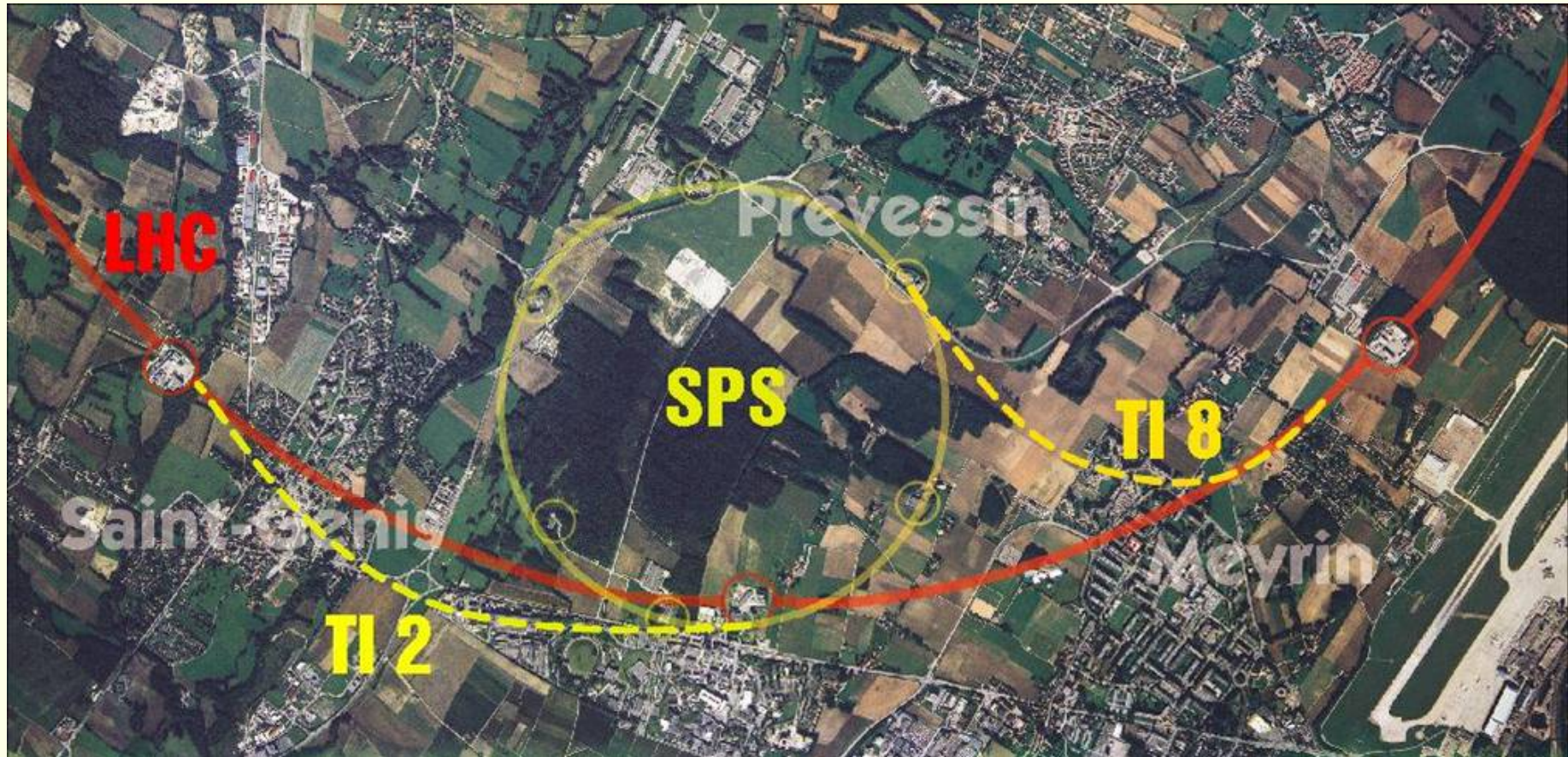
COST STRUCTURE OF THE LHC



CMS : CIVIL WORKS COMPLETED ON FEBRUARY 05



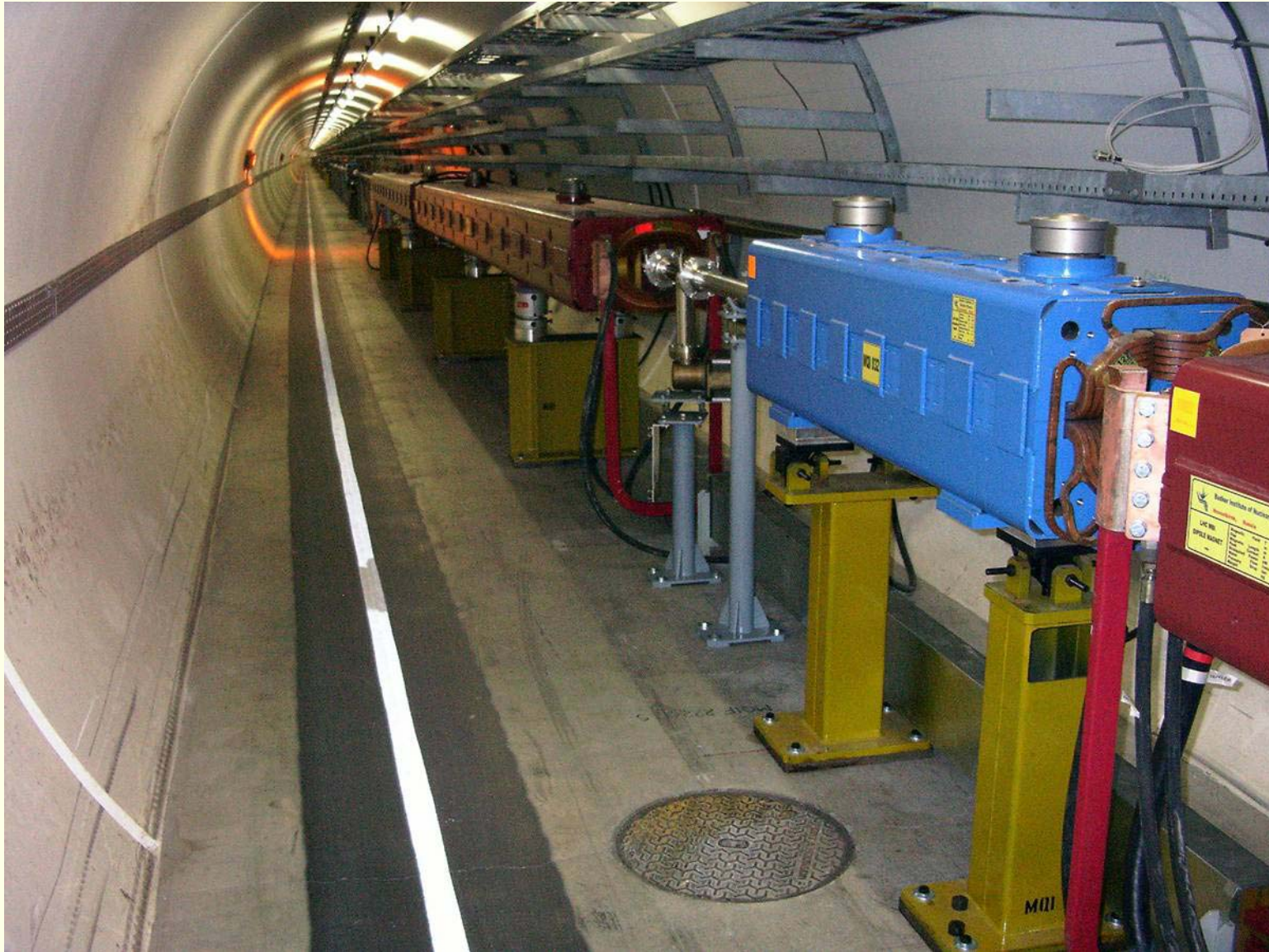
LHC INJECTION LINES : 5.6 km, 700 magnets



TI8 INSTALLED AND TESTED WITH BEAM (OCT 04)



TI2 HALF INSTALLED



D.Tommasini

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Milano September 16th 2005

LOWERING OF FIRST DIPOLE (MARCH 2005)



LOWERING OF FIRST SSS (APRIL 2005)



REPAIR OF CRYOLINES AT CERN



QRL INSTALLATION IN SECTOR 4-5



QRL INSTALLATION IN SECTOR 7-8



QRL INSTALLATION IN SECTOR 8-1



MAGNET INSTALLATION : TRANSFER ON JACKS

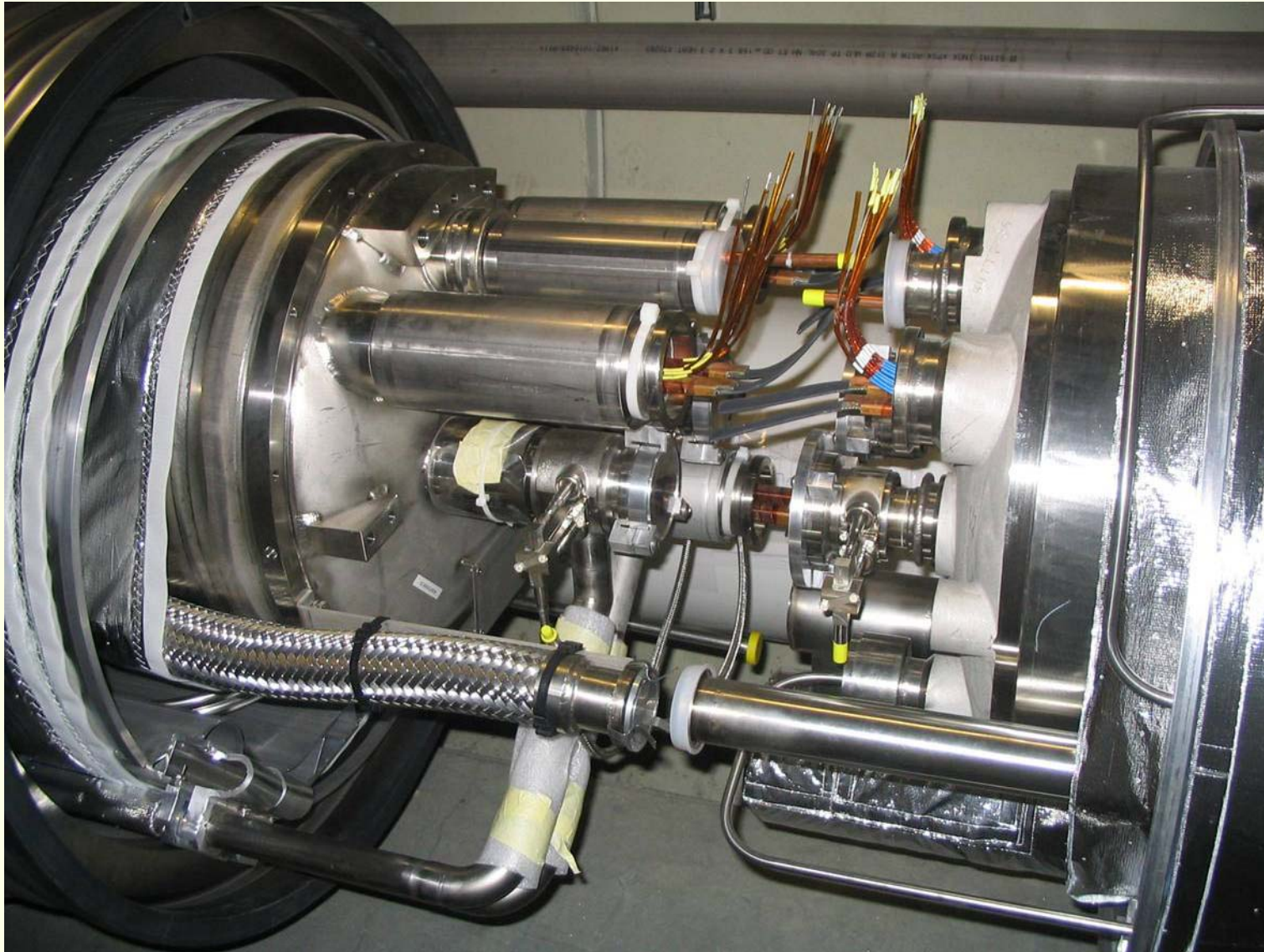


D.Tommasini

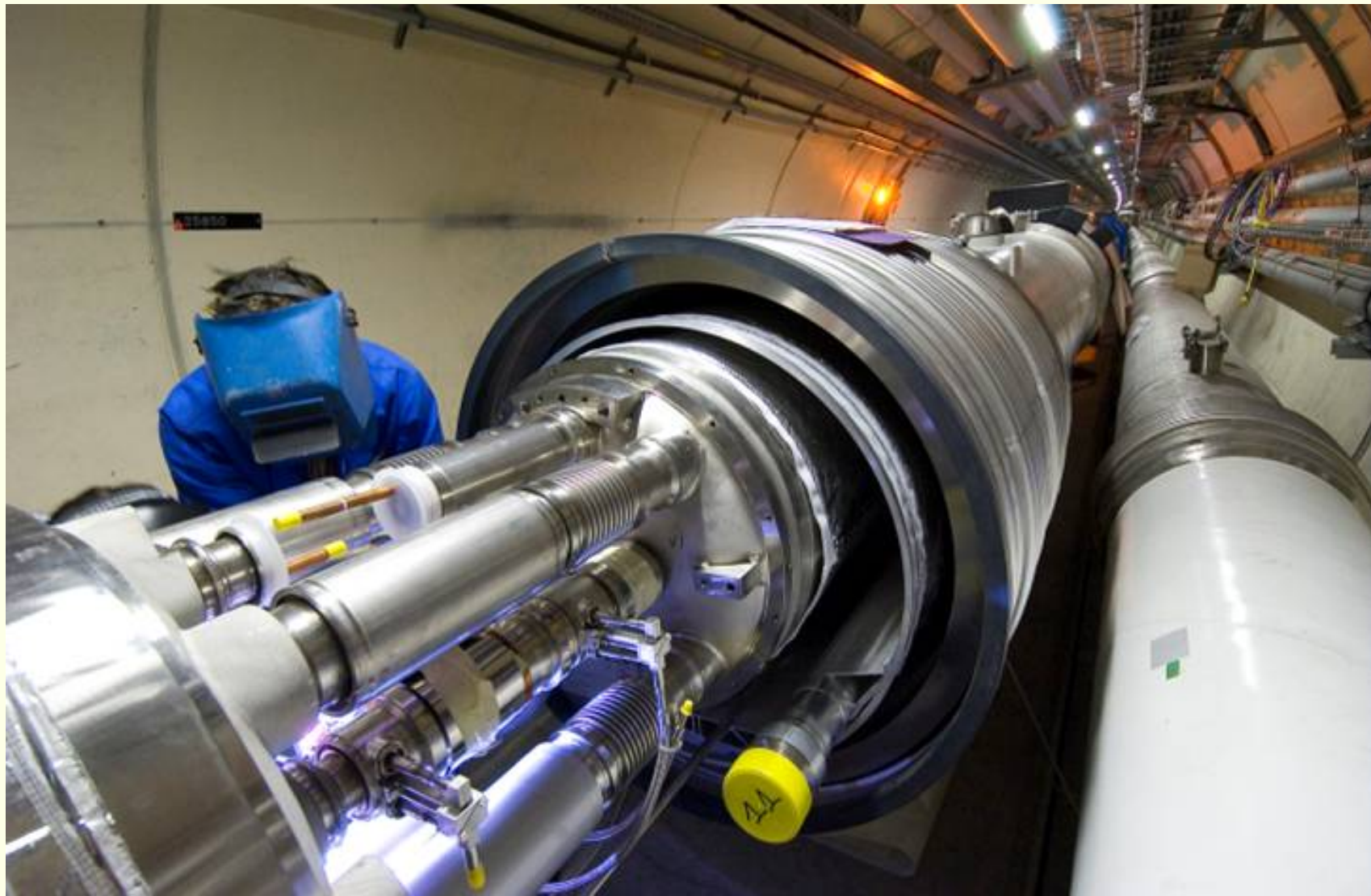
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PREPARATION OF INTERCONNEXION



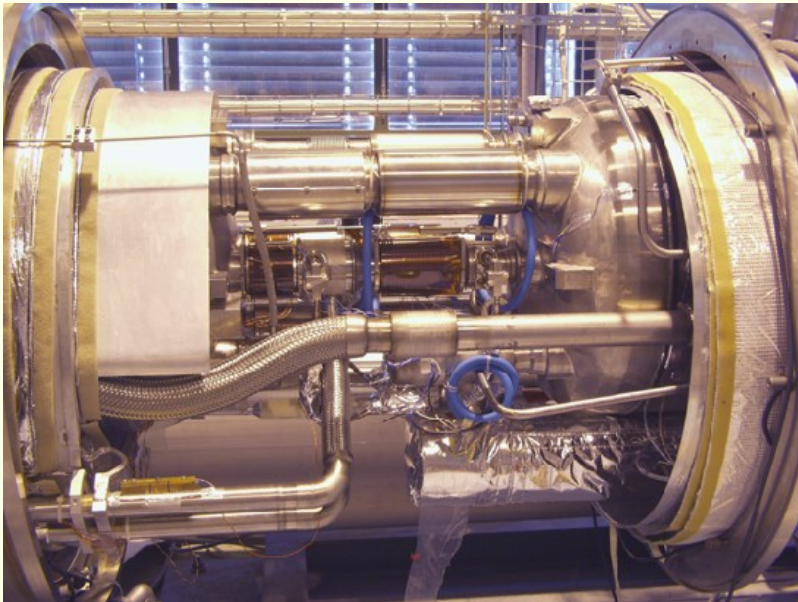
BEAM PIPES INTERCONNECTION





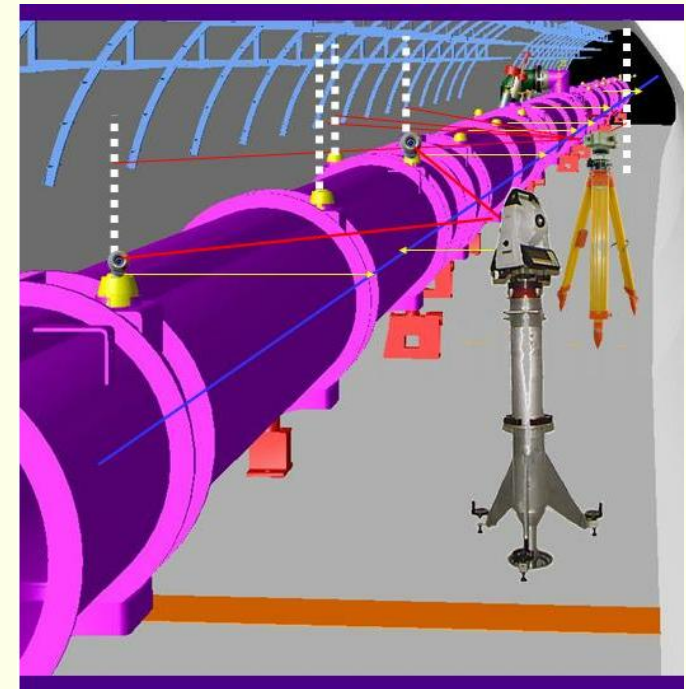
IN THE TUNNEL

- Marking the floor
- Positioning of the jacks (all jacks accuracy 2 mm r.m.s.)
- First positioning (few missing magnets acceptable)
- Connection, vacuum, cool-down
- Smoothing

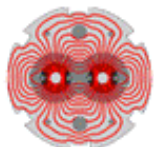


D.Tommasini

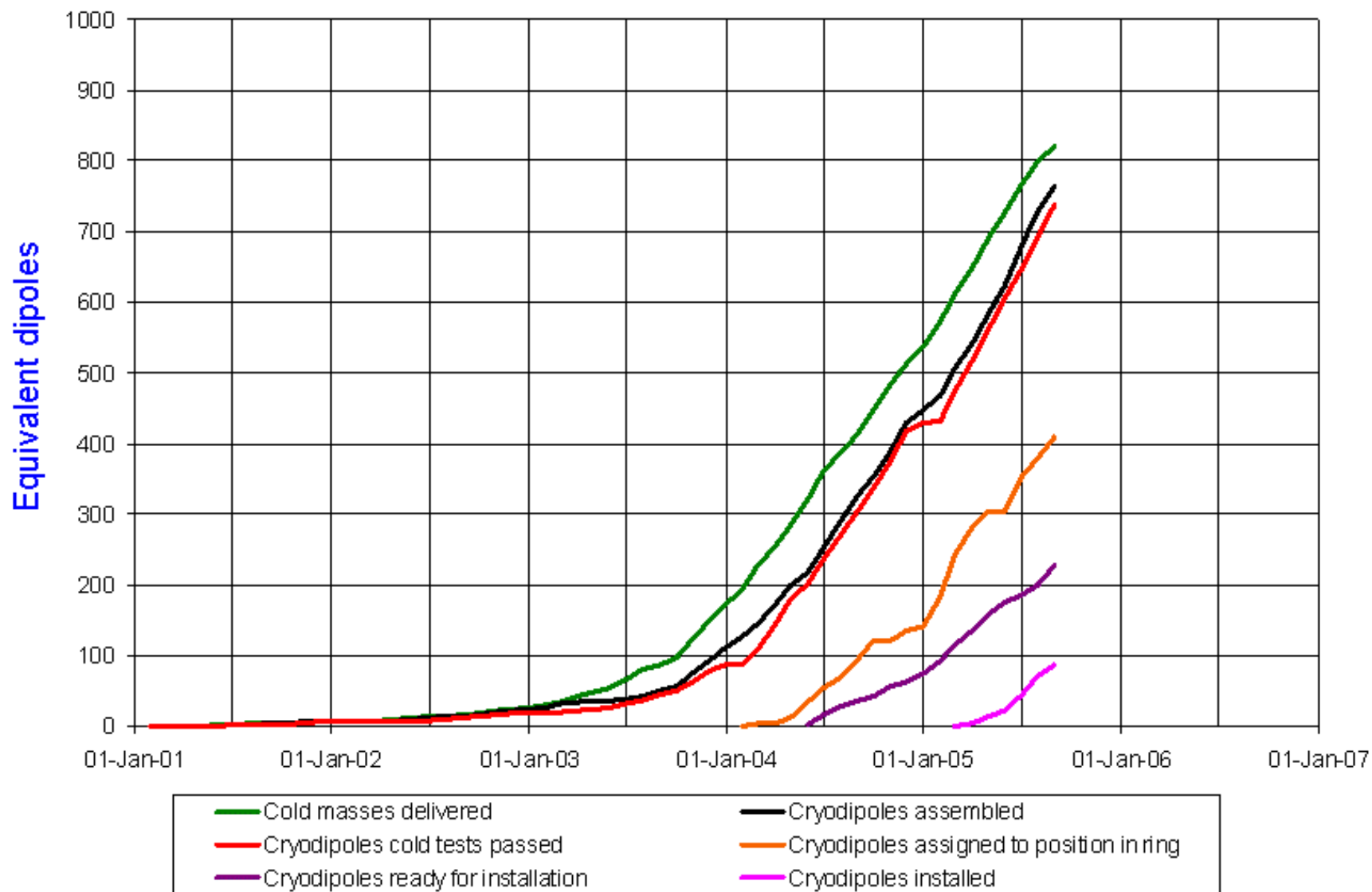
Frontier Science 2005

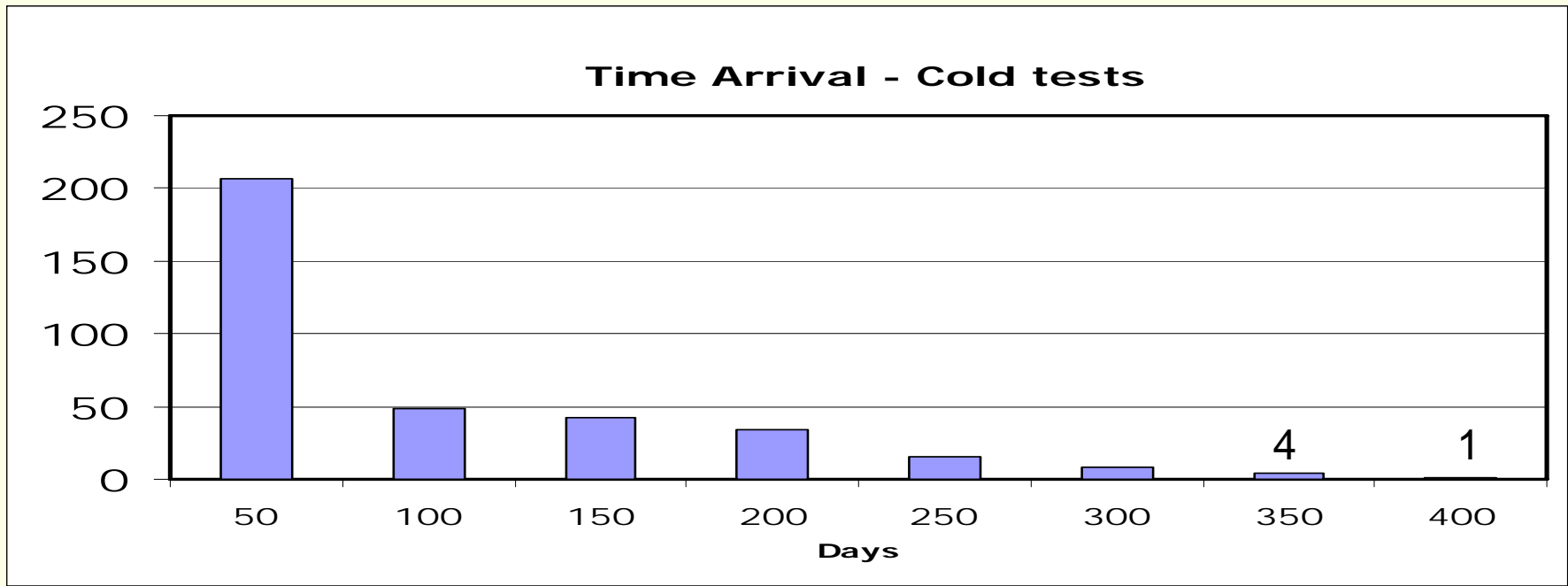


Milano September 16th 2005

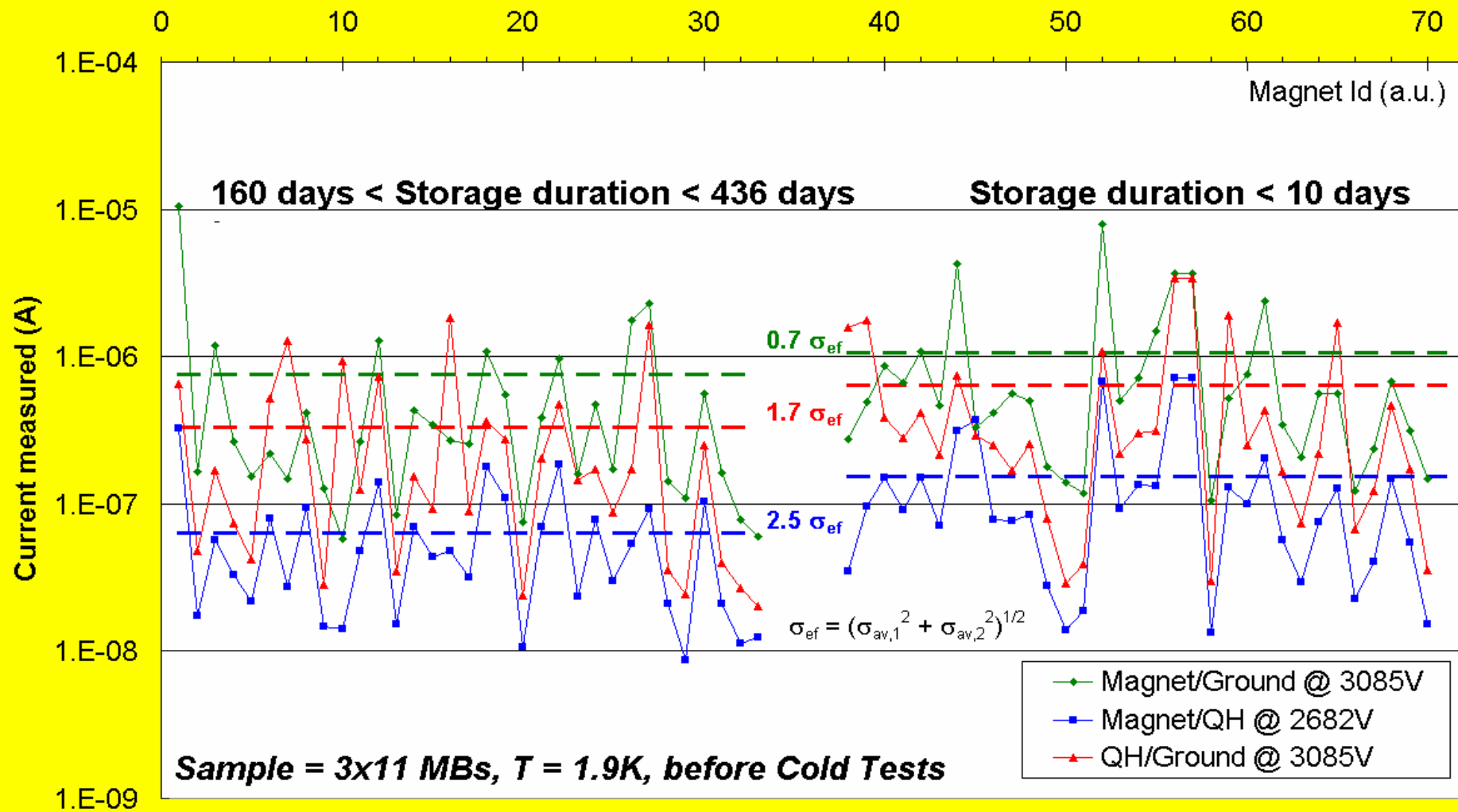


Cryodipole overview



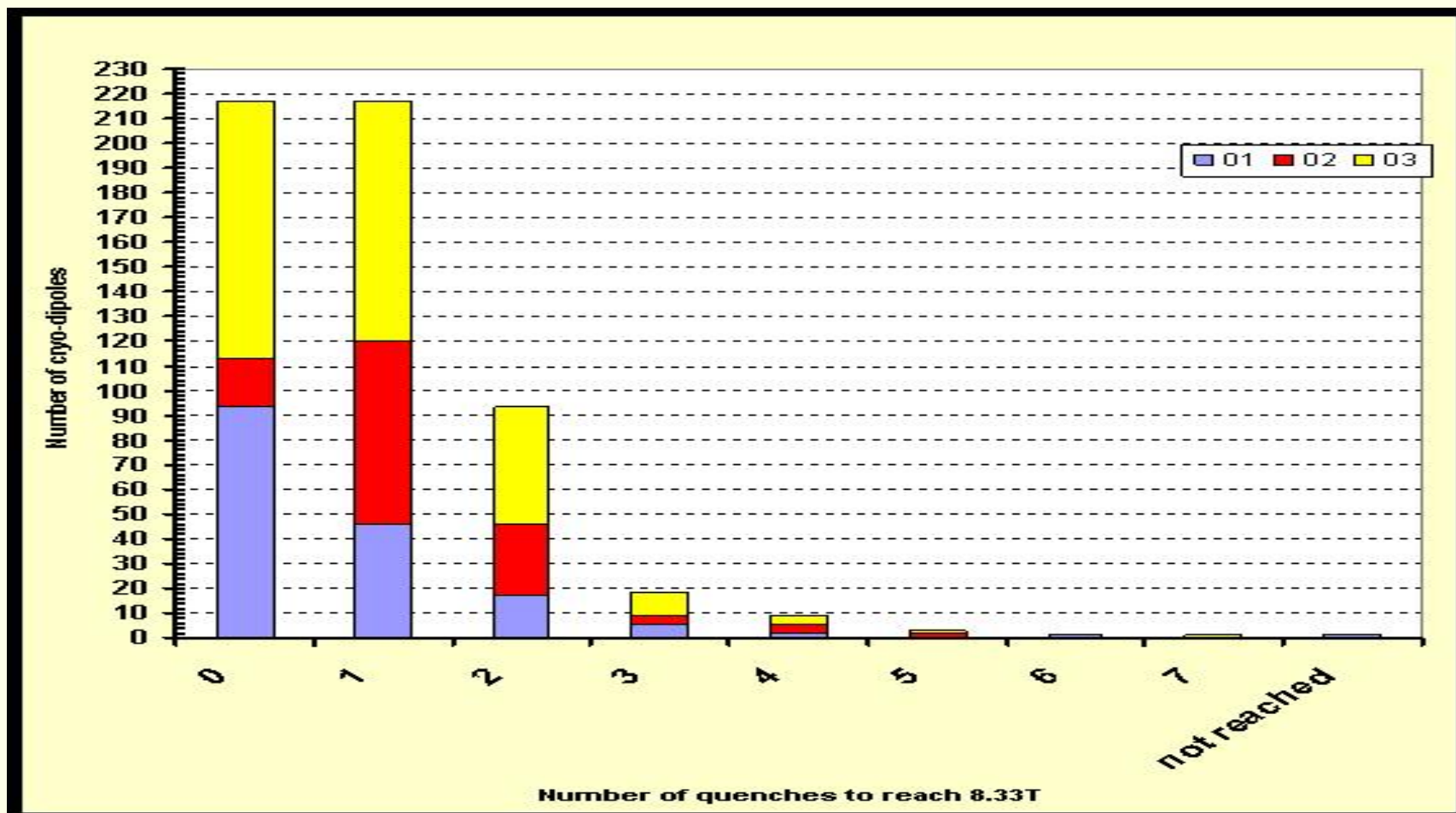


No degradation of electrical insulation

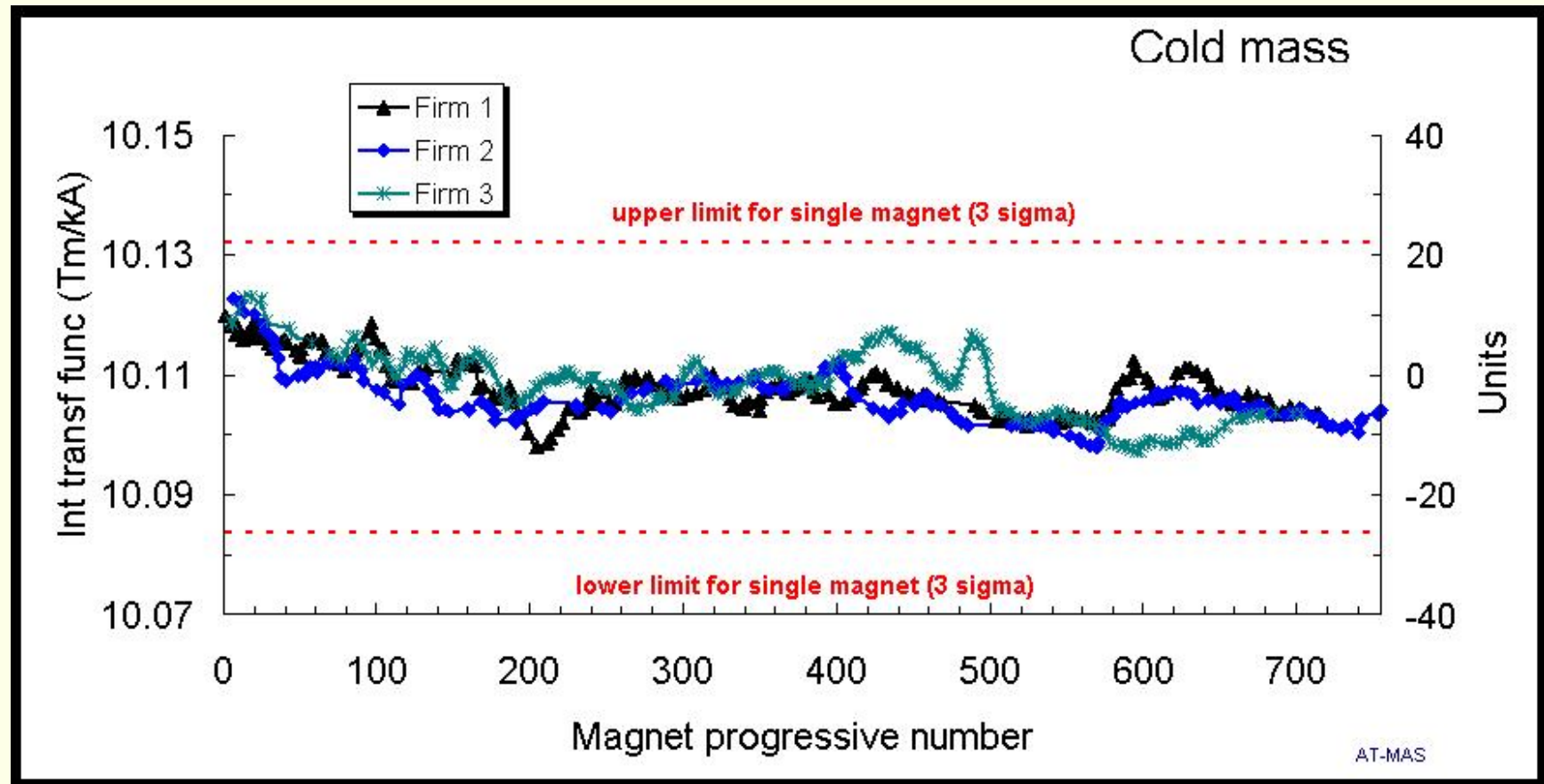


Courtesy Pierre Pugnât AT-MTM

NUMBER OF QUENCHES TO REACH NOMINAL FIELD



DIPOLES : INTEGRATED FIELD



ASSEMBLY OF INSERTION QUADRUPOLES AT CERN



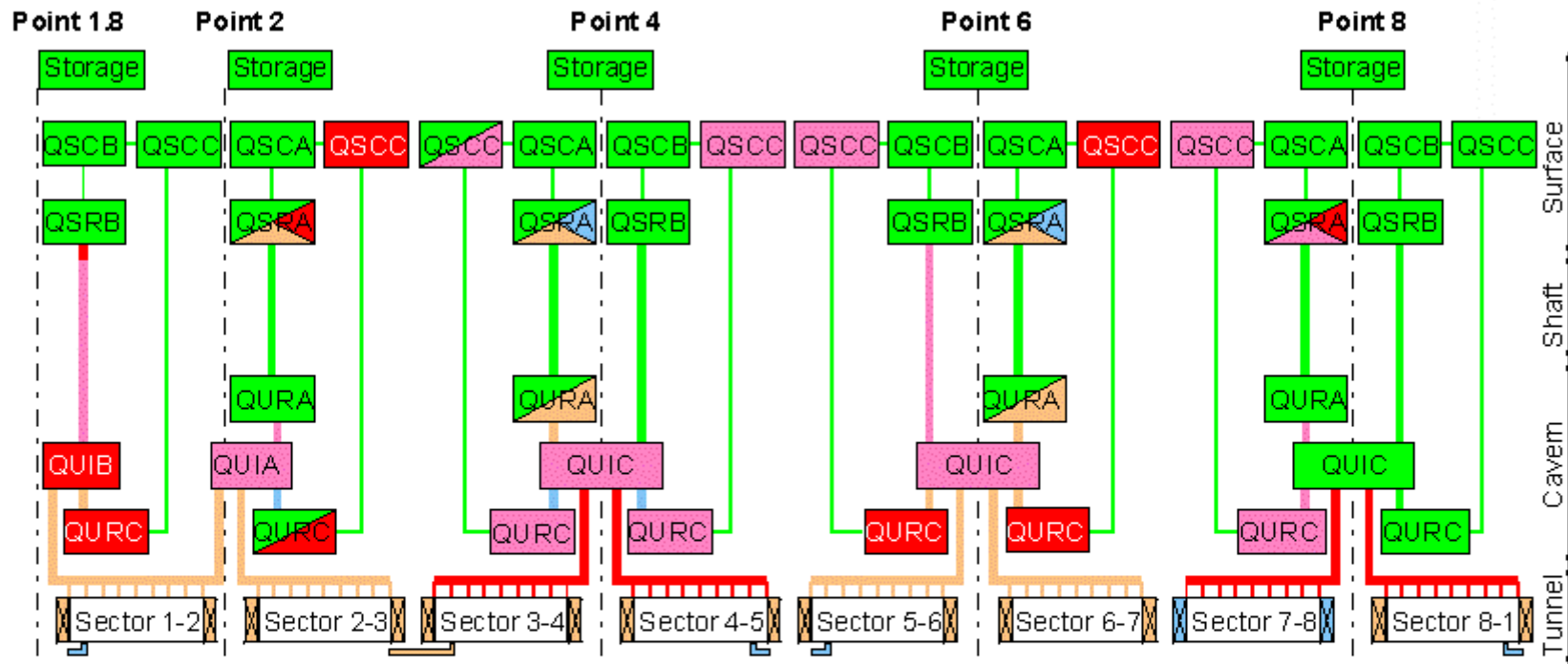






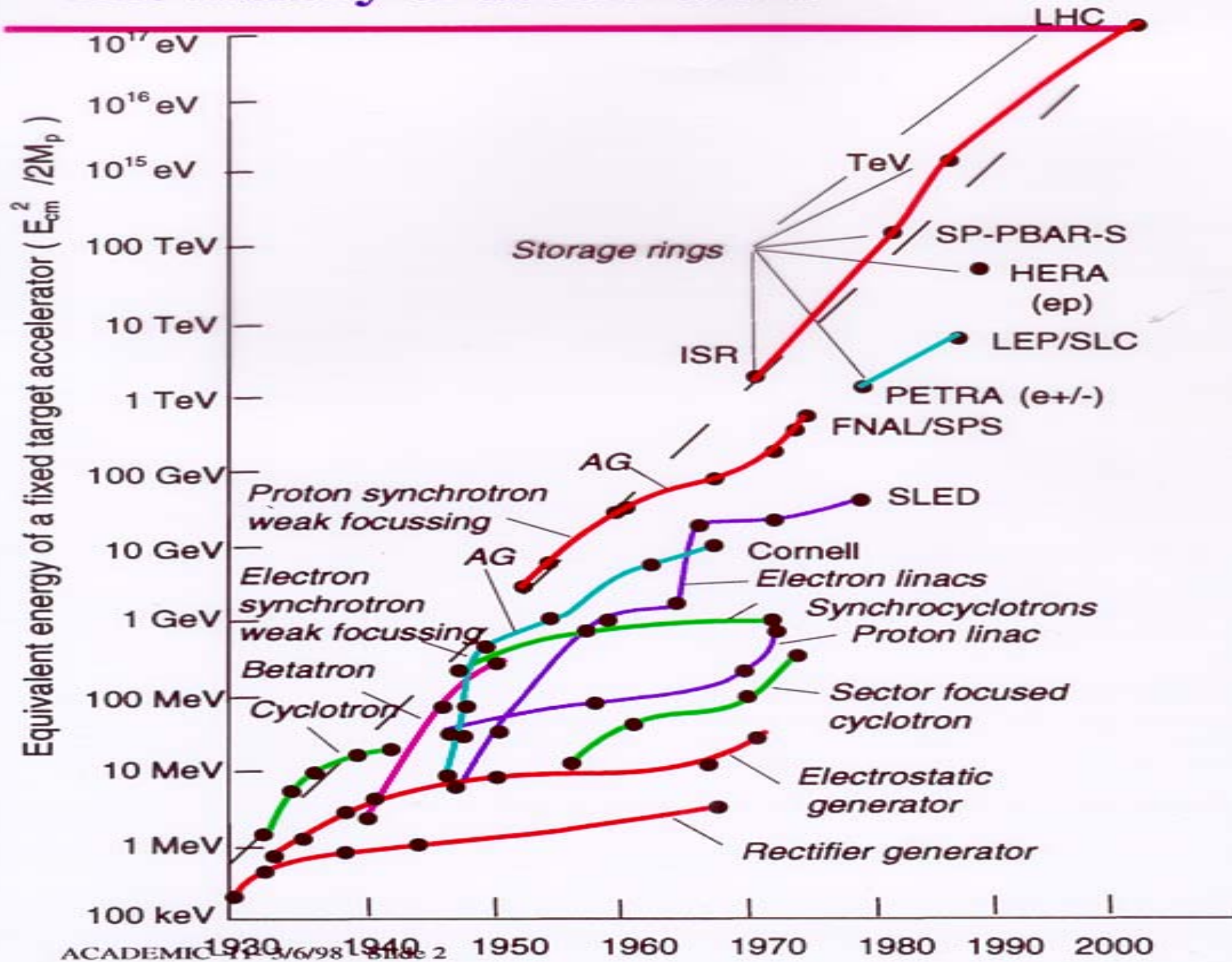


Cryogenics overview



| Legend | | | |
|--------|--|--|--------------------------------|
| | Comissionned & accepted | | Delivered / Under installation |
| | Under commissioning | | Under fabrication |
| | Ordered (Contract placed) | | Under definition |
| | Cryogenic Distribution Line | | Electrical Feed Box |
| | Superconducting Link | | |
| | QSC_(A,B,C): Warm Compressor Station | | |
| | QSR_(A,B): Surface 4.5 K Refrigerator Cold Box | | |
| | QURA: Underground 4.5 K Refrigerator Cold Box | | |
| | QURC: 1.8 K Refrigeration Unit Cold Box | | |
| | QUI_(A,B,C): Cryogenic Interconnection Box | | |

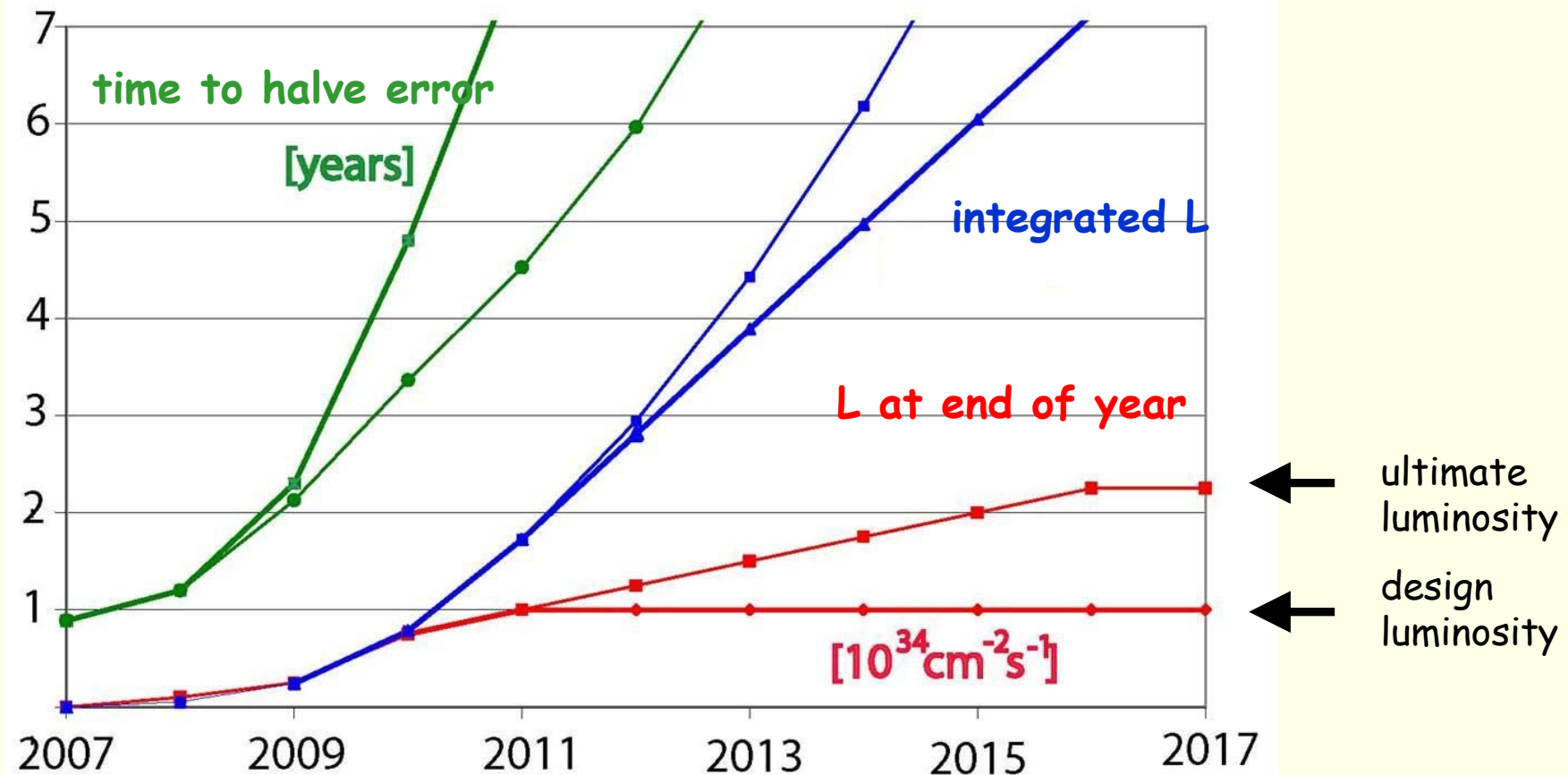
The history of accelerators



LHC CHALLENGES

- Factor of 2 on magnetic field (energy upgrade)
- Factor of 20 on luminosity
- Factor of 100 on reduction of beam losses (collimation)
- Factor of 1000 on density of energy

TIME-SCALE OF LHC LUMINOSITY UPGRADE



courtesy J. Strait

- (1) *life expectancy of LHC IR quadrupole magnets* is estimated to be <10 years due to high radiation doses
- (2) the *statistical error halving time* will exceed 5 years by 2011-2012
- (3) therefore, it is reasonable to plan a *machine luminosity upgrade based on new low- β IR magnets before ~2014*

HIGHER FIELDS

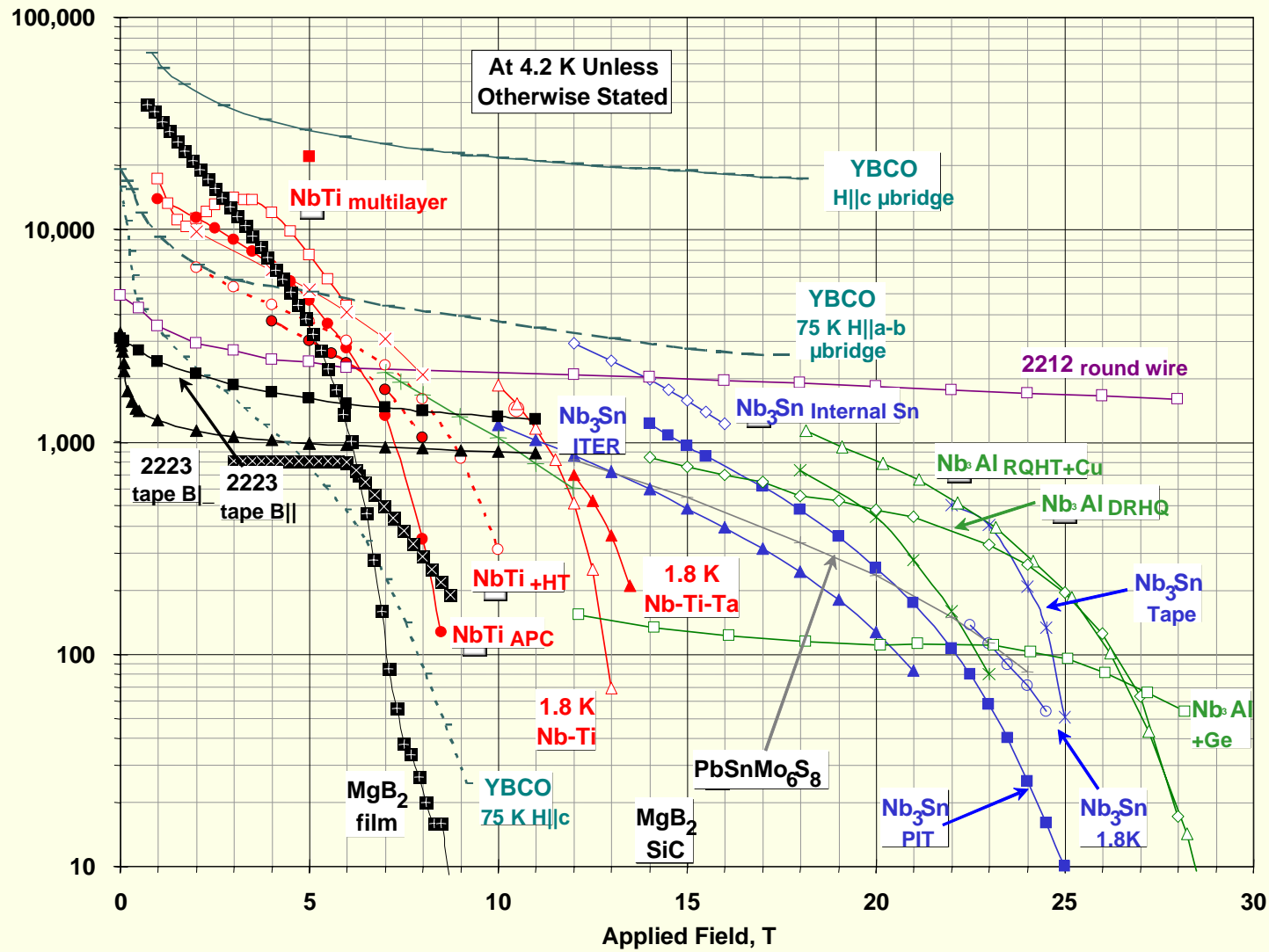
- ENERGY : circular machine $E \cong 0.3 R_b B$ (TeV, km, T)
- LUMINOSITY : strongly depends on Interaction Regions(IR's) mainly limited by strength and quality of quadrupole magnets. In the LHC stronger low-beta insertions would double luminosity

PULSED HIGH FIELDS

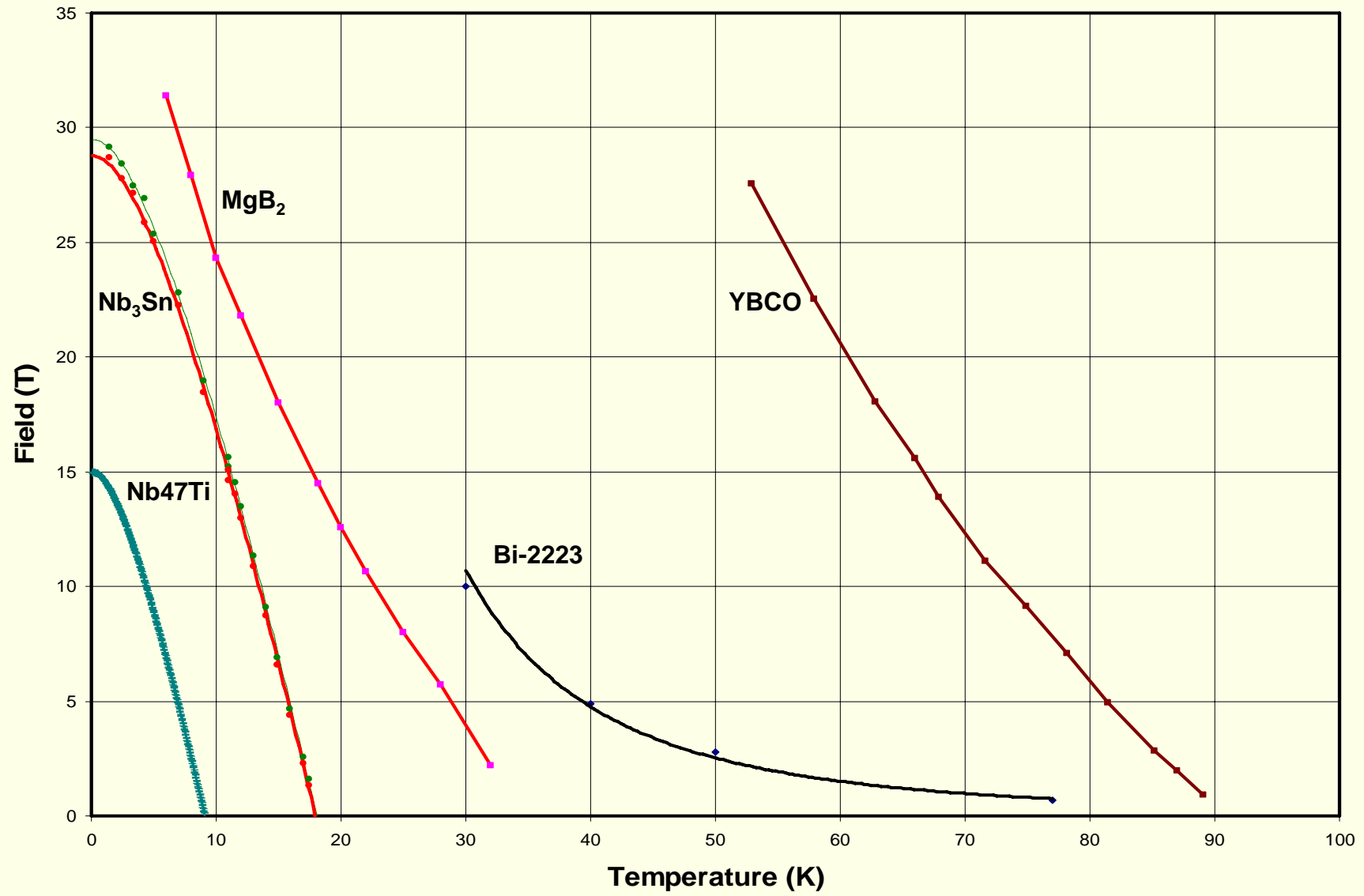
Upgrade of the LHC injector chain, which allows to :

- double the number of bunches (thus doubling Luminosity)
- allow a possible LHC energy upgrade
- have a more reliable injection

Critical Current
Density, A/mm²



Peter Lee - www.asc.wisc.edu

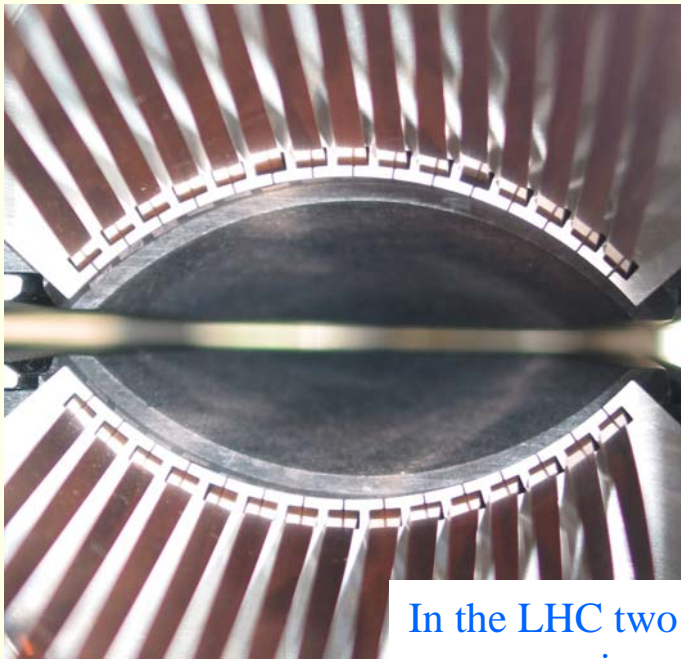


COLLIMATION

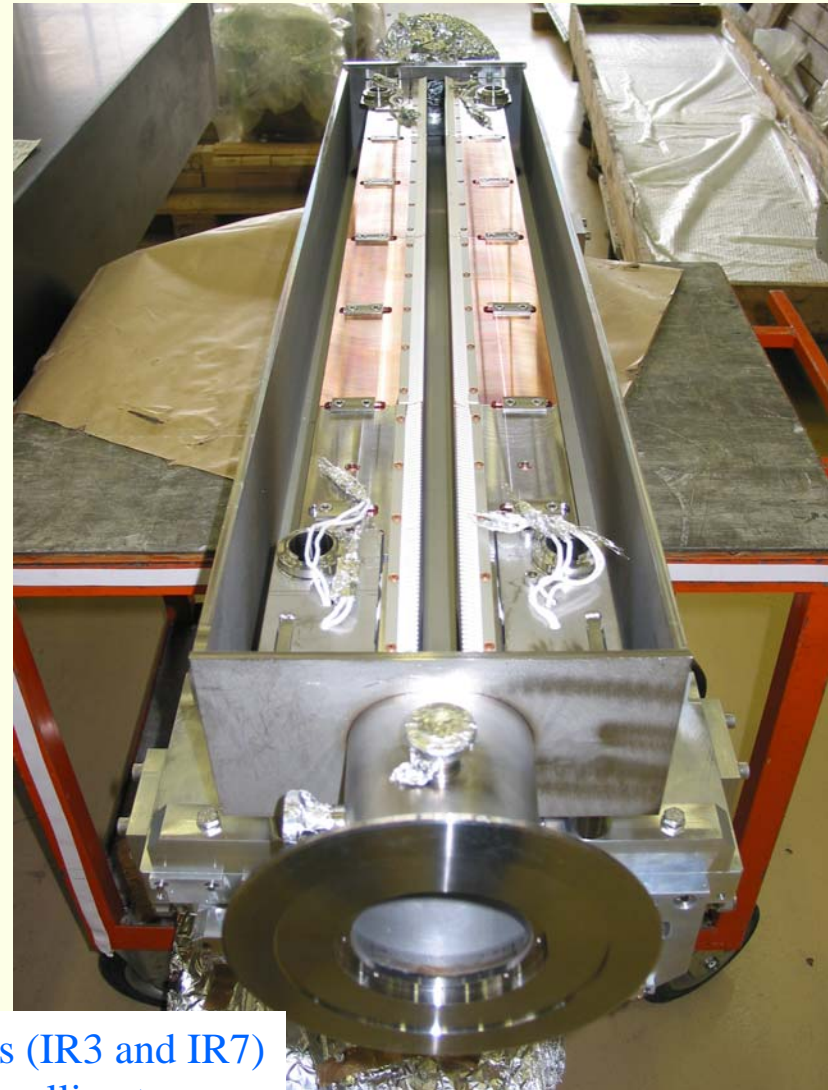
Position

Thermal dissipation

Interaction with beam



In the LHC two insertions (IR3 and IR7) are equipped with 54 collimators



IN SUMMARY

- o Equipments delivery: more or less according to schedule
- o Cryomagnets performance : very good, robust to outdoor storage
- o Cryomagnets installation : is late due to QRL problems. The installation strategy is being optimized to keep schedule

The main objective remains :

- o complete cryomagnets installation by end 2006
- o get first collisions by summer 2007

THE NEXT CHALLENGES ARE VERY AMBITIOUS IN TERMS OF TECHNOLOGIES AND MATERIALS

NOMINAL PARAMETERS OF THE LHC

| | | |
|------------------------------|-------------------------------------|-----------------------|
| Collision energy | (TeV) | 2x7.0 |
| Dipole peak field | (T) | 8.3 |
| Luminosity | (cm ⁻² s ⁻¹) | 10 ³⁴ |
| Injection energy | (TeV) | 0.45 |
| Circulating current per beam | (A) | 0.56 |
| Number of bunches | | 2808 |
| Particles per bunch | | 1.15x10 ¹¹ |
| Stored beam energy per beam | (MJ) | 350 |
| Beam size at IP | (μm) | 15.9 |
| Beta values at IP | (m) | 0.55 |
| Normalised emittance | (μm) | 3.75 |
| Crossing angle | (μrad) | 300 |
| Beam lifetime | (h) | 22 |
| Luminosity lifetime | (h) | 10 |
| Radiated power per beam | (kW) | 3.7 |