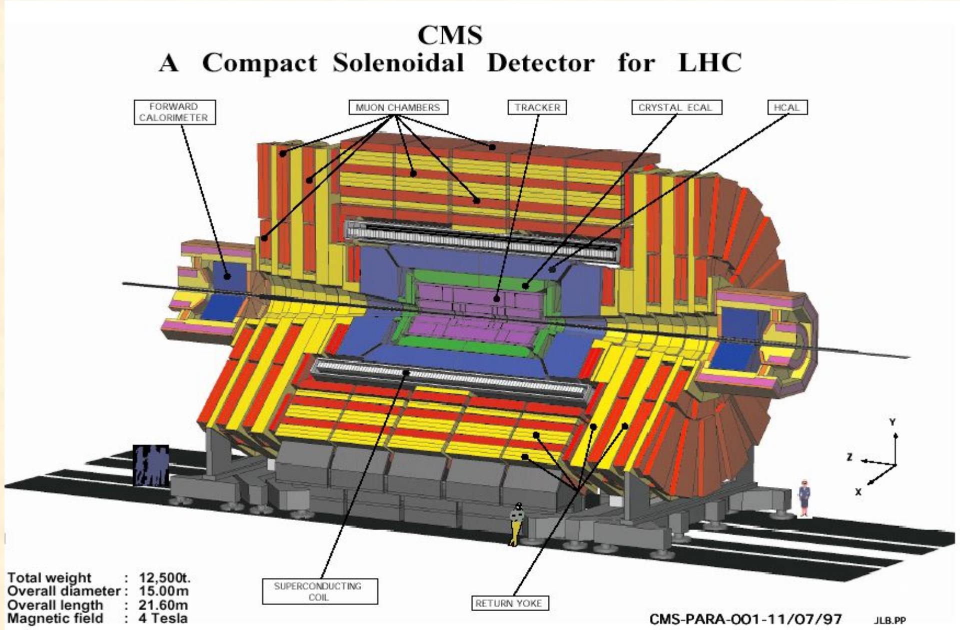
CMS Collaboration

Russia and Dubna Member States CMS Collaboration



Коллаборация CMS России и стран-участниц ОИЯИ

LHC, CMS, RDMS - Status and Plans

I.Golutvin and A.Zarubin (JINR, Dubna)

4th International Sakharov Conference on Physics, 21 May 2009

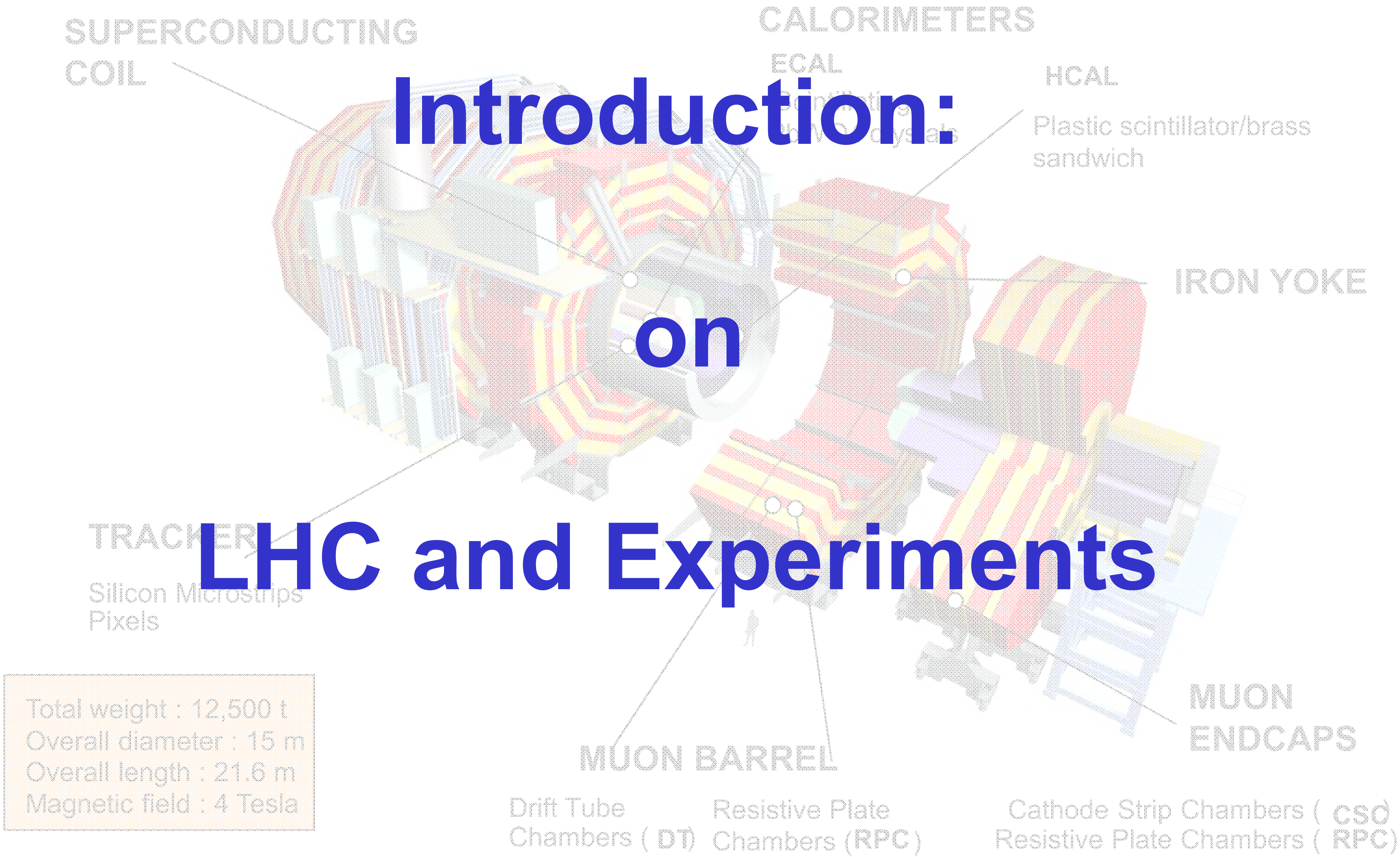
Outline

1. Introduction: LHC and CMS
2. RDMS CMS Overview
3. Readiness of CMS for physics. CMS start-up
4. LHC preparation for 2009/2010 Run
5. Prospects for physics with 2009/2010 data
6. RDMS in CMS Physics Program
7. RDMS Computing
8. Summary

Introduction:

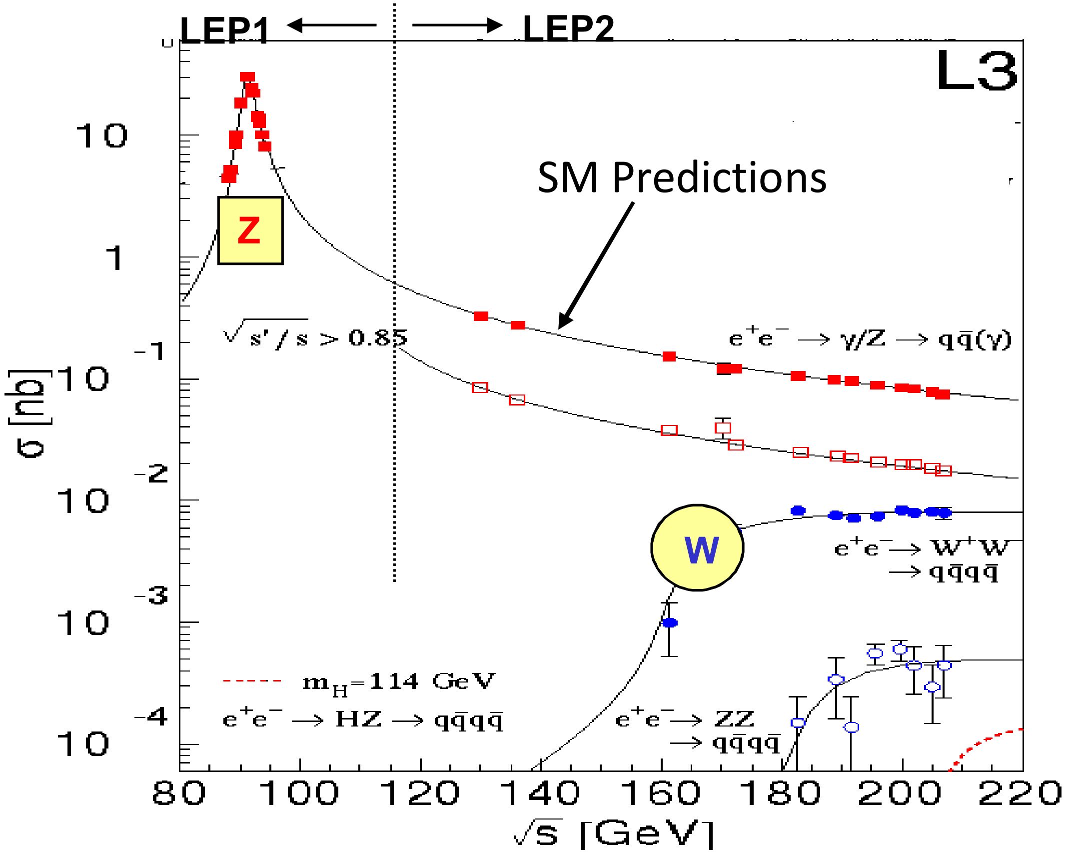
on

LHC and Experiments



Successes of the Standard Model

LEP, SLC, Tevatron and B-factories established that Standard Model really describes the physics at energies up to √s ~ 100 GeV



Standard Model is precisely tested theory

Standard Model does not provide the whole picture…

Missing ingredient, Higgs particle, has been searched for decades but not yet found

LHC Physics Goals

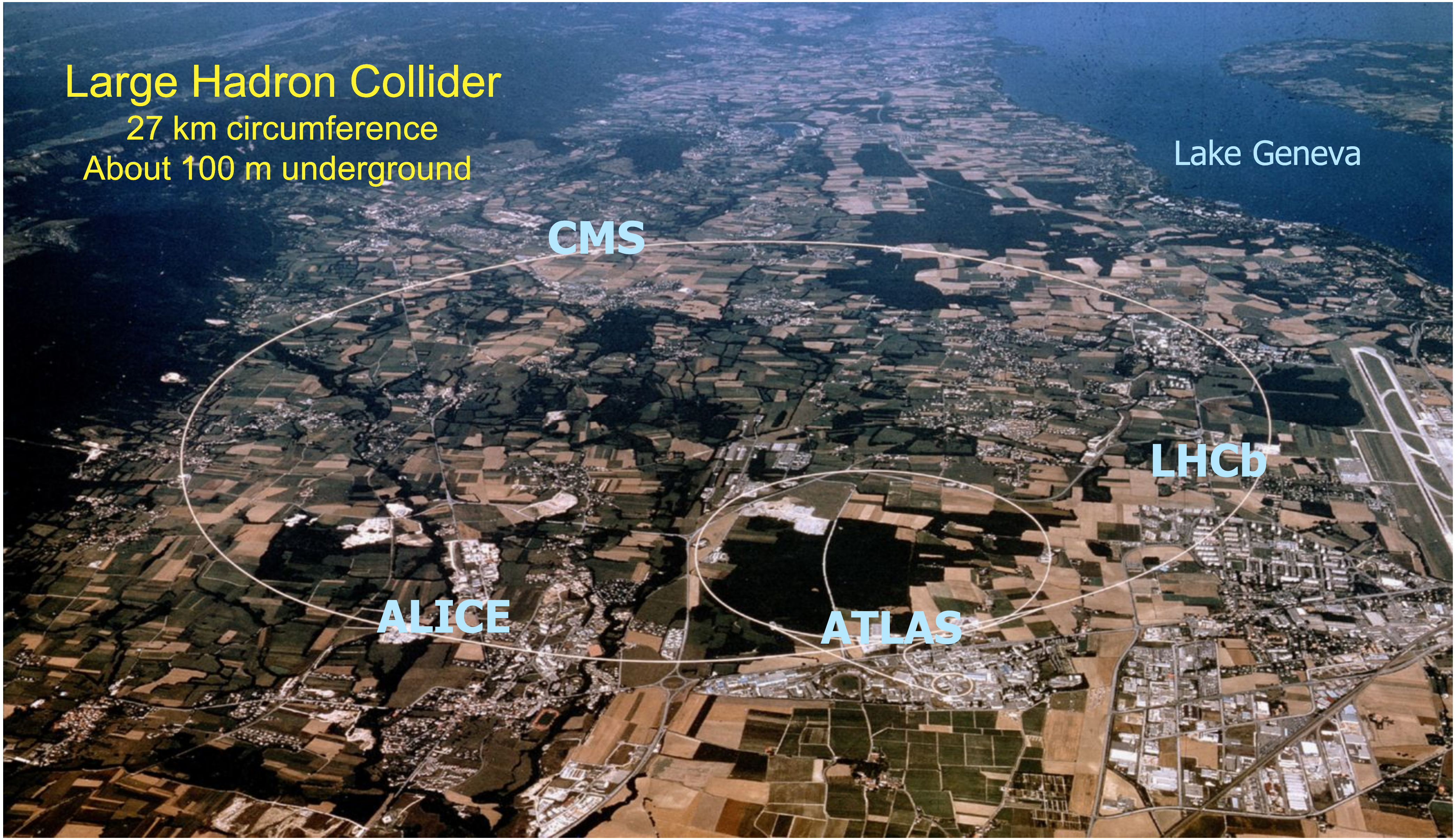
Main Goals:

- **Search for the SM Higgs boson over ~ 115 $< m_H <$ 1000 GeV**
- **Search for New Physics beyond the SM**

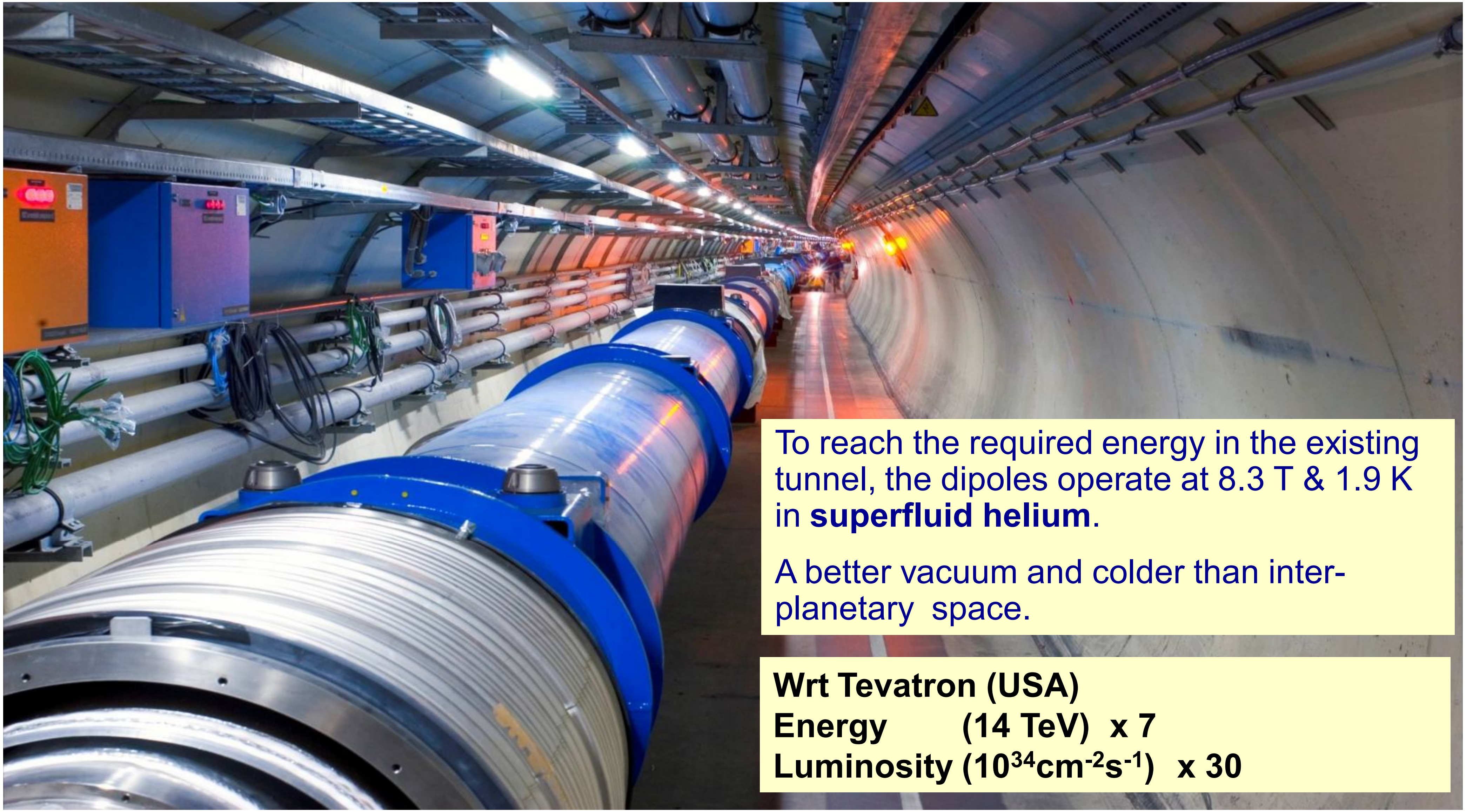
  - Explore TeV-scale directly (ATLAS & CMS) and indirectly (LHCb)

- **Study phase transition at high density from hadronic matter to quark-gluon plasma (ALICE)**

CERN LHC


Large Hadron Collider
27 km circumference
About 100 m underground
Lake Geneva
CMS
LHCb
ALICE
ATLAS

The LHC Machine - a marvel technology

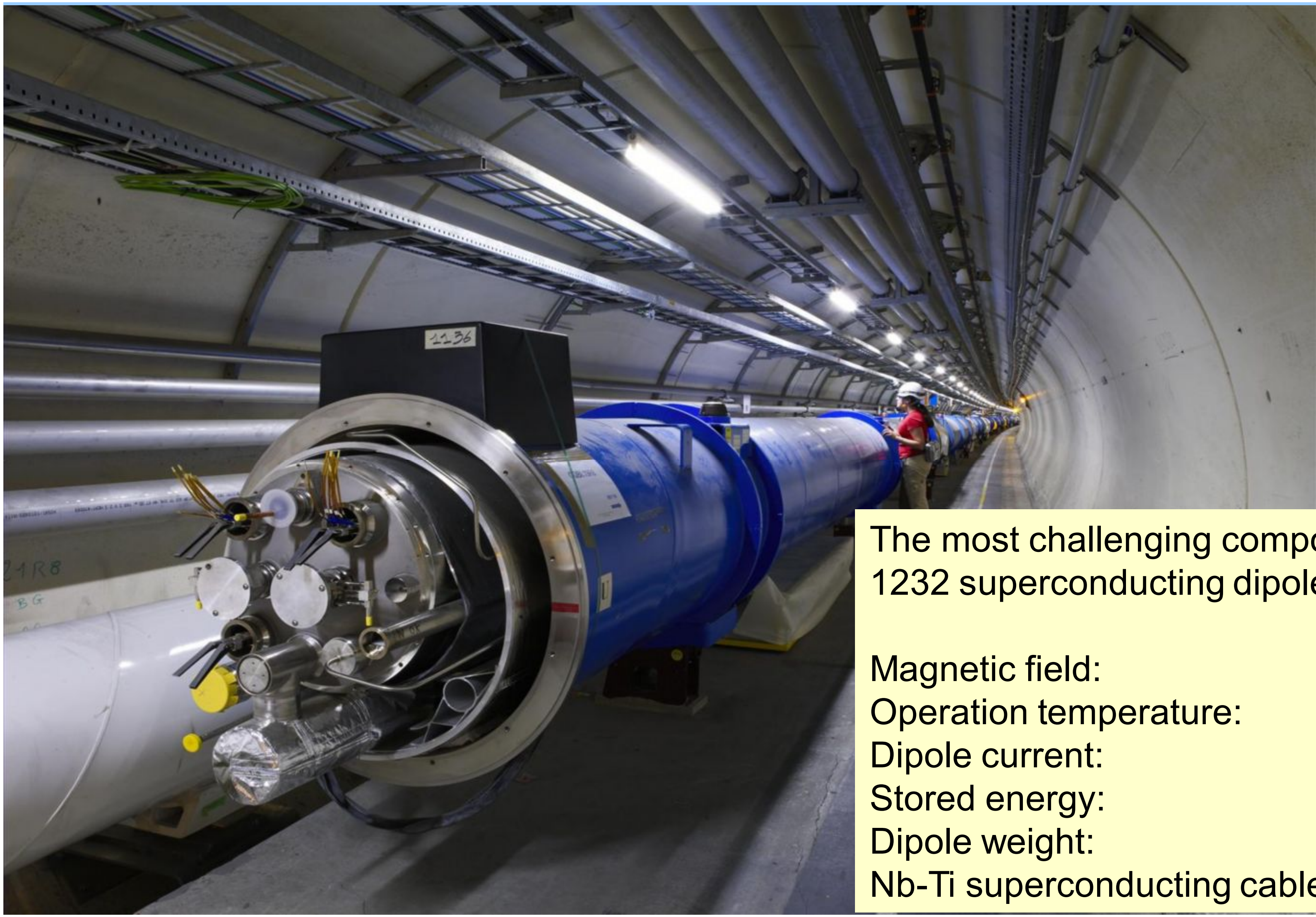


To reach the required energy in the existing tunnel, the dipoles operate at 8.3 T & 1.9 K in **superfluid helium**.

A better vacuum and colder than inter-planetary space.

Wrt Tevatron (USA)
Energy (14 TeV) x 7
Luminosity ($10^{34}cm^{-2}s^{-1}$) x 30

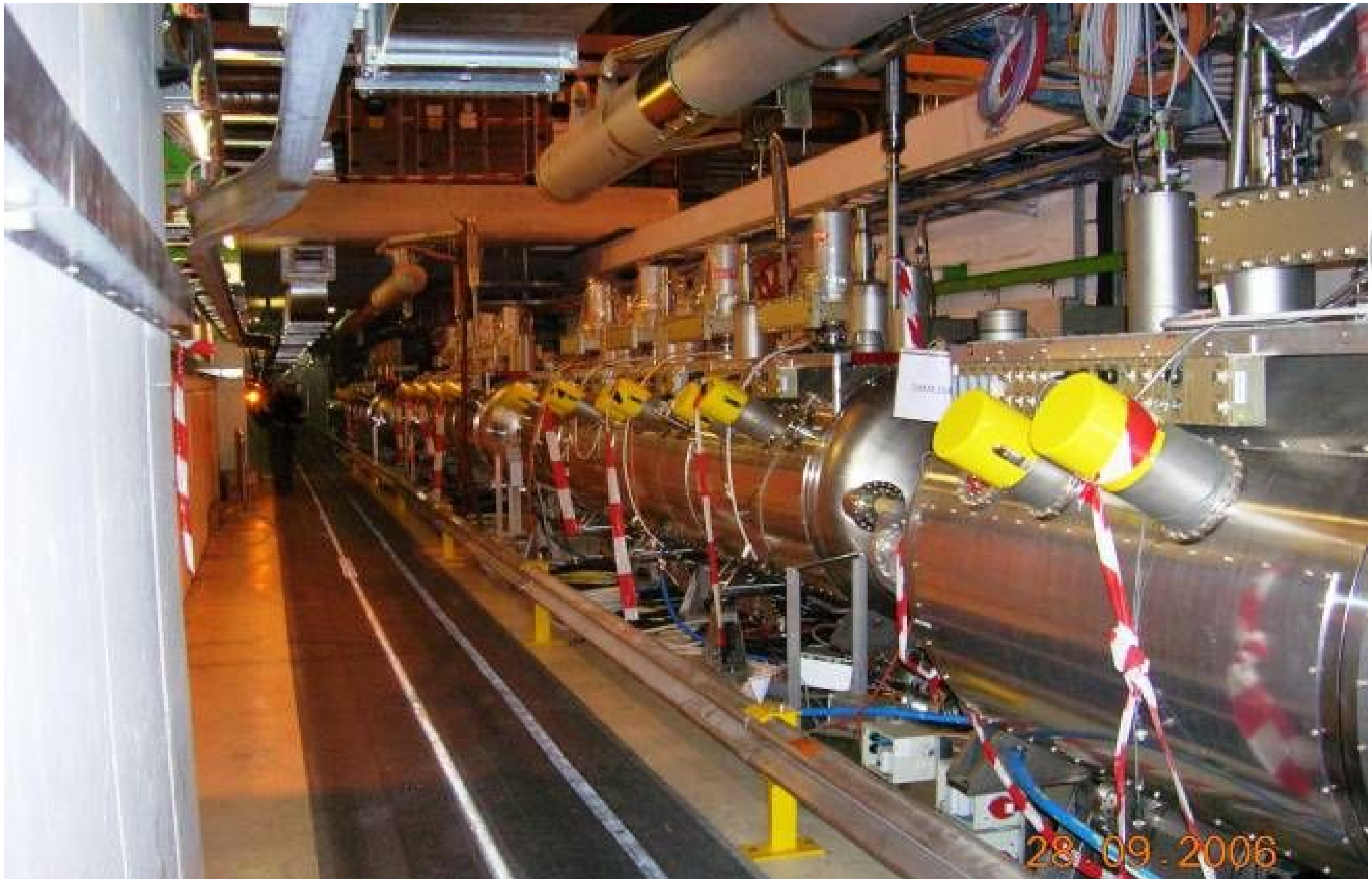
The LHC Accelerator

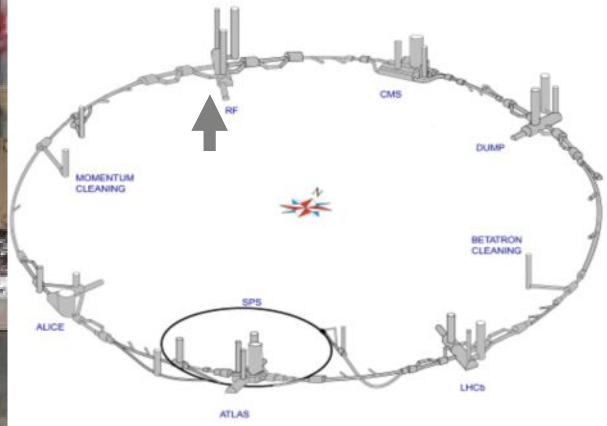


The most challenging components are the 1232 superconducting dipole magnets

Magnetic field:	8.4 T
Operation temperature:	1.9 K
Dipole current:	11700 A
Stored energy:	7 MJ
Dipole weight:	34 tons
Nb-Ti superconducting cable:	7600 km

The particle beams are accelerated by superconducting Radio-Frequency (RF) cavities

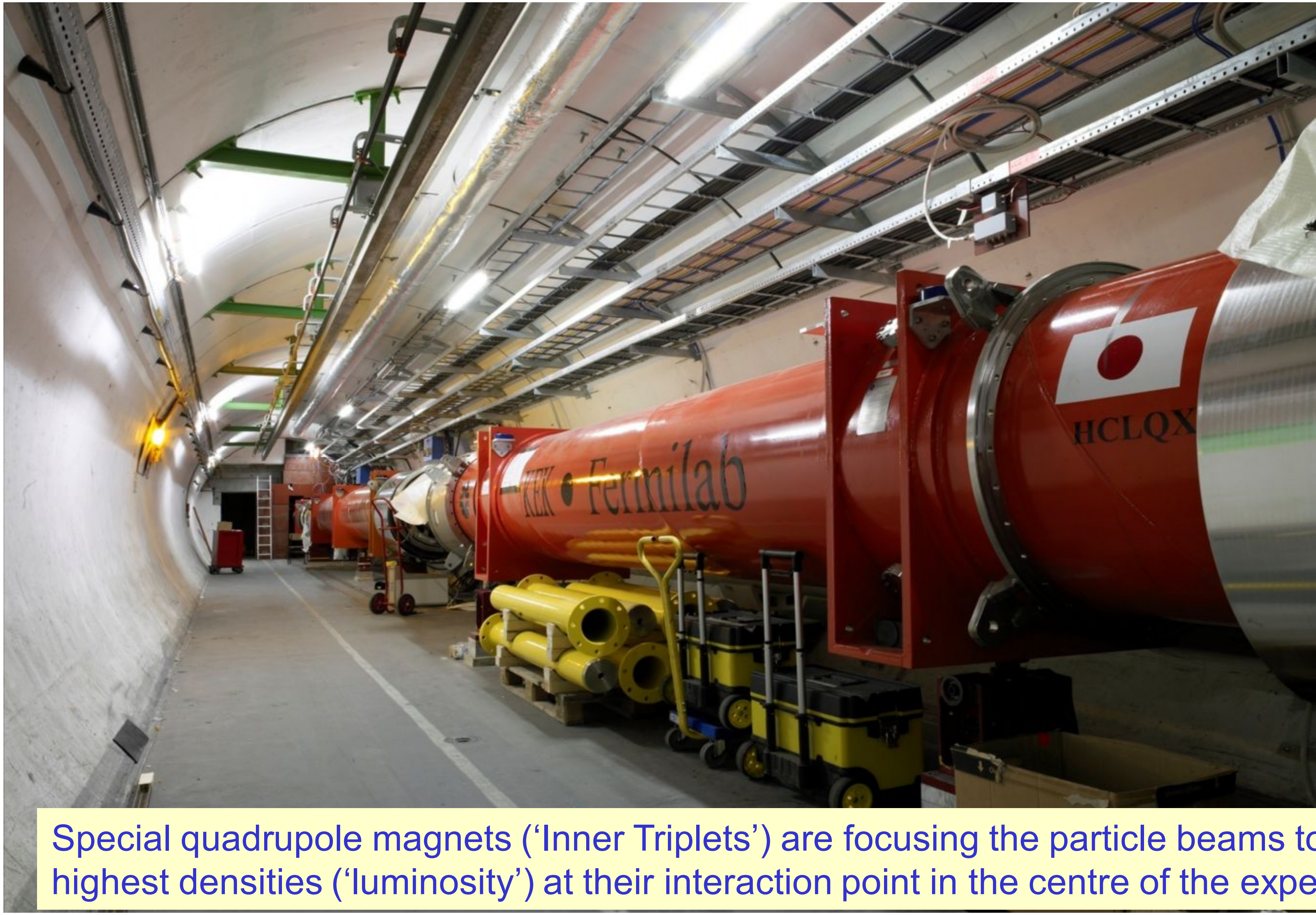




The acceleration is not such a big issue in pp colliders (unlike in e^+e^- colliders), because of the ~ $1/m^4$ behaviour of the synchrotron radiation energy losses [~ E^4_{beam}/Rm^4]

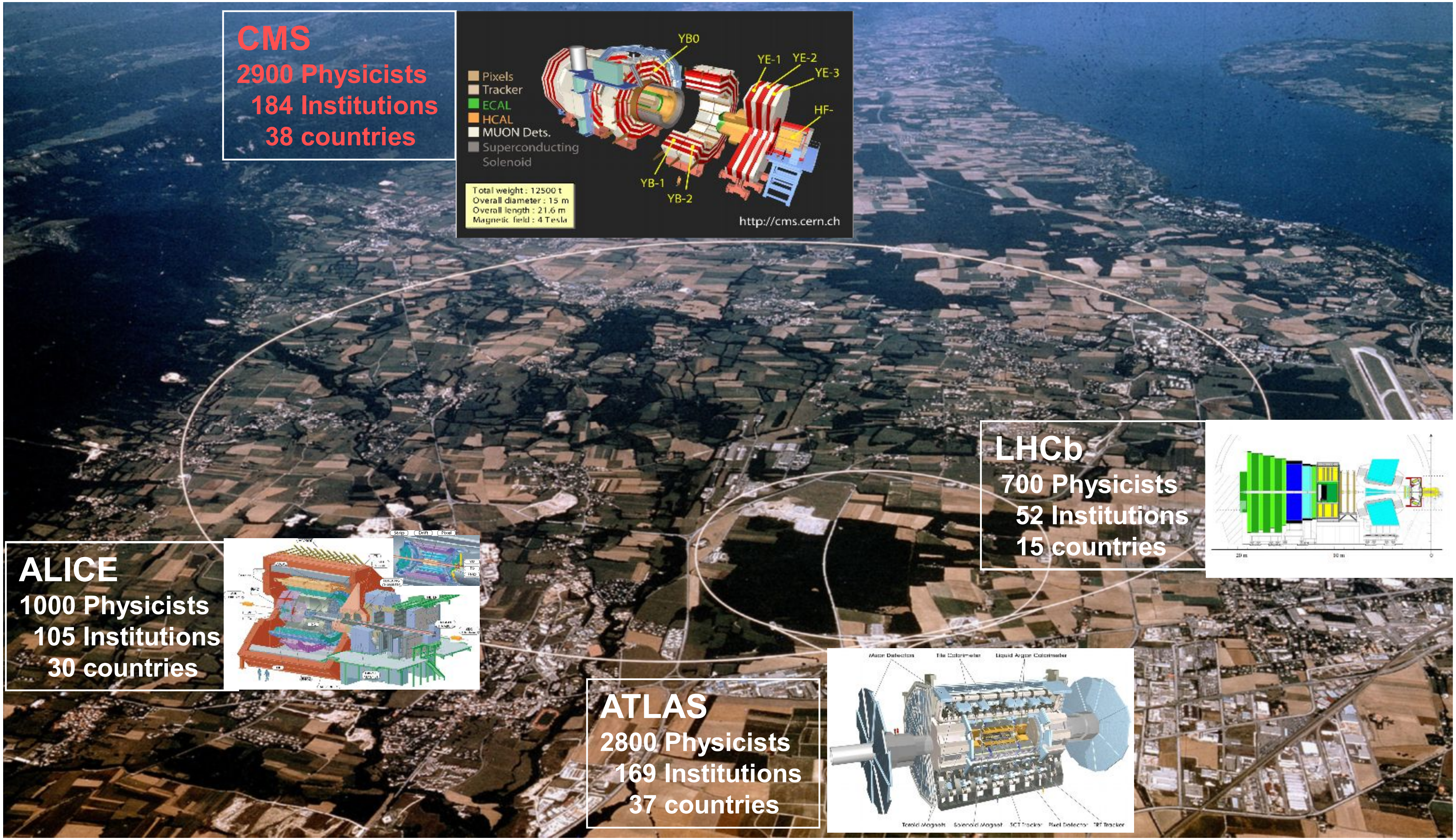
	LHC at 7 TeV	LEP at 100 GeV
Synchrotron radiation loss	6.7 keV/turn	3 GeV/turn
Peak accelerating voltage	16 MV/beam	3600 MV/beam

The LHC Accelerator



Special quadrupole magnets ('Inner Triplets') are focusing the particle beams to reach highest densities ('luminosity') at their interaction point in the centre of the experiments

The LHC Collaborations



CMS
2900 Physicists
184 Institutions
38 countries

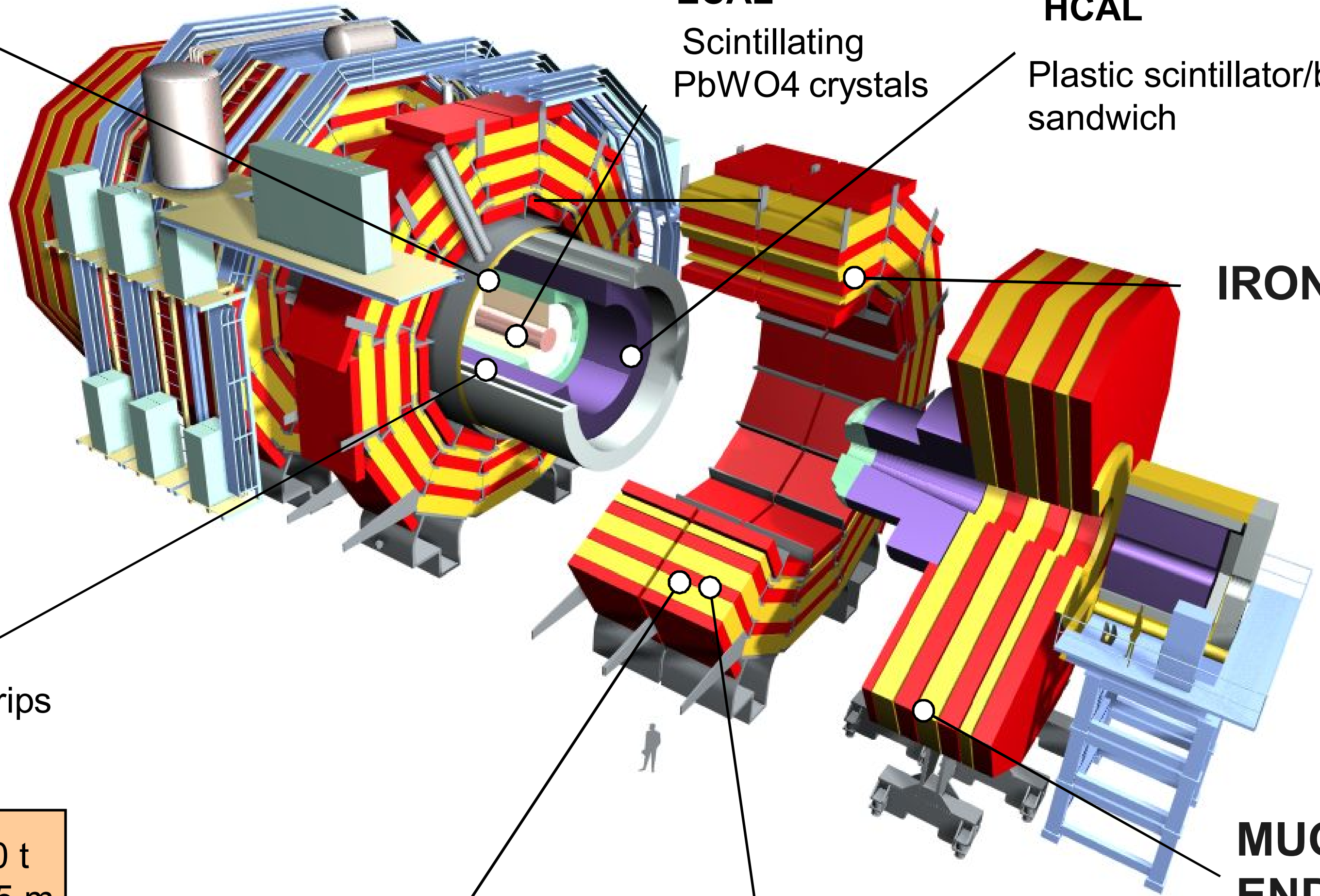
LHCb
700 Physicists
52 Institutions
15 countries

ALICE
1000 Physicists
105 Institutions
30 countries

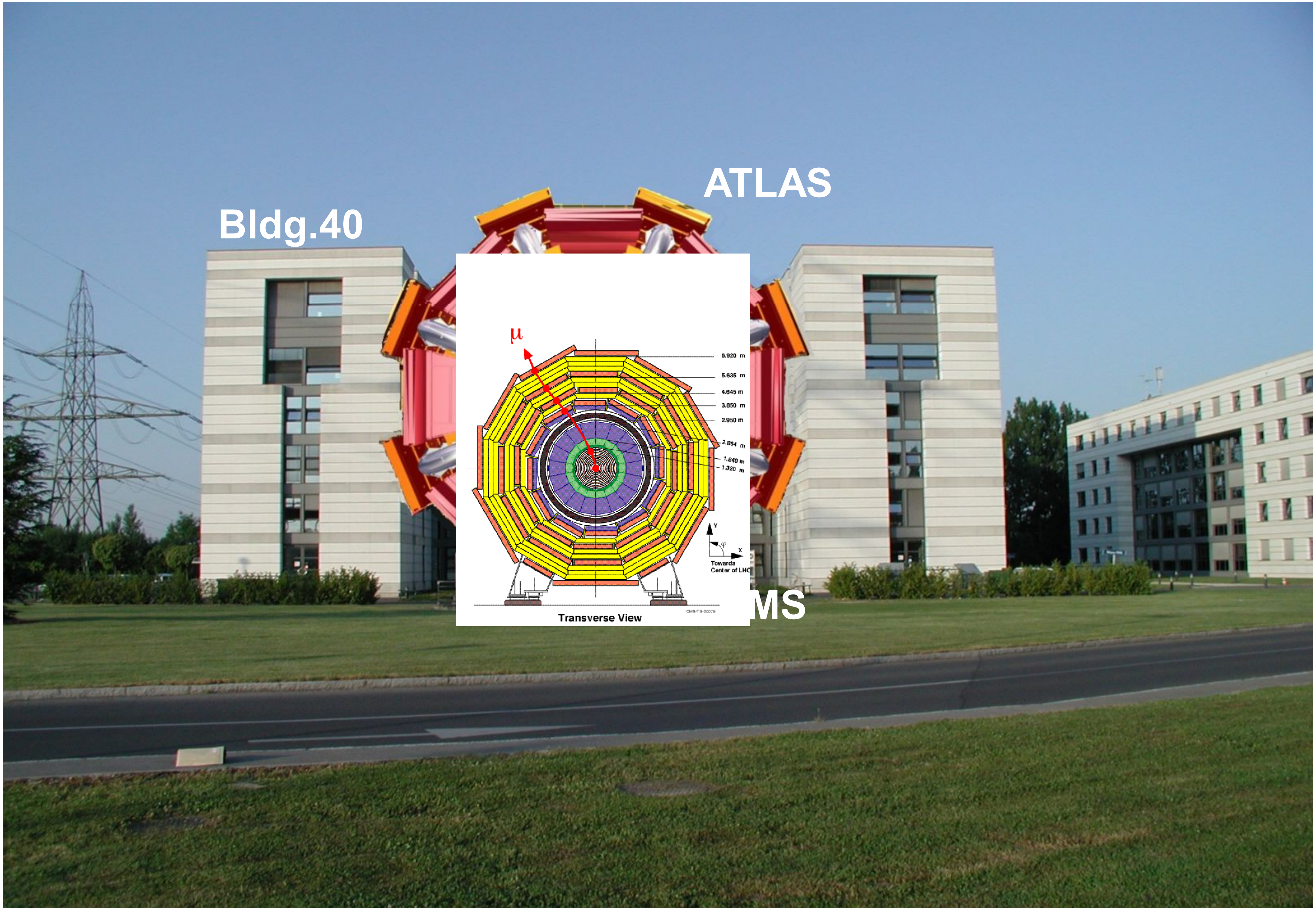
ATLAS
2800 Physicists
169 Institutions
37 countries

The CMS Detector

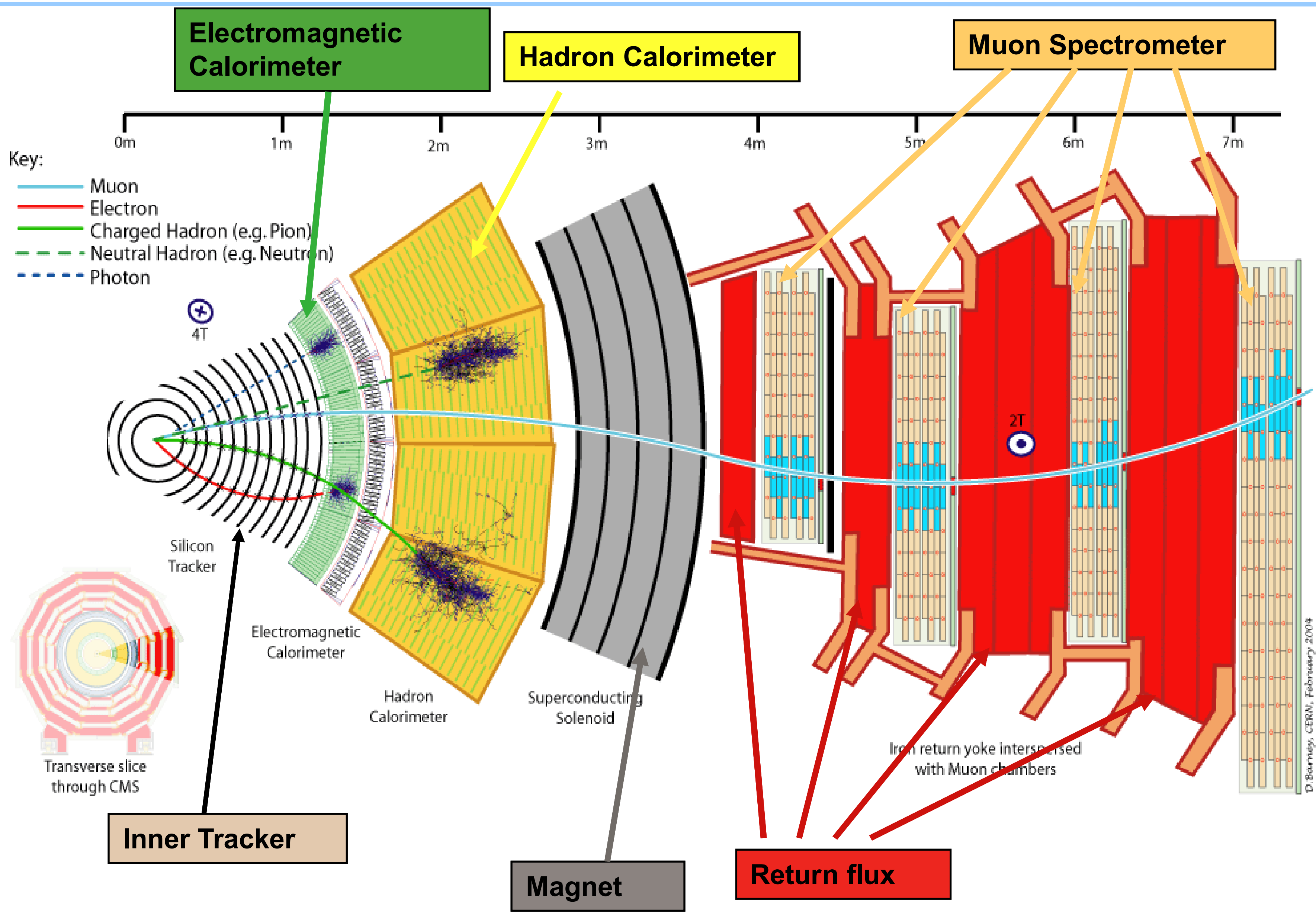
CMS
2900 Physicists
184 Institutions
38 countries



Total weight : 12,500 t
Overall diameter : 15 m
Overall length : 21.6 m
Magnetic field : 4 Tesla


ATLAS
Bldg.40
μ
6.920 m
5.635 m
4.645 m
3.850 m
2.950 m
2.864 m
1.840 m
1.320 m
Y
φ
X
Towards
Center of LHC
Transverse View
MS

A slice through CMS



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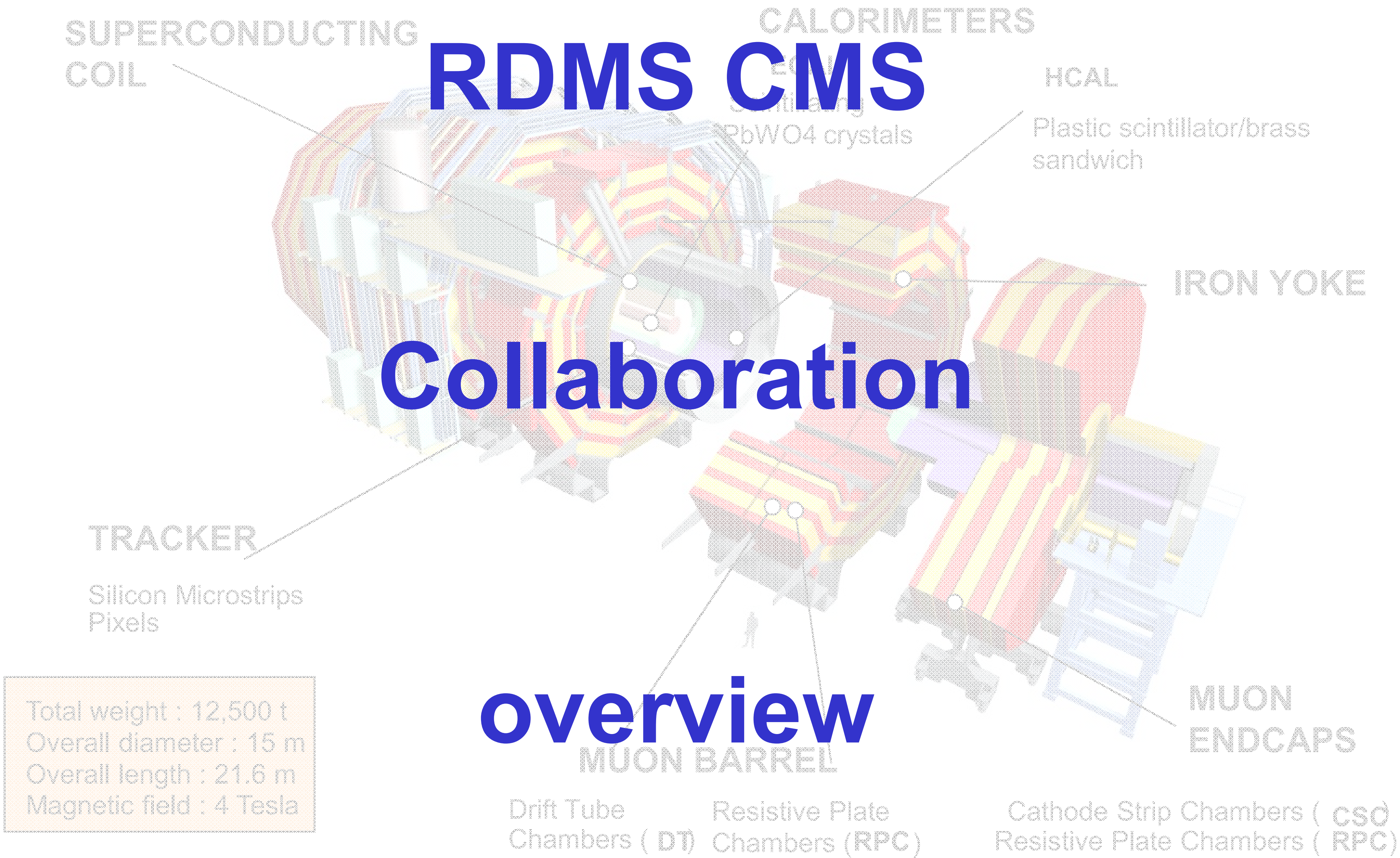
RDMS CMS Collaboration overview



RF Participation in CMS Project

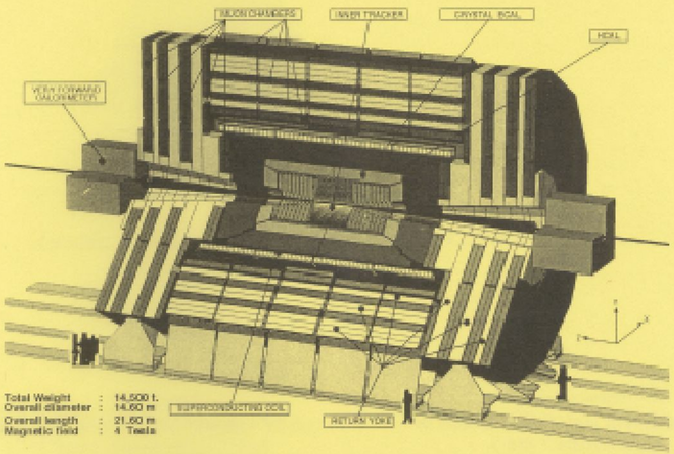
- Russia, JINR and JINR member-states participate in the CMS experiment as RDMS CMS Collaboration
- In fact RDMS physicists have participated in CMS since 1992 even before formal decision were made and agreements were signed.
- In RDMS there are about 300 scientists, many of them are in CMS from very beginning.
- Since about 15 years RDMS participates in the CMS Detector Construction according to the RDMS Project

RDMS Participation in CMS Project

Study of Fundamental Properties of the Matter in Super High Energy Proton-Proton and Nucleus-Nucleus Interactions at CERN LHC.
Participation in CMS Collaboration.

Project

Russia and Dubna Member States CMS Collaboration



Chairman
of Russia and Dubna Member States
CMS Collaboration Board

Victor Matveev

Spokesman
of Russia and Dubna Member States
CMS Collaboration

Igor Golutvin

Согласовано

Директор Государственного научного центра
"Институт Физики Высоких Энергий"
Академик РАН А.А.Логунов
"25" июля 1995

Директор Государственного научного центра
"Институт Теоретической и Экспериментальной Физики"
Профессор И.В.Чувило
"15" сент. 1995

Директор Государственного научного центра
"Институт Ядерных Исследований РАН"
Академик РАН В.А.Матвеев
"21" июля 1995

Директор Государственного научного центра
"Институт Ядерной Физики им. Г.И. Будкера СО РАН"
Академик РАН А.Н.Скринский
"19" IX 1995

Директор Научно-Исследовательского Института Ядерной Физики
Государственного Московского Университета
Профессор М.И.Панасюк
"14" сент 1995

Директор Государственного научного центра
"Петербургский Институт Ядерной Физики им. Б.П. Константинова РАН"
Профессор В.А.Назаренко
"___" ______ 1995

Директор Отделения Ядерной Физики
Физического Института им. П.Н. Лебедева РАН
Член-корреспондент РАН С.И.Никольский
"22" сентября 1995

Директор Объединенного Института Ядерных Исследований
Член-корреспондент РАН В.Г.Кадышевский
"21" июля 1995

RDMS CMS Project

CMS Document

96-85, 1995

In RDMS Collaboration are about 300 scientists

Russia

Russian Federation

- Institute for High Energy Physics, Protvino
- Institute for Theoretical and Experimental Physics, Moscow
- Institute for Nuclear Research, RAS, Moscow
- Moscow State University, Institute for Nuclear Physics, Moscow
- Petersburg Nuclear Physics Institute, RAS, St.Petersburg
- P.N.Lebedev Physical Institute, Moscow

Associated members:

- High Temperature Technology Center of Research & Development Institute of Power Engineering, Moscow
- Myasishchev Design Bureau, Zhukovsky
- Electron, National Research Institute, St. Petersburg

JINR

- Joint Institute for Nuclear Research, Dubna

Dubna Member States

Armenia

- Yerevan Physics Institute, Yerevan

Belarus

- Byelorussian State University, Minsk
- Research Institute for Nuclear Problems, Minsk
- National Centre for Particle and High Energy Physics, Minsk
- Research Institute for Applied Physical Problems, Minsk

Bulgaria

- Institute for Nuclear Research and Nuclear Energy, BAS, Sofia
- University of Sofia, Sofia

Georgia

- High Energy Physics Institute, Tbilisi State University, Tbilisi
- Institute of Physics, Academy of Science ,Tbilisi

Ukraine

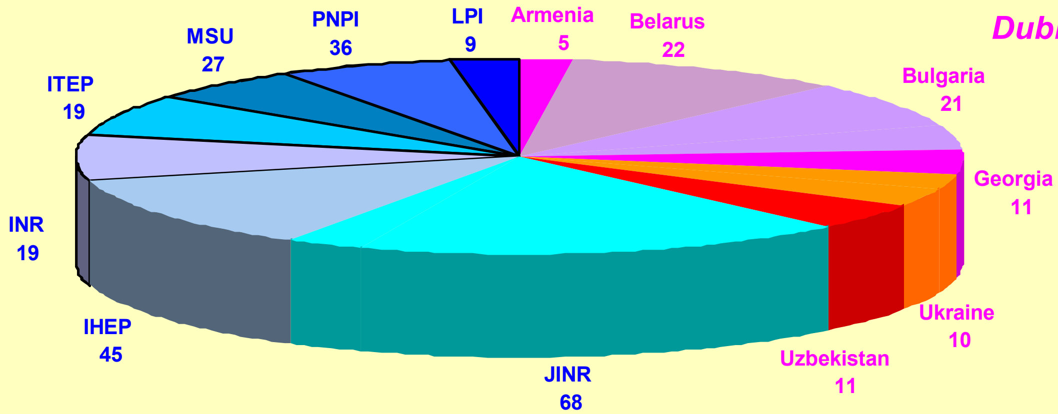
- Institute of Single Crystals of National Academy of Science, Kharkov
- National Scientific Center, Kharkov Institute of Physics and Technology, Kharkov
- Kharkov State University, Kharkov

Uzbekistan

- Institute for Nuclear Physics, UAS, Tashkent

JINR, Dubna - 68

Dubna Member States - 80



Russian Federation - 155

CMS members:

countries	7
institutions	20
scientists	303
students	32

Associated members:

institutions	3

Principles and Strategy of RDMS CMS

Main principles:

✓participation of Institutions in the CMS experiment as independent scientific groups and;

✓unification of technical and financial contributions and obligations of different Institutions as the joint Collaboration deliverables to experiment.

Main aims of the Collaboration strategy:

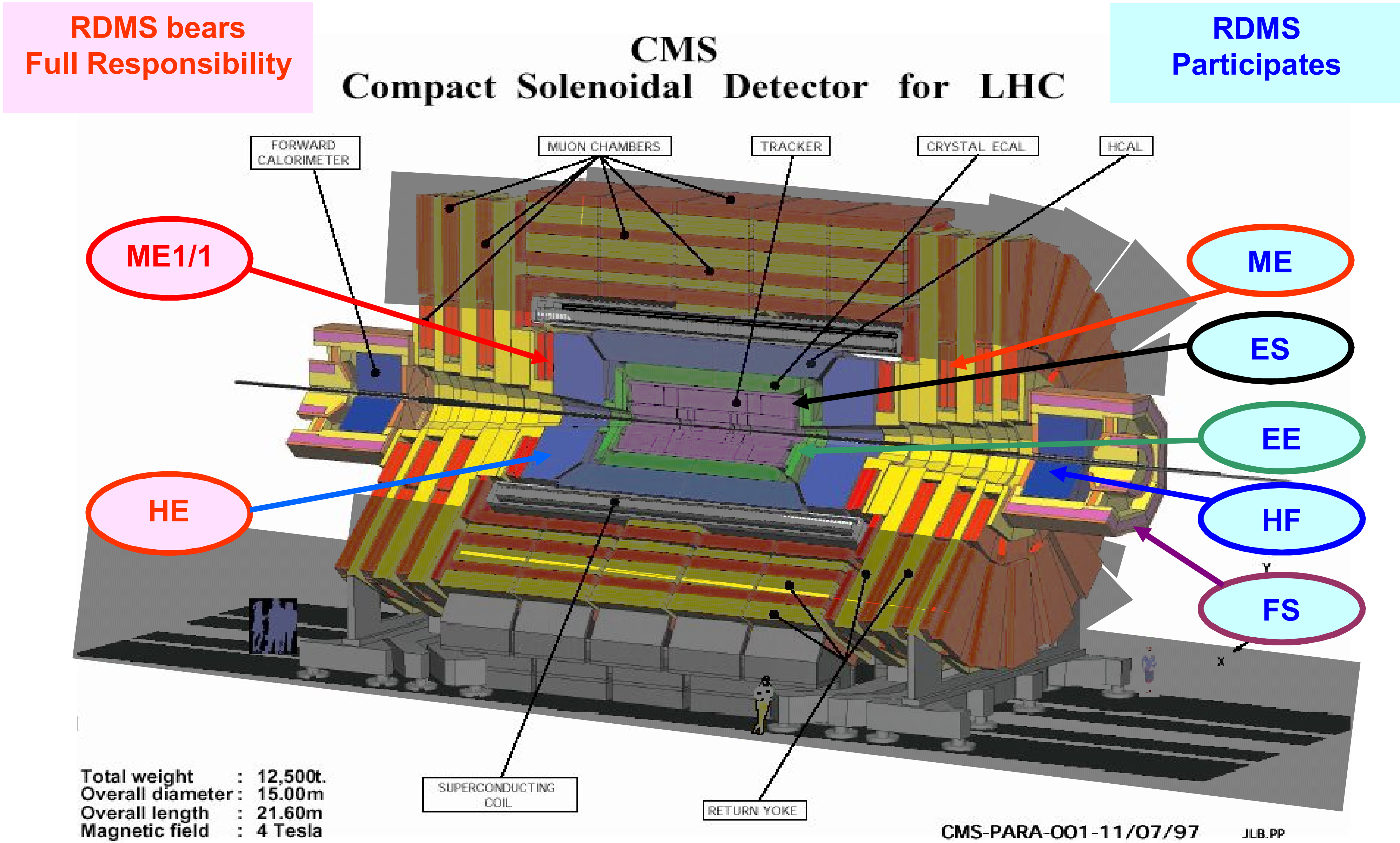
✓unification of the efforts of many groups from different institutions and countries;

✓concentration of efforts at several well defined CMS sub-systems (for example Endcap) and

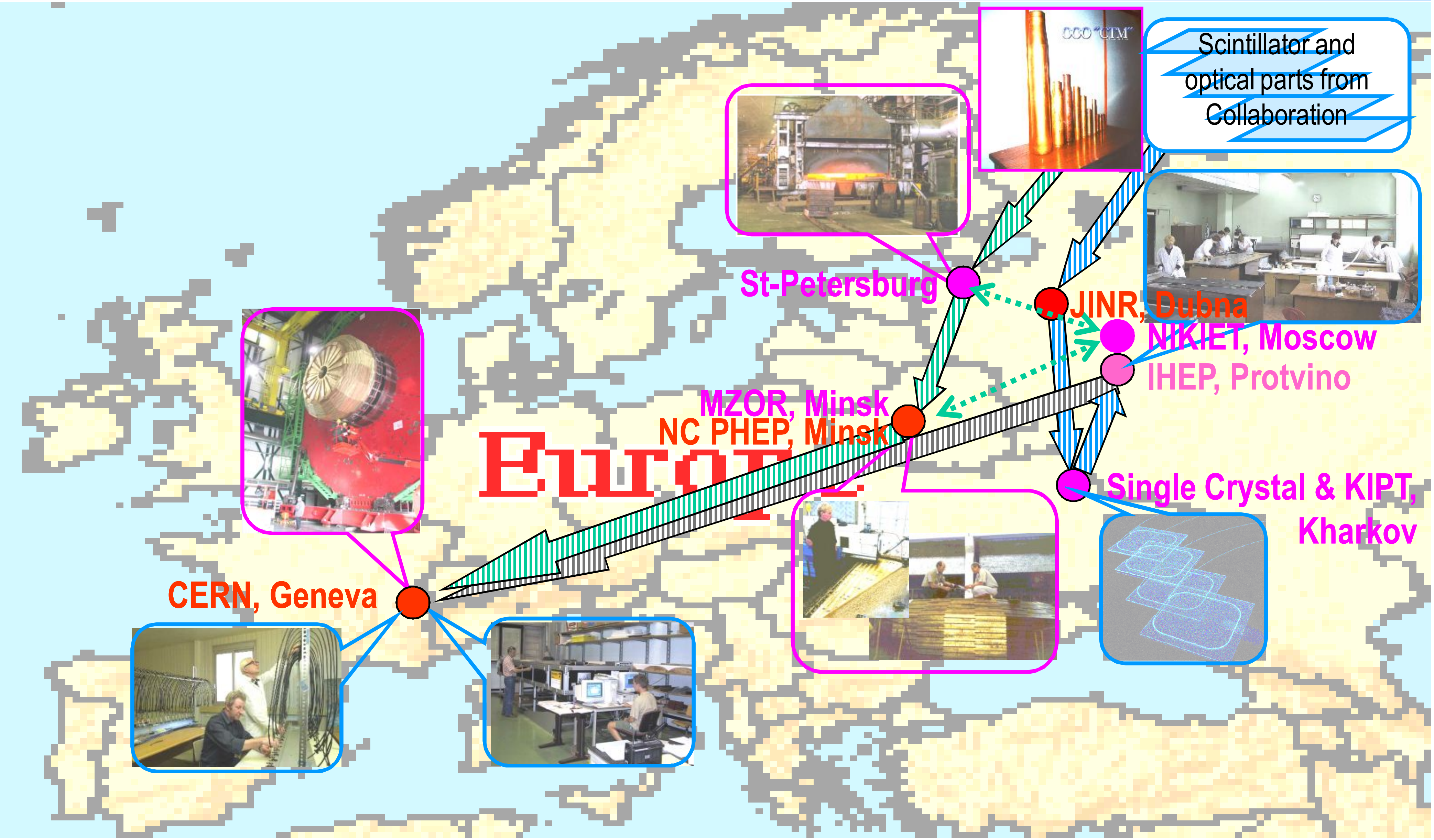
✓ broad involvement of Industry of participating States

Concerning to such participation the three-parties Agreements between Member State, JINR and CERN are very important.

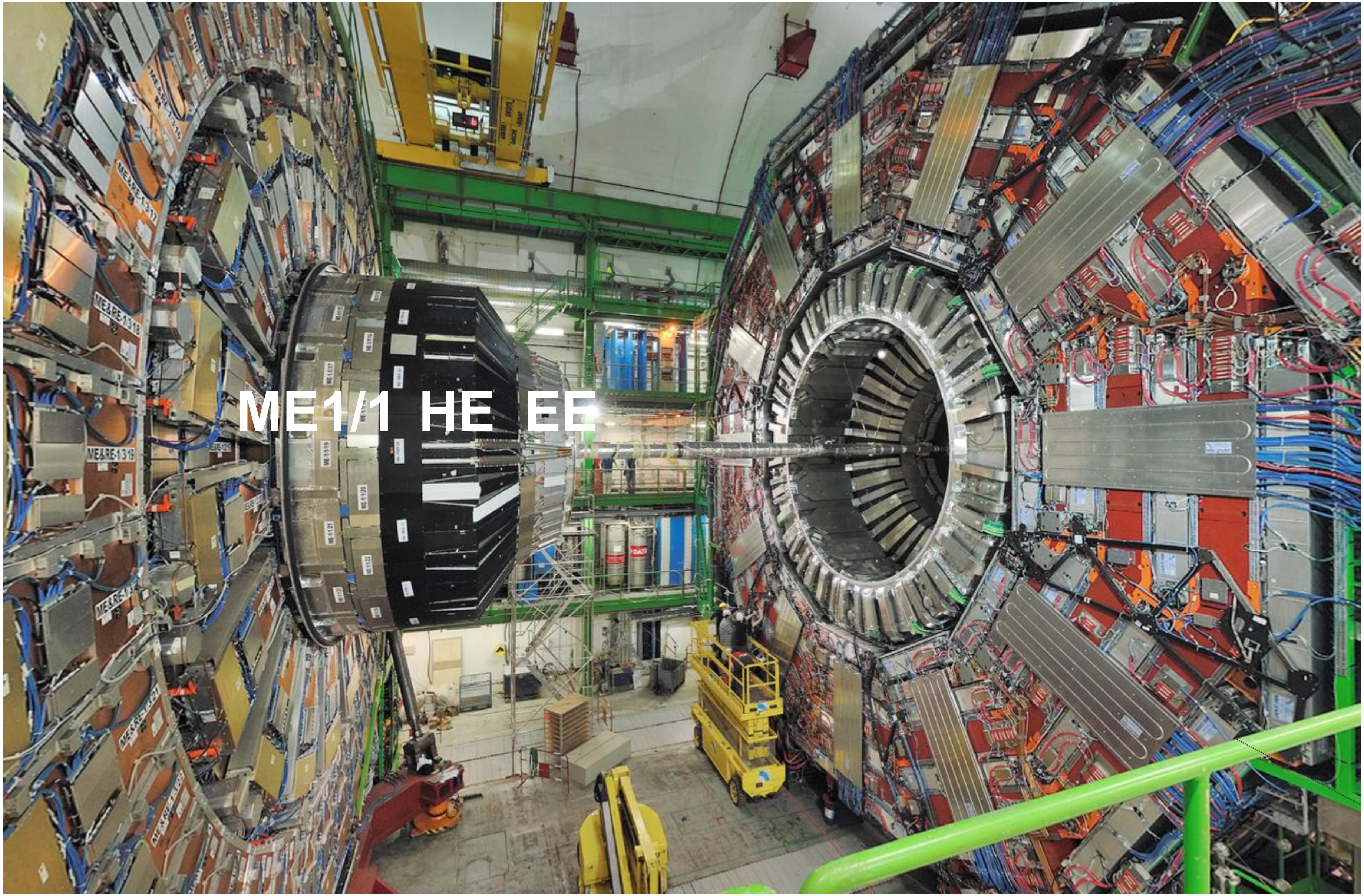
Main RDMS Obligations in CMS Construction



Construction of the Endcap Hadron Calorimeters,HE



Plus End : EE, HE, ME1/1



Minus End: EE, HE, ME1/1

Final Closure

Readiness of CMS for physics

Start-up

CMS detector have shown TDR performance during Cosmics and LHC synchronization Runs

Strategy to prepare CMS for physics

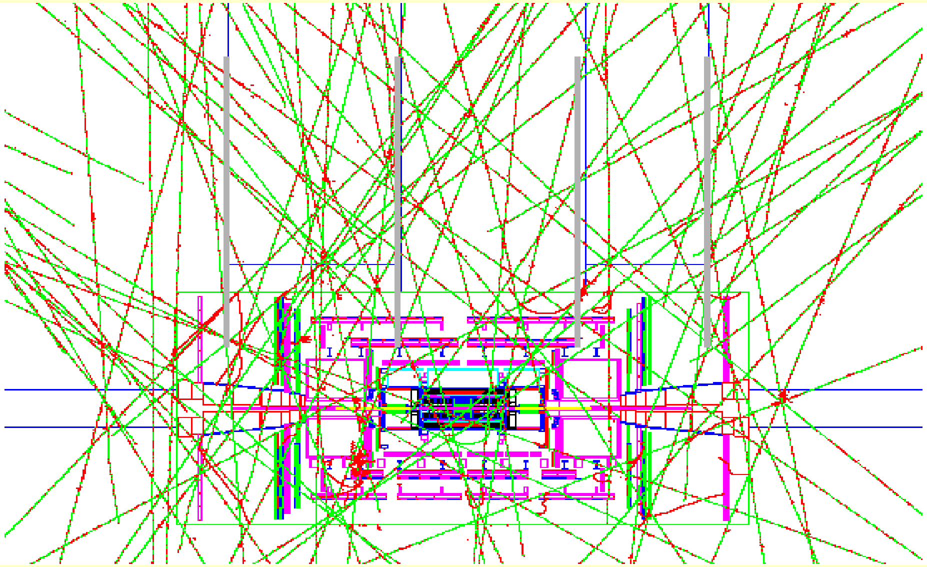
- Strict **quality controls** during detector construction in order to meet performance requirements
- 15 years long **test beam** campaign in order to understand (and calibrate large parts of the detectors) and validate/tune software tools
- Detailed simulation of realistic detector including misalignments, material non-uniformities, etc. in order to test and validate calibration/alignment strategies
- **Commissioning of completed detectors in the underground caverns using cosmic rays and "LHC beams"**
- Commissioning and calibration **with physics**
- Understanding **SM backgrounds** to New Physics
- **Discovery of New Physics …**

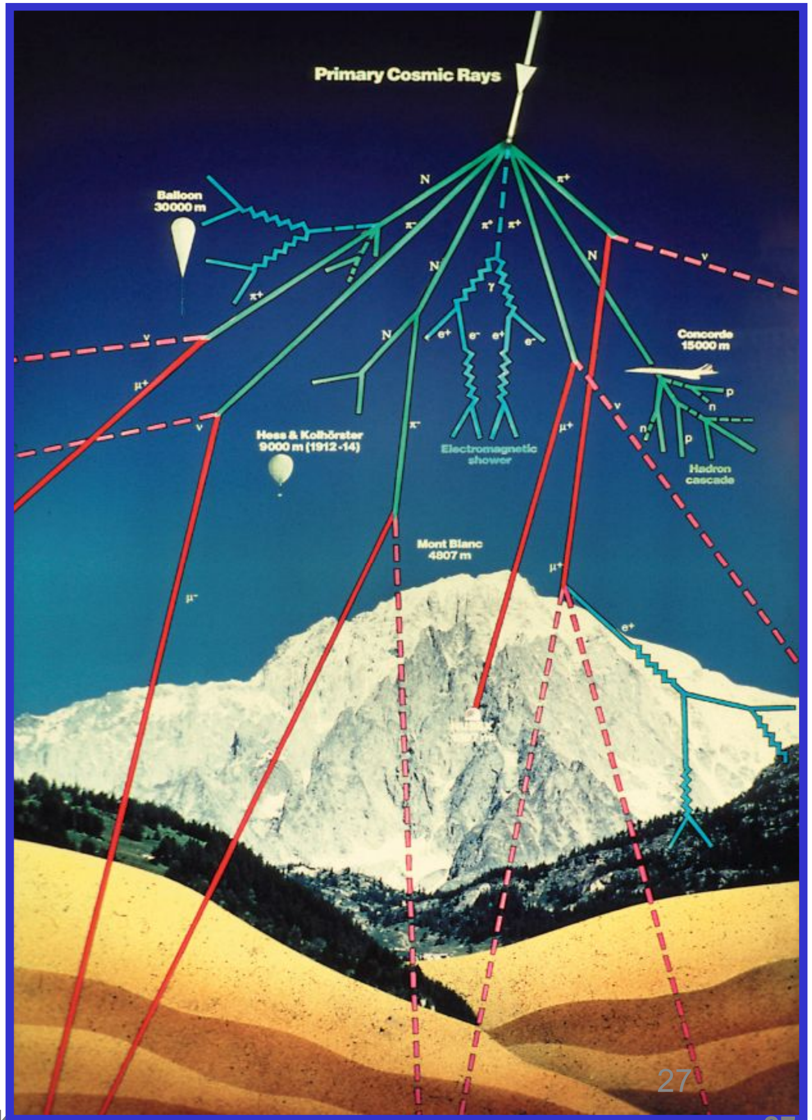
Commissioning with cosmics in the cavern

(the first real data in situ…)

Started more than three years ago. Very useful to:

- Run an increasingly more complete detector with final trigger, data acquisition and monitoring systems. Data analyzed with final software
- Shake-down and debug the experiment in its final position → fix problems
- Perform first calibration and alignment studies





Rate of cosmics in : 0.5-100 Hz
(depending on sub-detector size and location)

CMS Cosmic Run

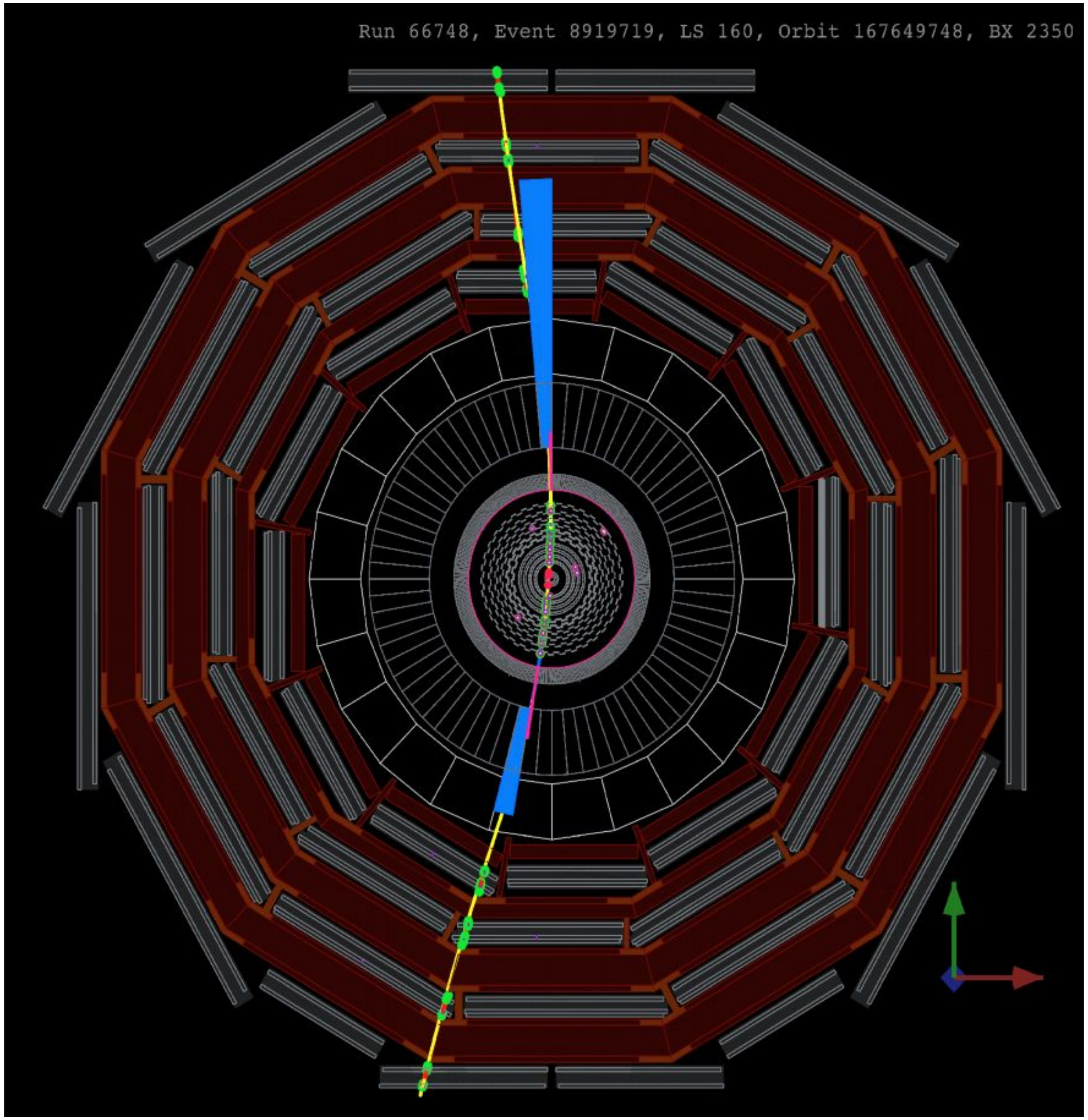
CRAFT:

Cosmics Run at Four Tesla

Oct-Nov'08: Ran CMS for 6 weeks continuously to gain operational experience

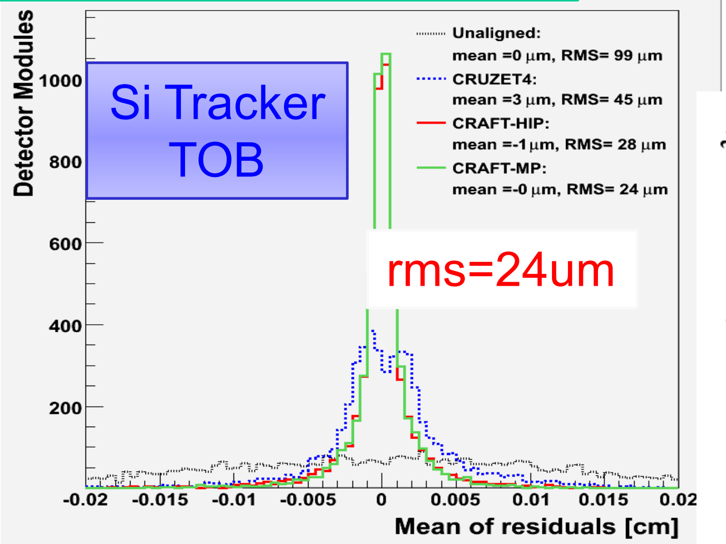
Collected 300M cosmic events with tracking detectors and field (≈ 70% live-time). About 400 TB of data distributed widely

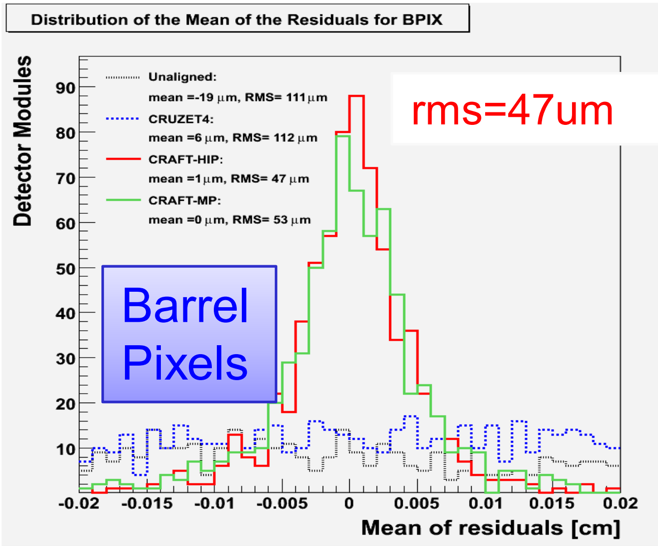
- 87% have a standalone muon track reconstructed
- 3% have a global muon track with strip tracker hits (~7M)
- 3-4×10^{-4} have a track with pixel hits (~70k)



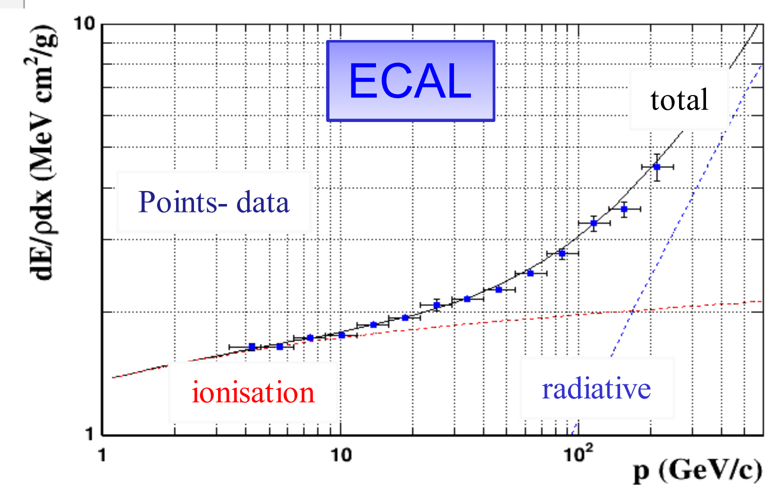
CMS Cosmic Run

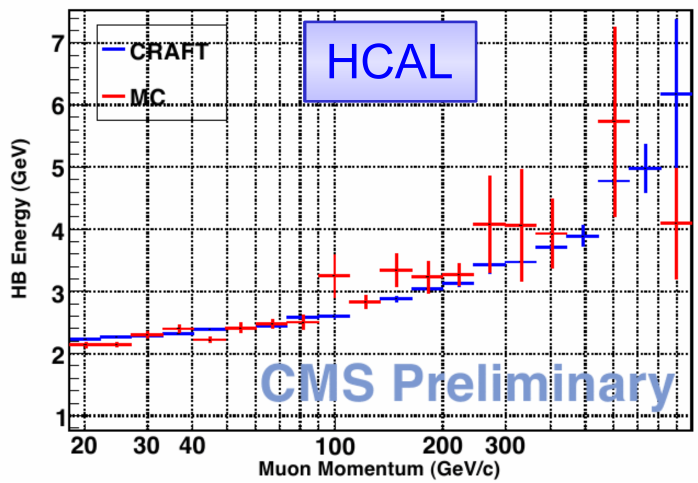
Alignment in Inner Tracker



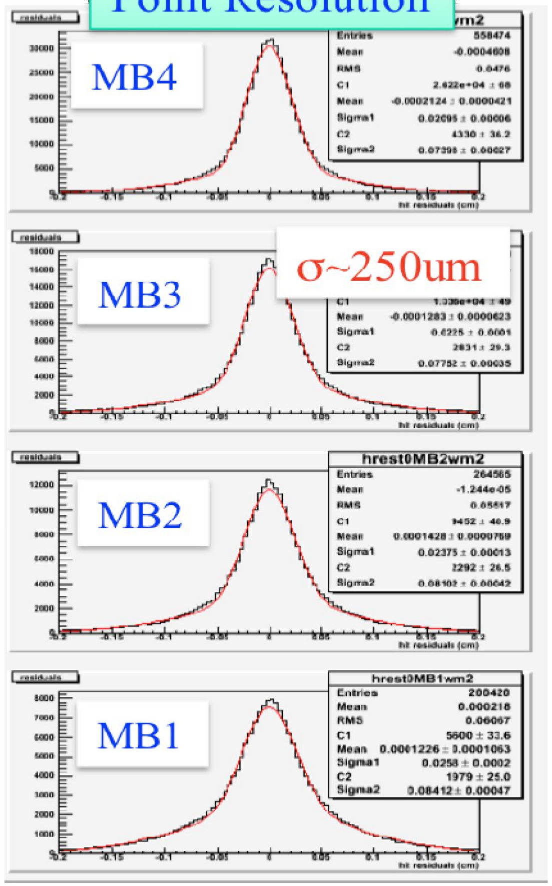


Energy deposited by muons



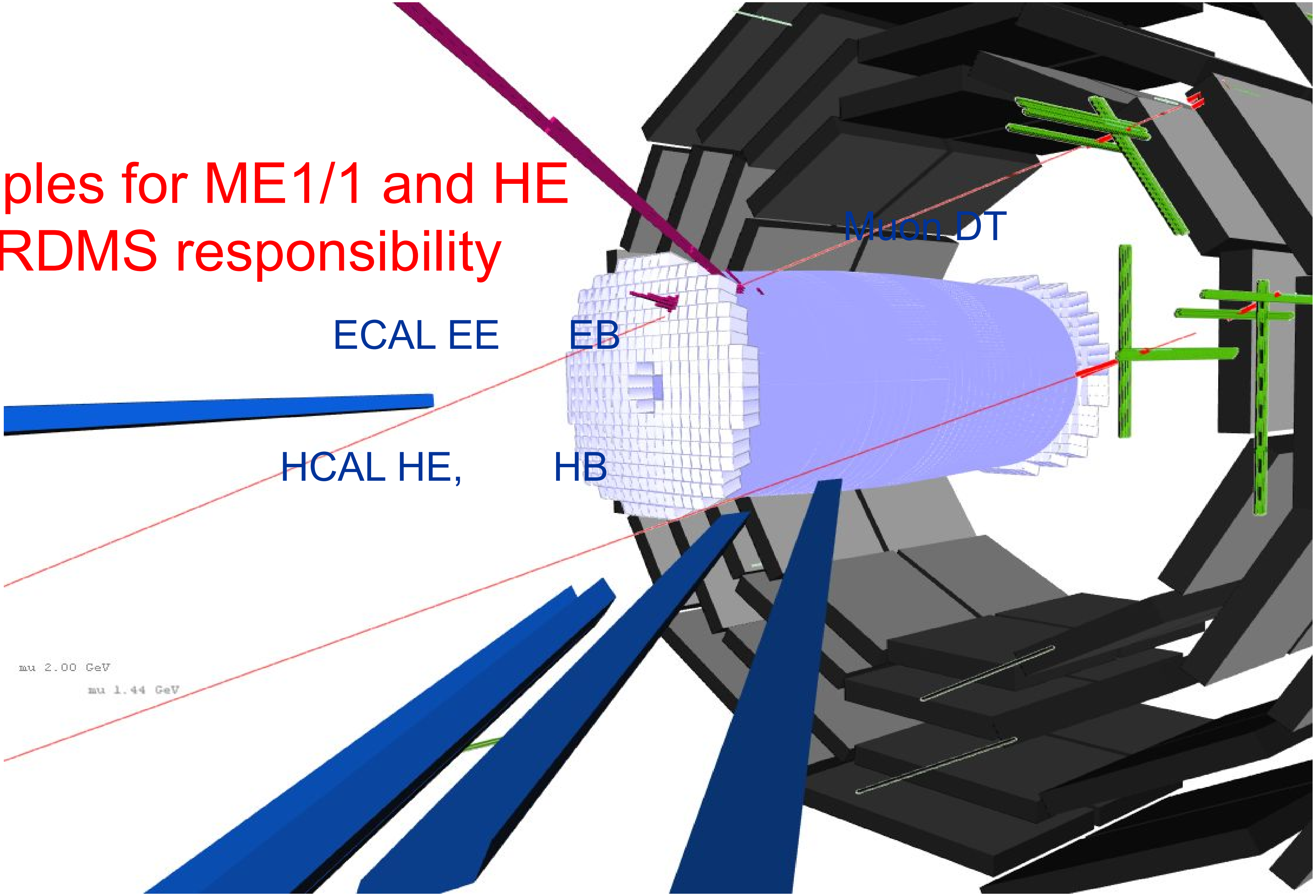


Muon Chambers Point Resolution



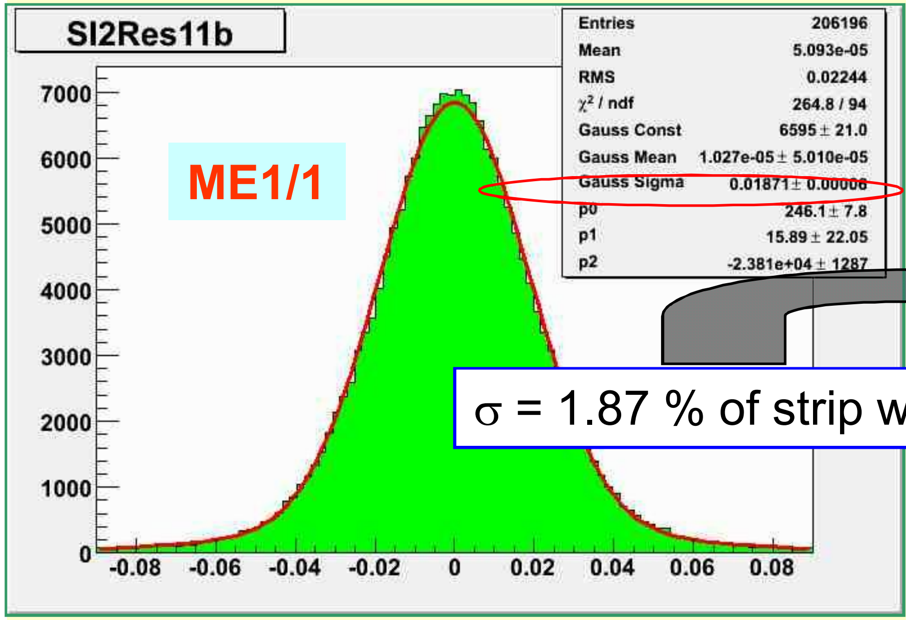
CRAFT: Cosmic Ray Event

Two examples for ME1/1 and HE under full RDMS responsibility



CRAFT: CSC Spatial Resolution

ME1/1 Example, ME2/1 and ME3/1 have also been studied



σ = 1.87 % of strip width

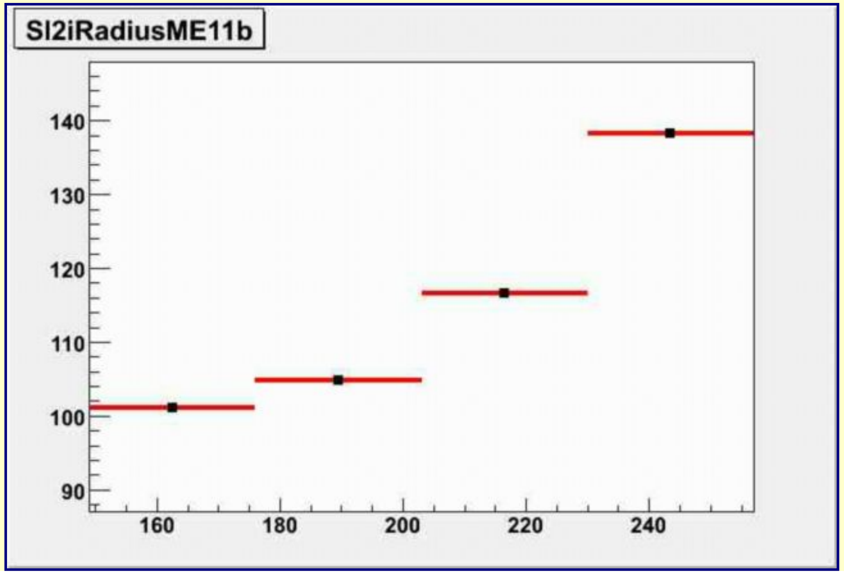
ME1/1 Spatial Resolution after additional cross-talk corrections (see 08.12.08 report at CMS Week)

σ(ME1/1) = 112 μm **per Layer**

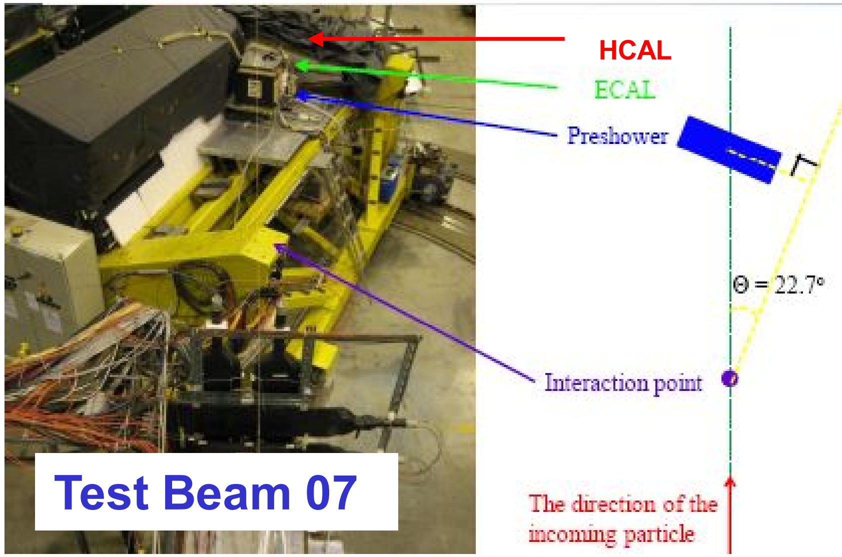
i.e.:

σ(ME1/1) ~ 50-55 μm **per Station**

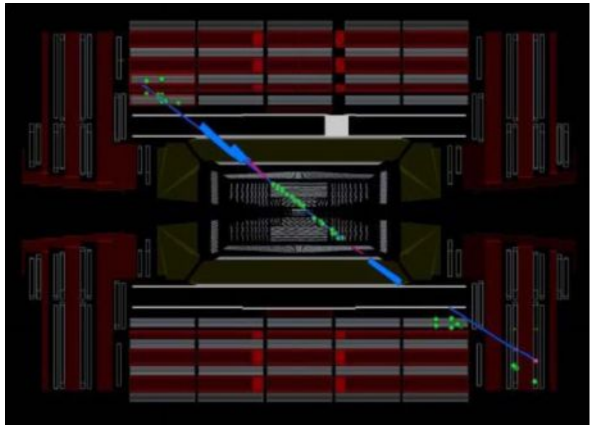
Resolution versus Radius



HE Calibration for the First LHC day



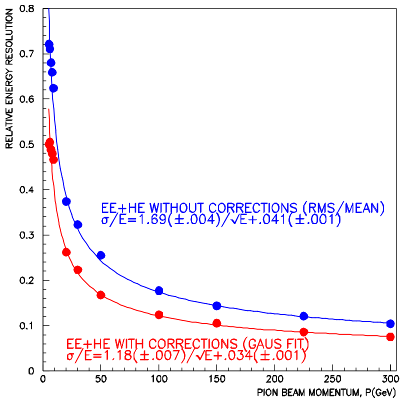
CRAFT08



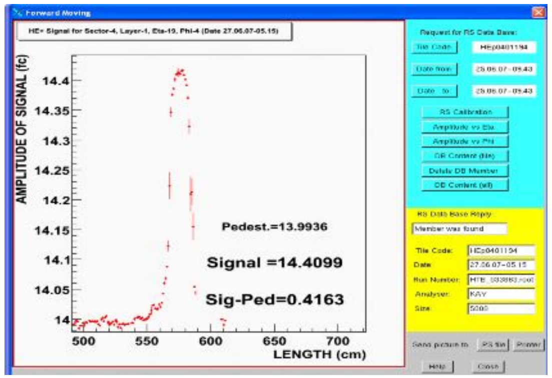
CERN

RAW Data

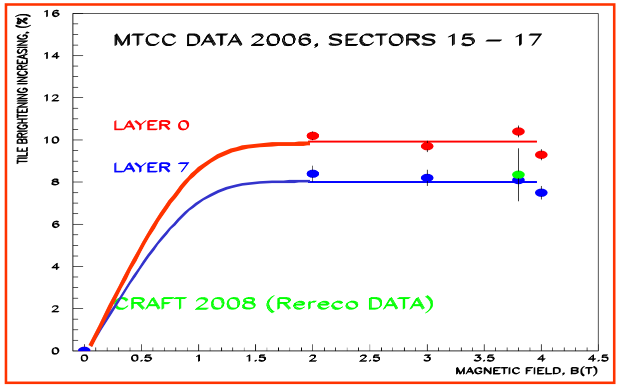
HE Resolution



HE Sourcing

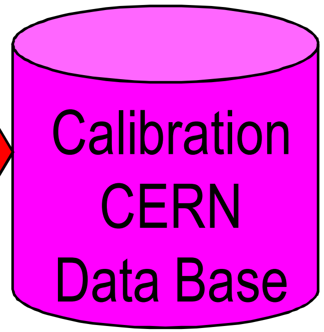


Scintillator brightening in magnetic filed



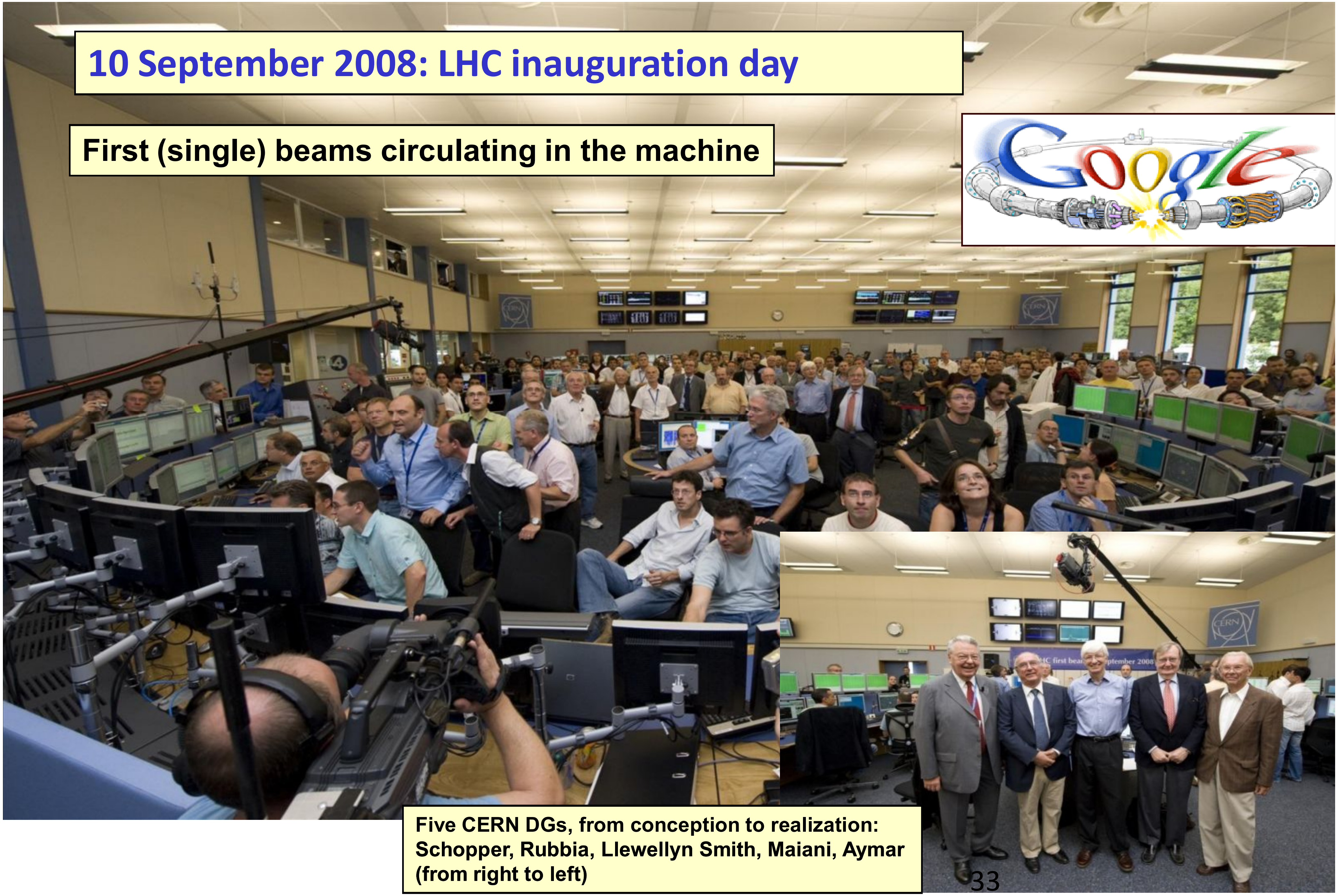
Dubna

HE calibration constants



10 September 2008: LHC inauguration day

First (single) beams circulating in the machine



Five CERN DGs, from conception to realization: Schopper, Rubbia, Llewellyn Smith, Maiani, Aymar (from right to left)

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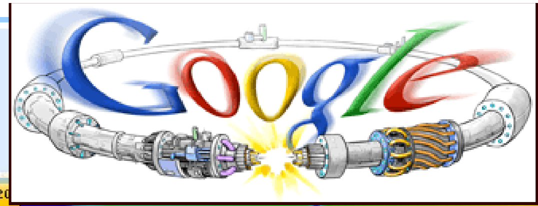
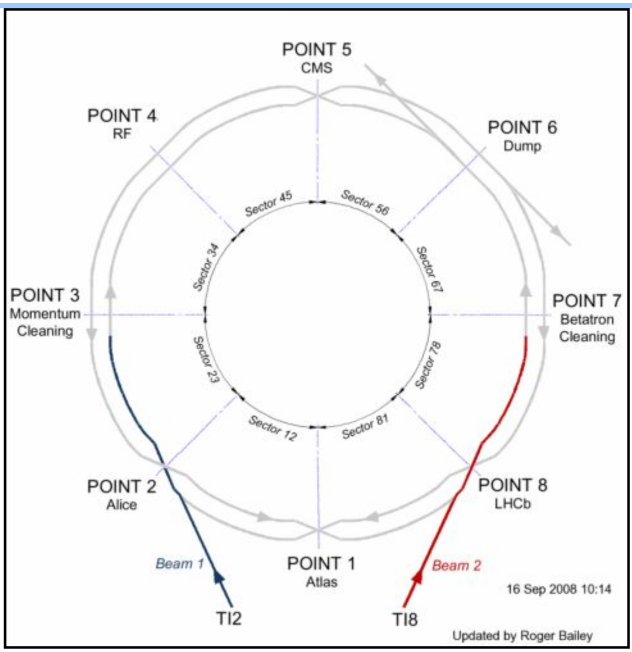
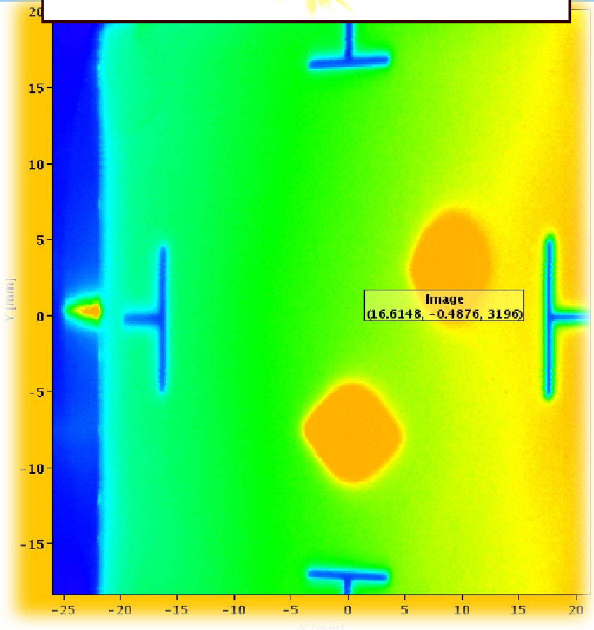
First Turn! 10 Sept 2008





10:30 am
Two beam spots on a screen near ALICE indicate that Beam 1 has made 1 turn



10:30 : Beam 1 (clockwise) around the ring (in ~ 1 hour), makes ~ 3 turns, then dumped

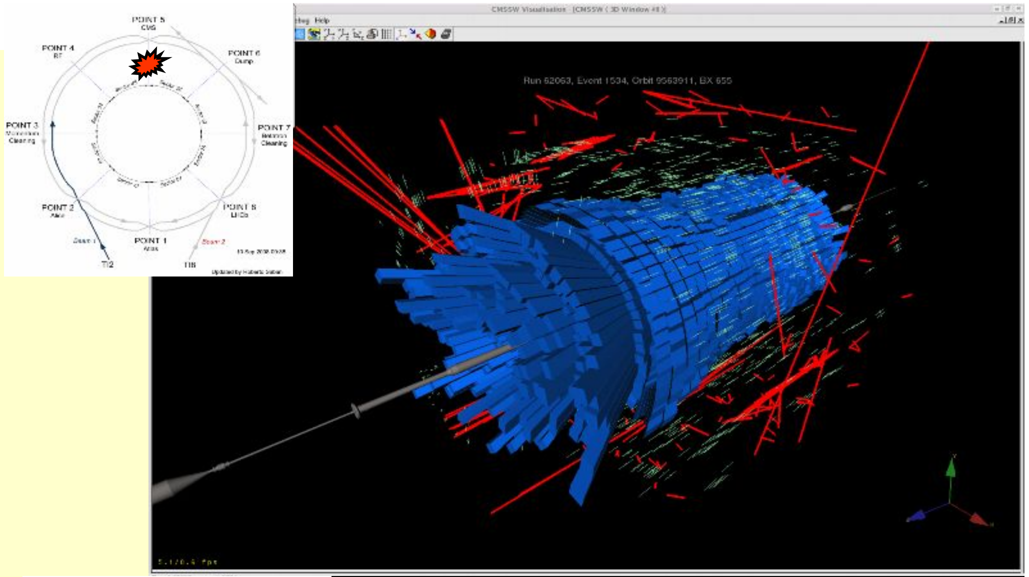
15:00 : Beam 2 (counter-clockwise) around the ring, makes 3-4 turns, then dumped

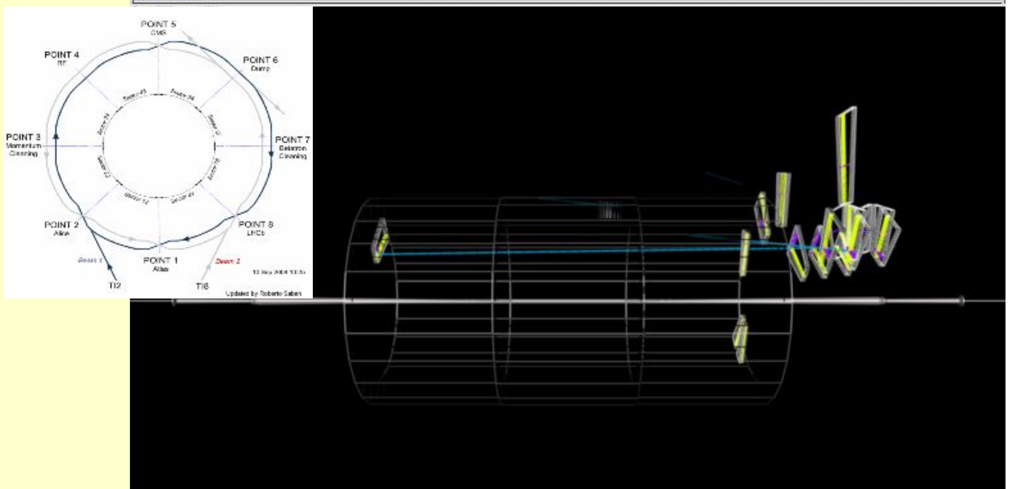
22:00 : Beam 2 circulates for hundreds of turns …

Beam Energy: 450 GeV, Beam Intensity: 2 x 10^9 protons per bunch

CMS Detector: Start-up on 10 September 2008

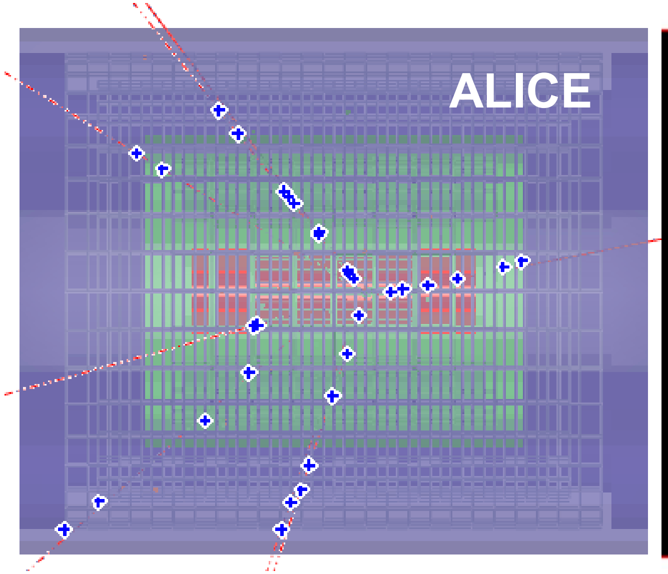
- **Inner Endcaps including endcap hadron calorimeter HE and Forward Muon Station ME1/1 of full RDMS responsibility demonstrated an efficient operation**
  - –with beam dumped on collimator (on top) First Beam-Induced events in hadron calorimeters seen at CMS
  - –and beam halo (on bottom) in endcap muon system

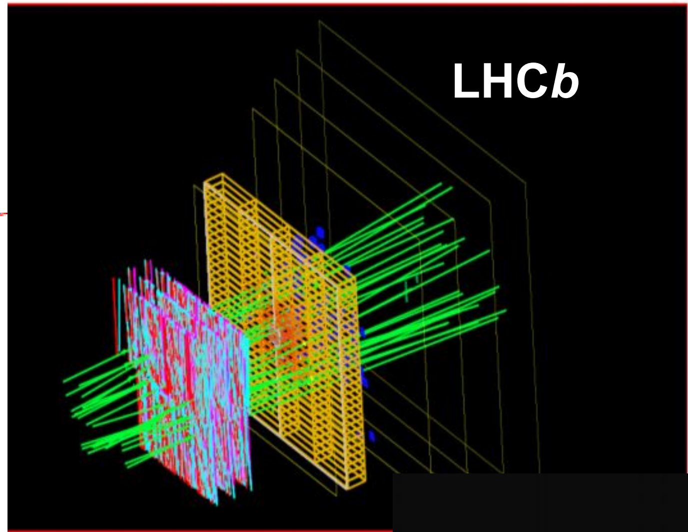


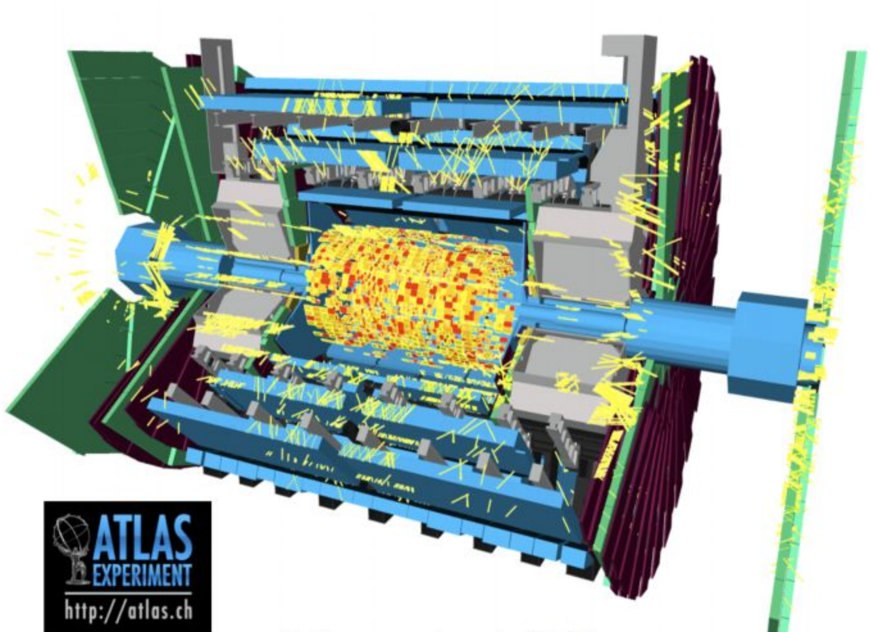


Detectors of RDMS responsibility are ready for data-taking

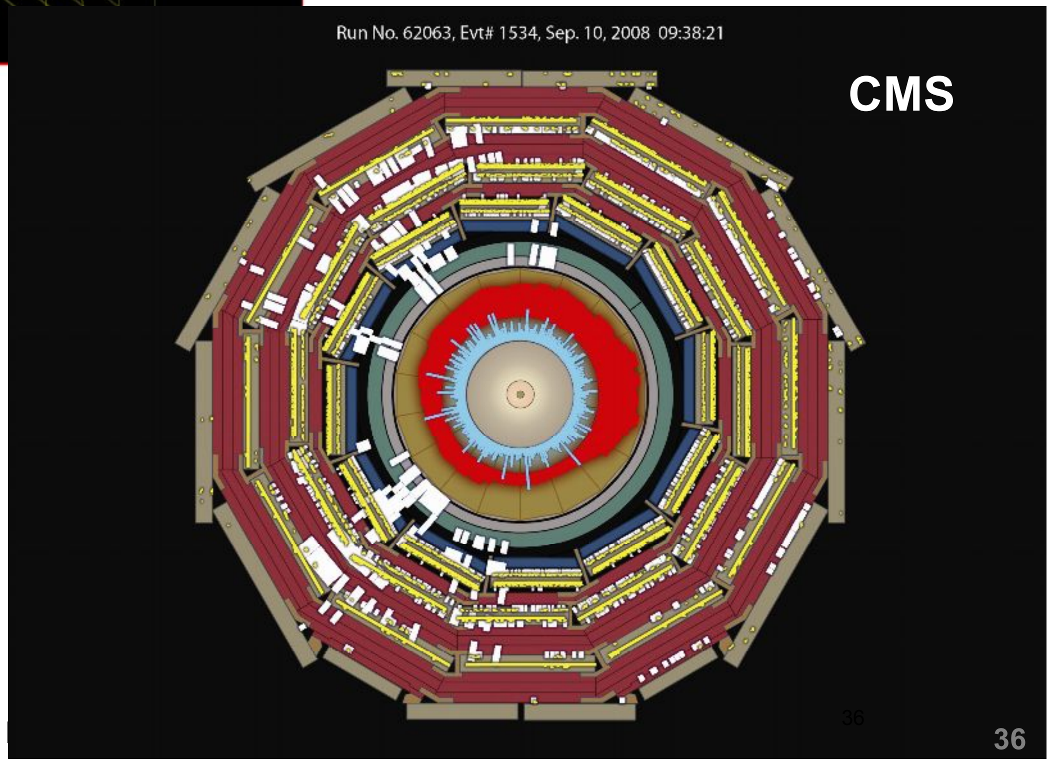
First LHC Beam: Events Recorded by 4 Experiments







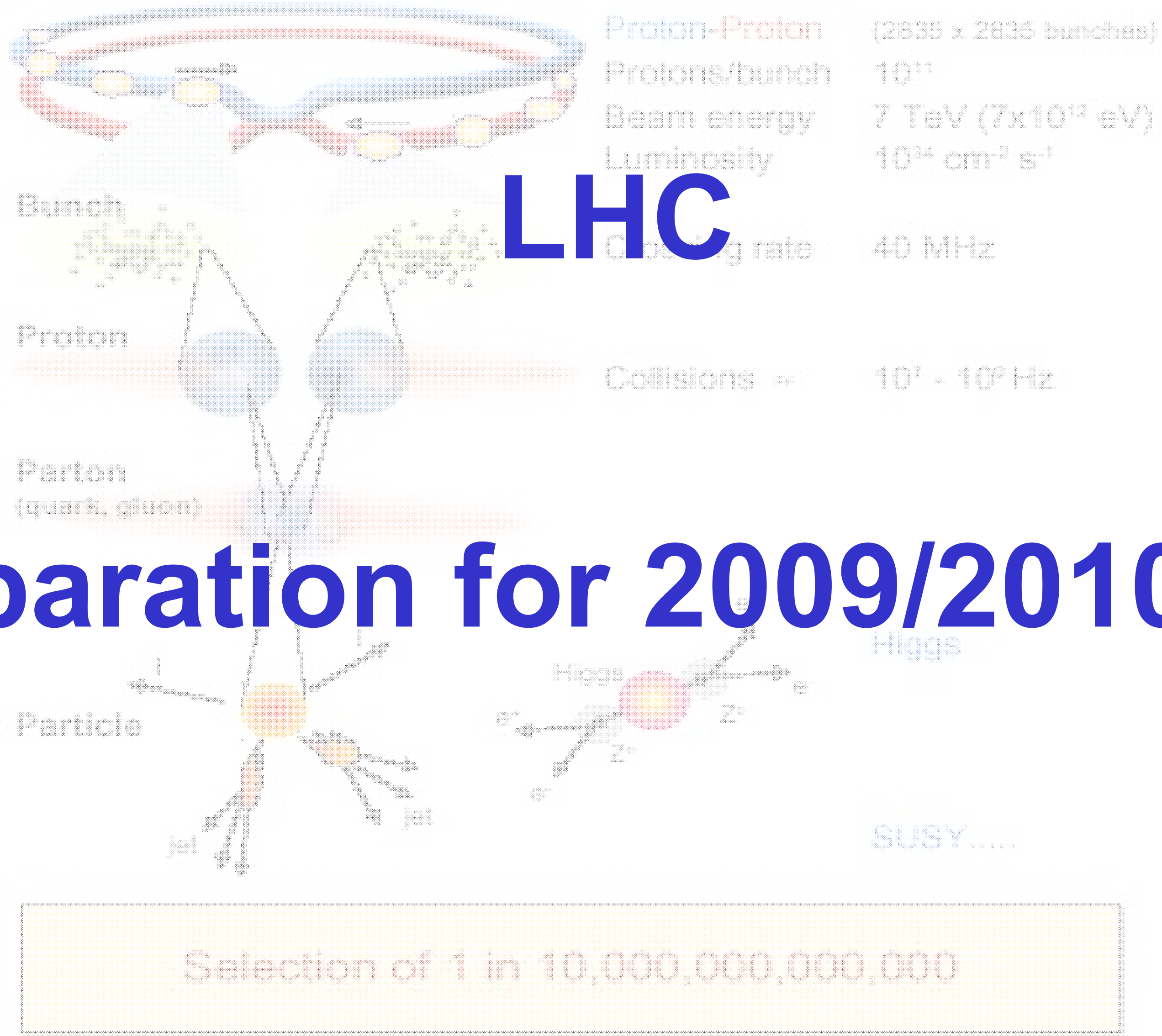
first beam event seen in ATLAS



4

LHC

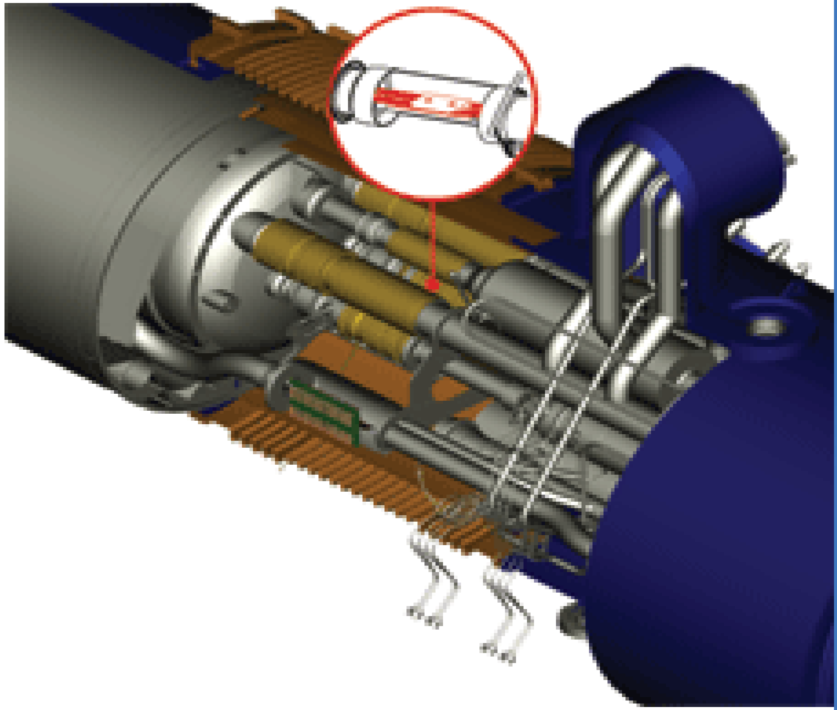
preparation for 2009/2010 Run

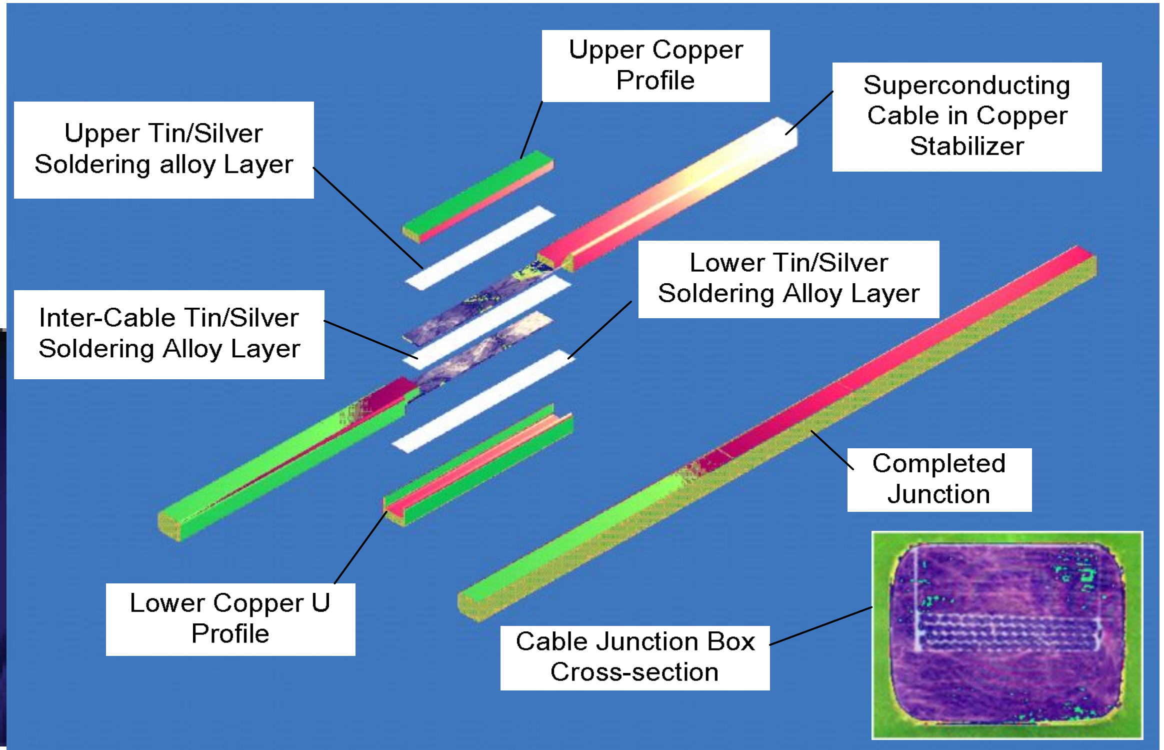


Incident on 19th September 2008

The LHC decided to use a few days of down-time due to a 'standard' power converter fault to finish work on powering tests in sector 3-4 (all other sectors were tested to 5.5 TeV equivalent currents)

At 8.7 kA (corresponding to ~ 5.1 TeV), a resistive zone appeared in the superconducting busbar between quadrupole Q24 and the neighboring dipole (probably due to a bad welding 'splice')





Incident on 19th September 2008

- ***Most likely, an electrical arc developed, which punctured the He enclosure***

- ***Large amounts of He gas were released into the insulating vacuum of the cryostat:***

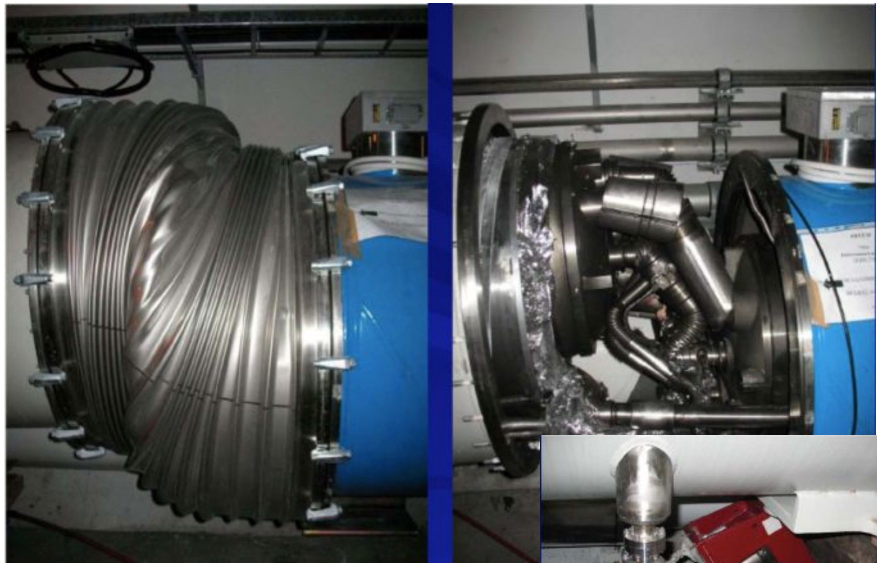
- Self actuating relief valves opened releasing a large amount of He in the tunnel, but could not handle huge pressure

- Shock wave within 2 cells (about 300 m)

- Collateral mechanical damage in part of this sector

- 53 magnets have been removed to be repaired and reinstalled (2 other magnets will be replaced)

- Damaged interconnects and super-insulation
- Perforated beam tubes → pollution of the vacuum system with soot and debris from super insulation

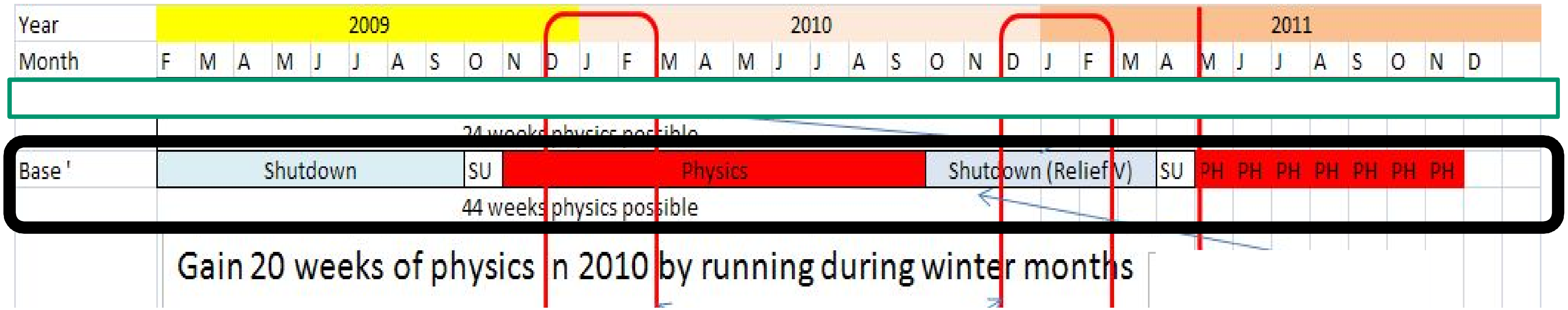


Several quadrupoles
Displaced by up to 50 cm

LHC repair and restart

- *The four warm sectors will be equipped with extra pressure relief valves (PRVs) on all dipole cryostats.*
- *The four cold sectors will get extra PRVs on all short straight section cryostats. This can be done with the sectors cold and is adequate for 5 TeV operation.*
- *The quench protection system will be upgraded everywhere to cover all busbar splices.*
- *The whole will be cold by mid August, ready for first injected beam in late September.*
- *The machine will run at 5 TeV until autumn 2010 after which the remaining 4 sectors will be equipped with PRVs and will be prepared for high energy operation.*

Summary of the New LHC Schedule



Current Plan:

- Machine ready for start-up operation again in October 2009

- Run the LHC over winter until September 2010

- This first physics run will be at 10 TeV collision energy

- At the end of the run, a first run with heavy ion collisions (Pb-Pb) is also foreseen

Beam Conditions for Physics

- **Conclusion 5TeV/beam for Physics**
- Machine Protection will be Tested with beam (at 0.5TeV energy levels)
- 4 TeV "on the way" to 5TeV (limited in 2010)
- Estimated integrated luminosity
  - during first 100 days of operation.. ≈100pb-1
    - » Peak L of 5.10^{31} η (overall) = 10% gives 0.5pb-1/day
    - » Peak L of 2.10^{32} η (overall) = 10% gives 2.0pb-1/day
  - During next 100 days of operation.. ≈ 200pb-1?
- Then towards end of year ions (to be planned in detail soon)

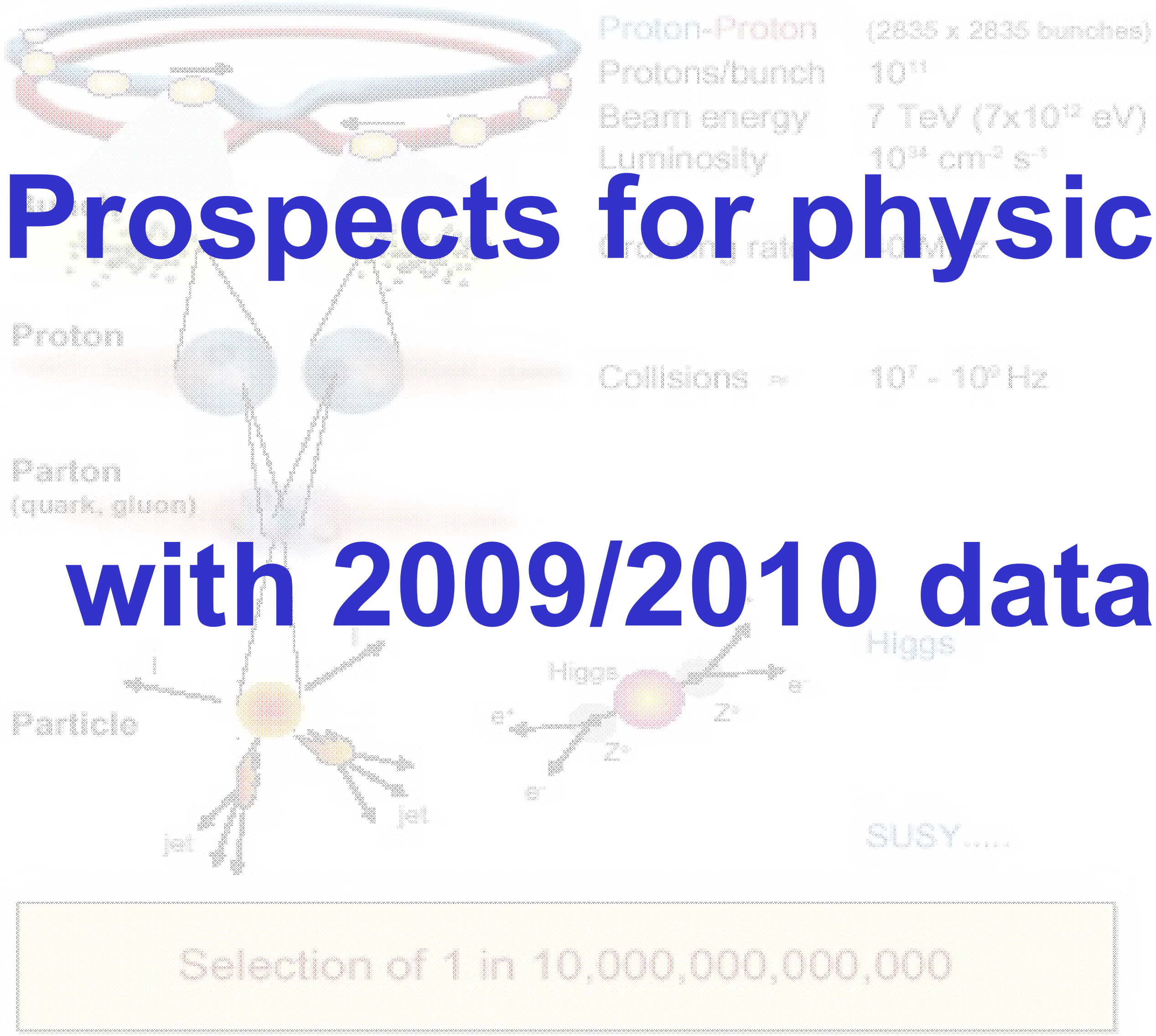
<u>New conditions:</u> 5 TeV beams and 10^{30}-10^{32} $cm^{-2}s^{-1}$ luminosity

$\Rightarrow$ trigger, calibration, alignment, mass reach

from the talk by Steve Myers

Prospects for physics

with 2009/2010 data

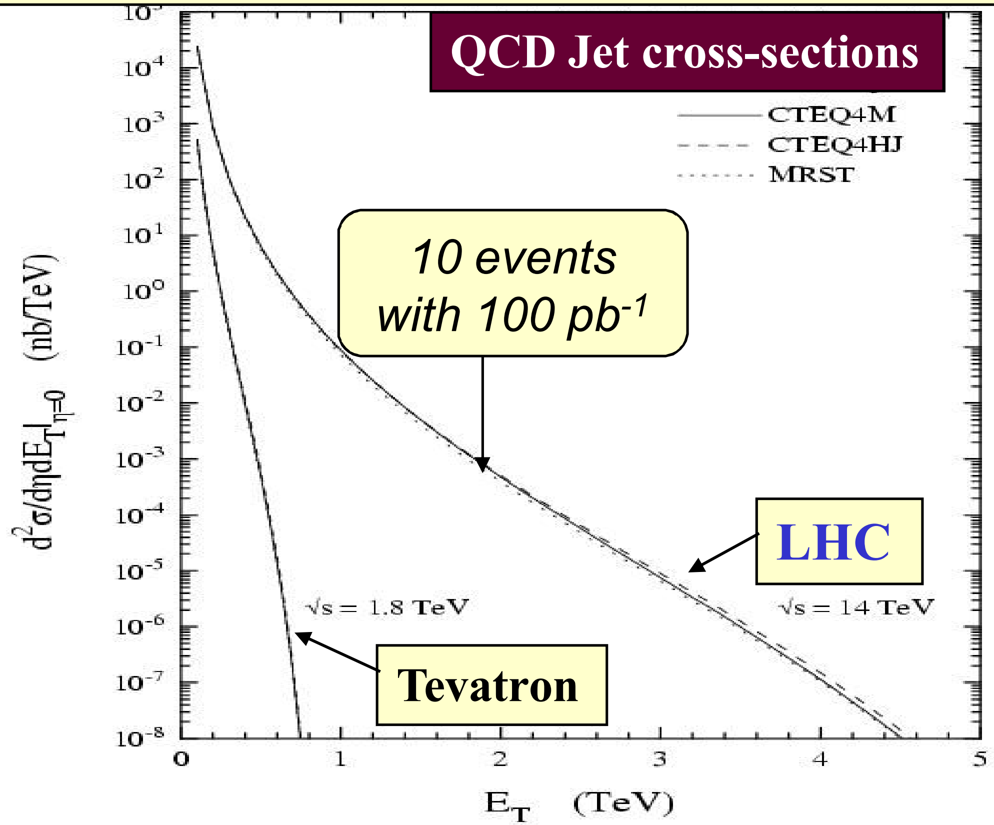


First physics data at LHC

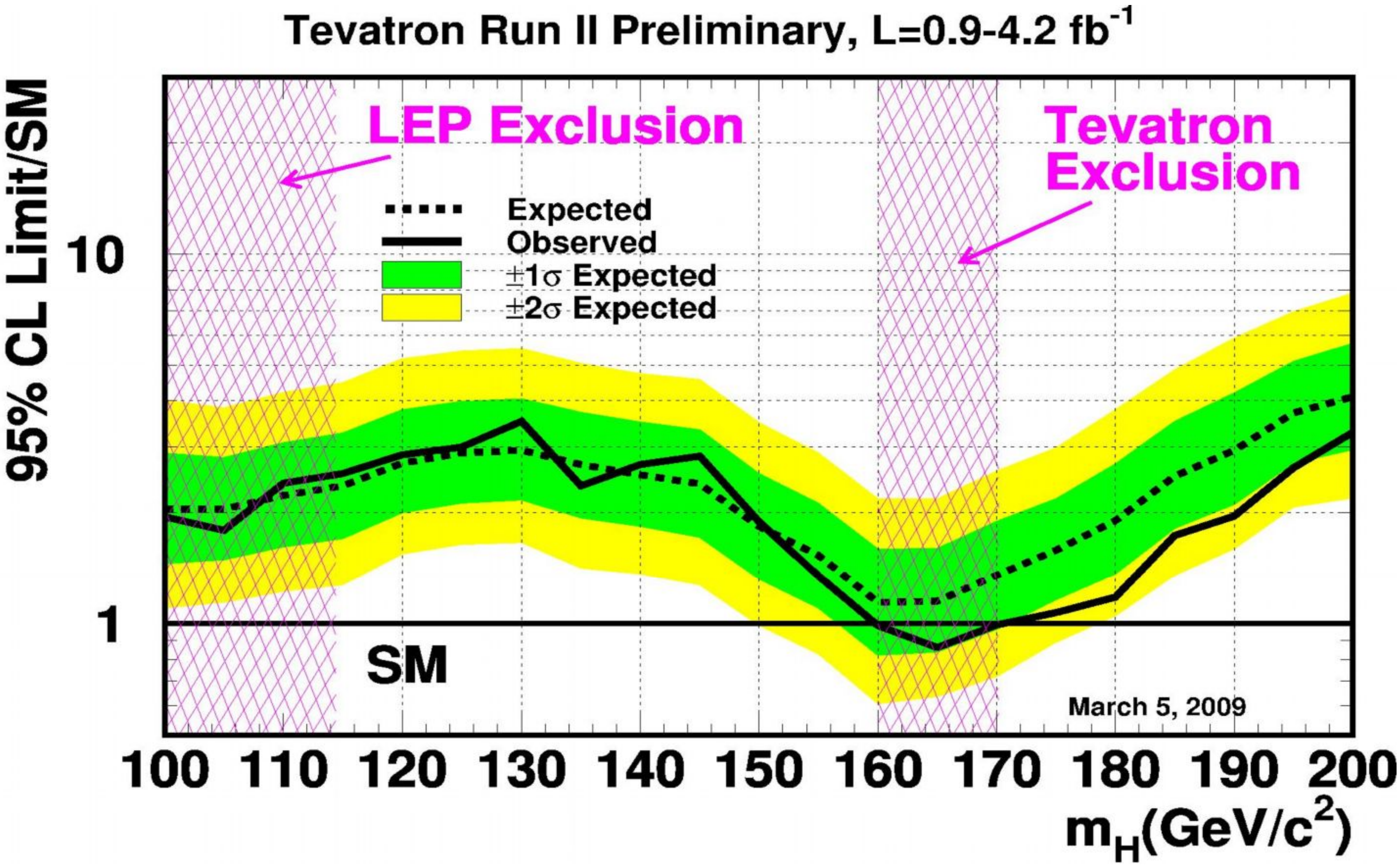
~100 pb^{-1} per experiment may be collected within a month

Channels (<u>examples</u> …)	Events to tape for 100 pb^{-1} ATLAS or CMS	Total statistics from LEP and Tevatron
$W \to \mu\nu$	$\sim 10^6$	$\sim 10^4$ LEP, $\sim 10^{6-7}$ Tevatron
$Z \to \mu\mu$	$\sim 10^5$	$\sim 10^6$ LEP, $\sim 10^{5-6}$ Tevatron
$tt \to W\,b\,W\,b \to \mu\nu + X$	$\sim 10^4$	$\sim 10^{3-4}$ Tevatron
QCD jets $p_T > 1$ TeV	$> 10^3$	---
$m = 1$ TeV	~ 50	---

Will jump immediately into a new territory …



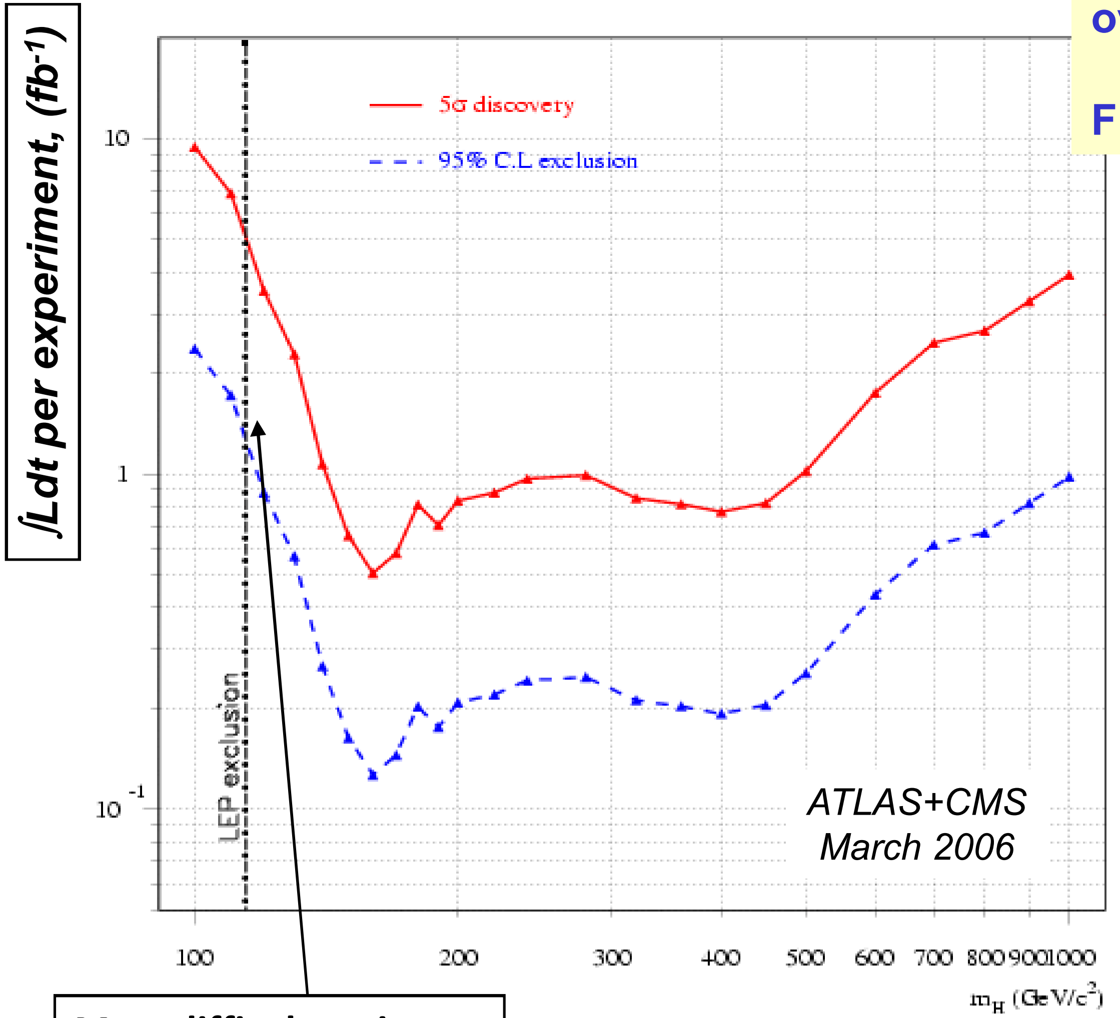
Higgs Search at Tevatron (March 2009)



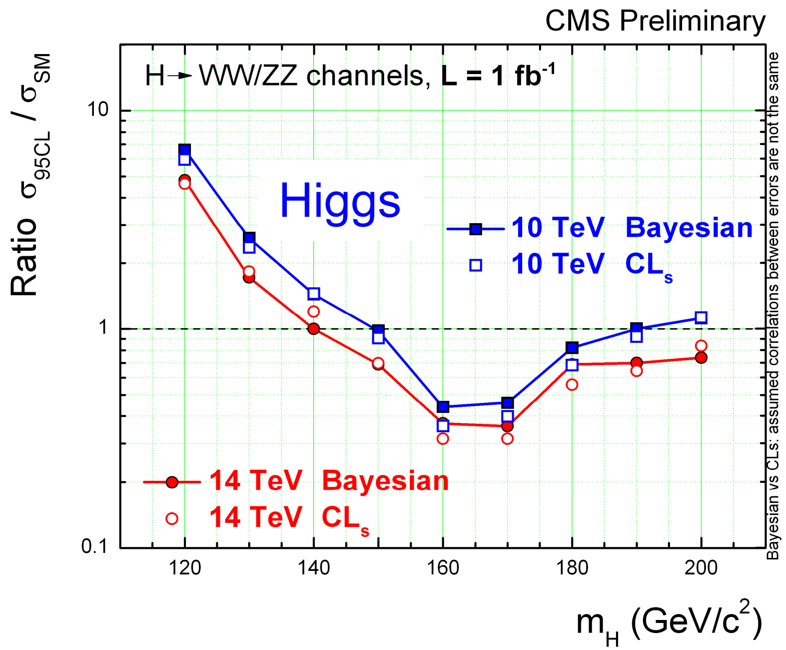
SM Higgs @ 14 TeV

With1 fb^{-1}: 95% C.L. exclusion
5 fb^{-1}: 5σ discovery
over full allowed mass range

Final word about Higgs mechanism by 2012 ?



Most difficult region

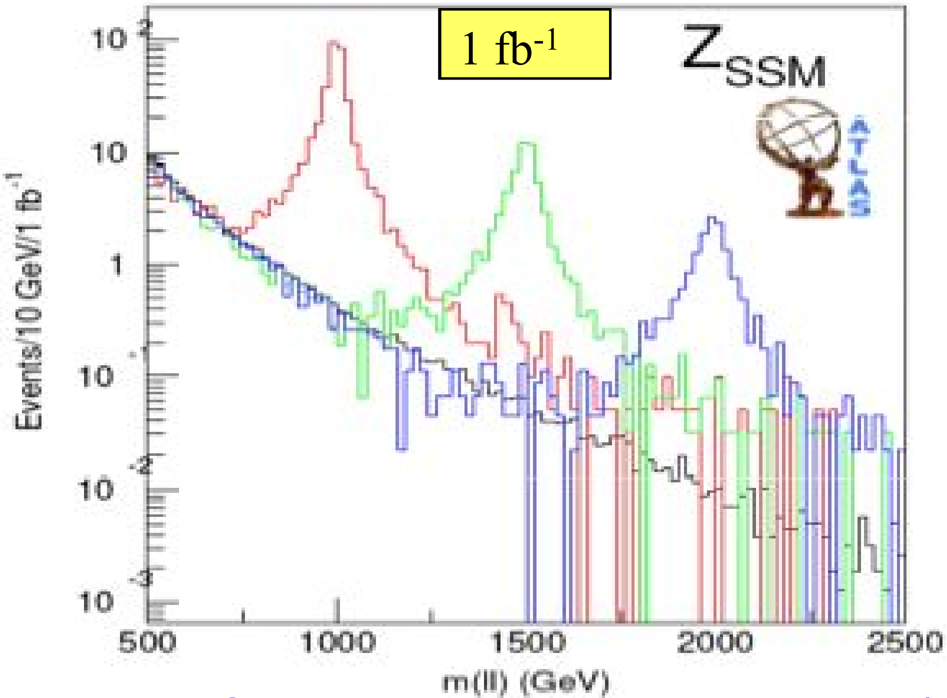


With 200 pb^{-1}, reach current Tevatron sensitivity for Higgs

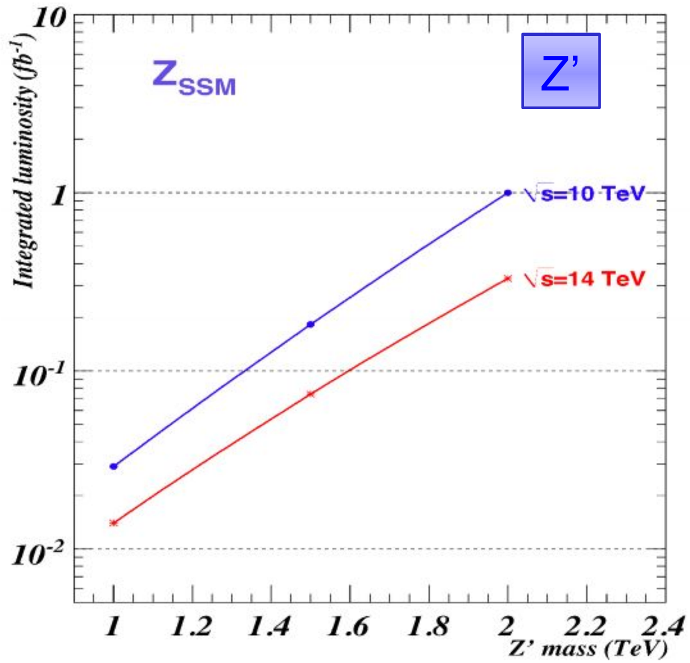
One of the best candidates for early discovery :
a narrow resonance Z' → l+ l- with SM-like couplings (Z_{SSM}) with mass ~ 1 TeV

Mass	Expected events for 1 fb^{-1} (after all analysis cuts)	Integrated luminosity needed for discovery (corresponds to 10 observed events)
1 TeV	~ 160	~ 70 pb^{-1}
1.5 TeV	~ 30	~ 300 pb^{-1}
2 TeV	~ 7	~ 1.5 fb^{-1}

Talk was given by I.Belotelov on May 18

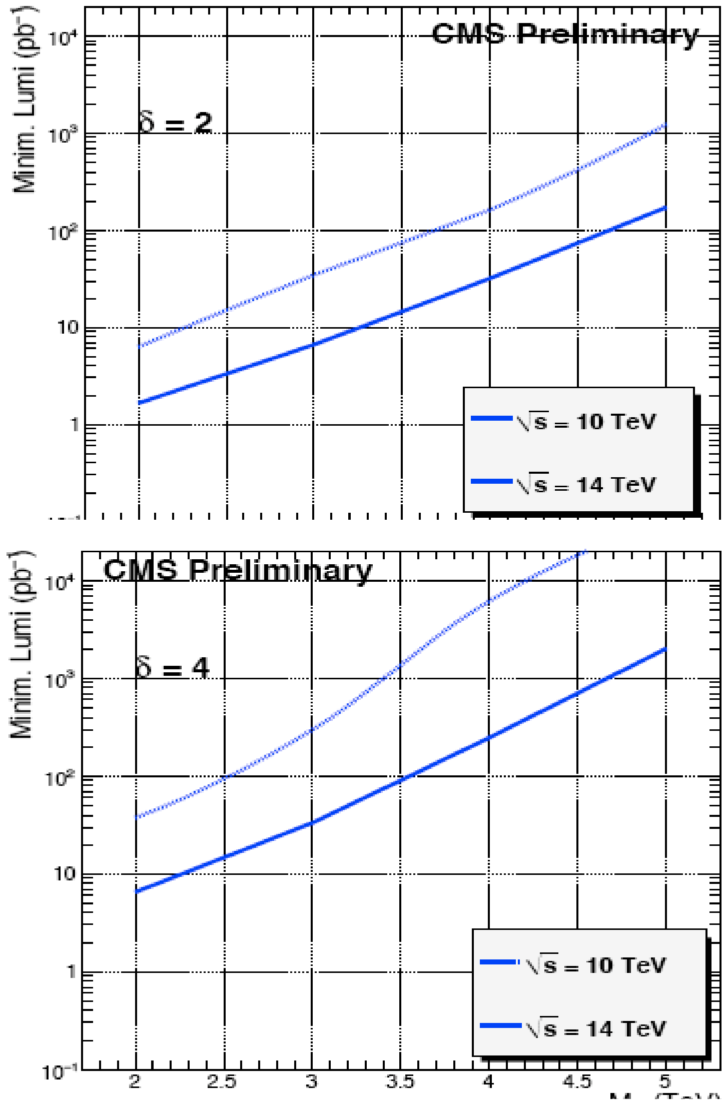


Signals and background are scaled from 14 TeV; plots are indicative for CMS reach



Discovery of m up to ~1TeV possibly in 2009/2010
(narrow mass peak on top of small Drell-Yan background)

Extra Dimensions (*ArcaniDimopoulosDvalimonojets*)

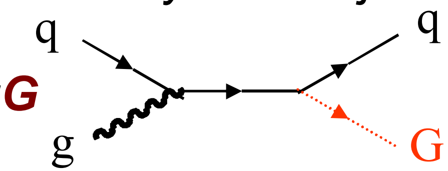


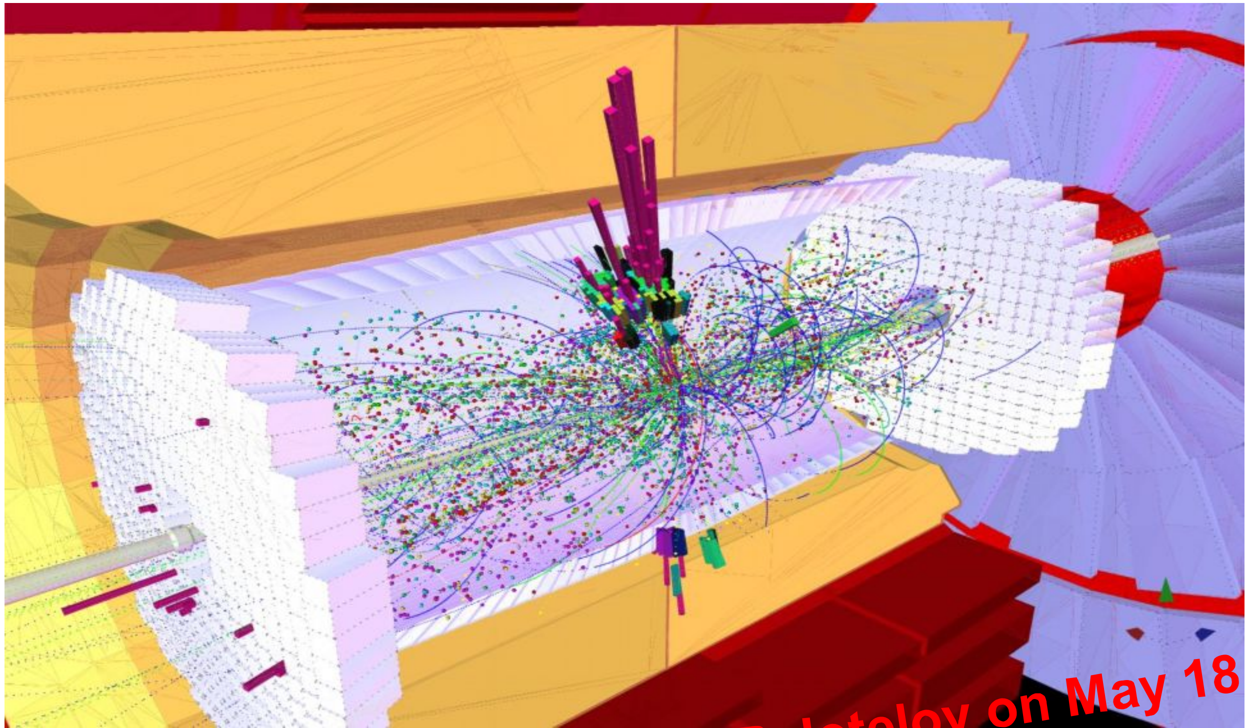
M_D, TeV

4+δ dimensional space:

Production of a Graviton is balanced by a monojet:

*qq/qg/gg→g**G***





Cross-section

Talk was given by I.Belotelov on May 18

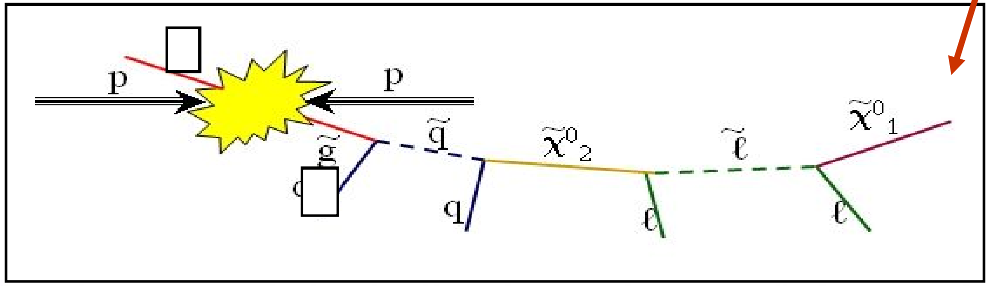
M_D = gravity scale

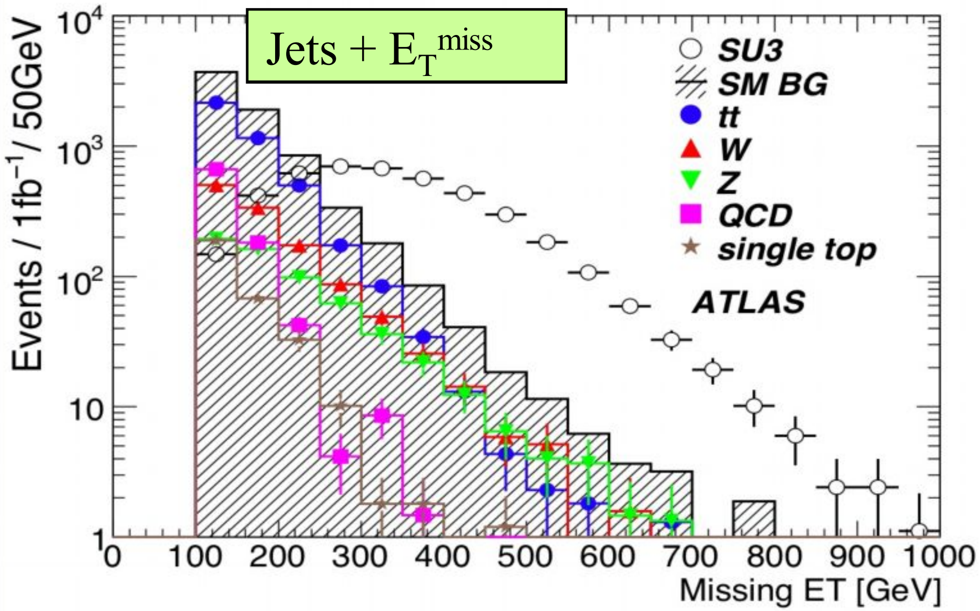
δ = number of extra-dimensions

Possible quick discovery of SUSY at LHC

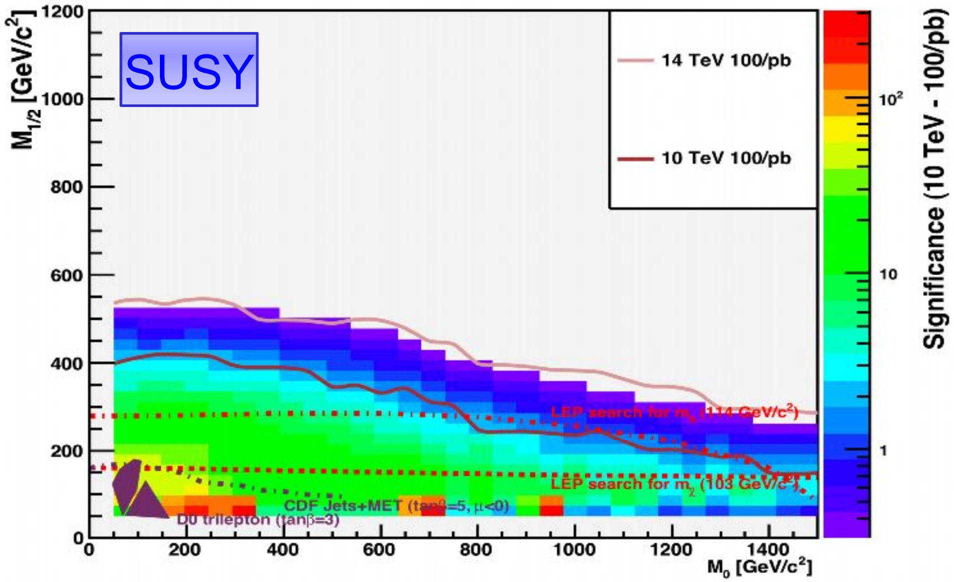
Large (strong) cross-section for $\tilde{q}\tilde{q}, \tilde{g}\tilde{q}, \tilde{g}\tilde{g}$ production → Expect ~1evt./day at L~10^{31}(m~1TeV)

Spectacular signatures (many jets, leptons, missing E_T)





Indicative CMS reach



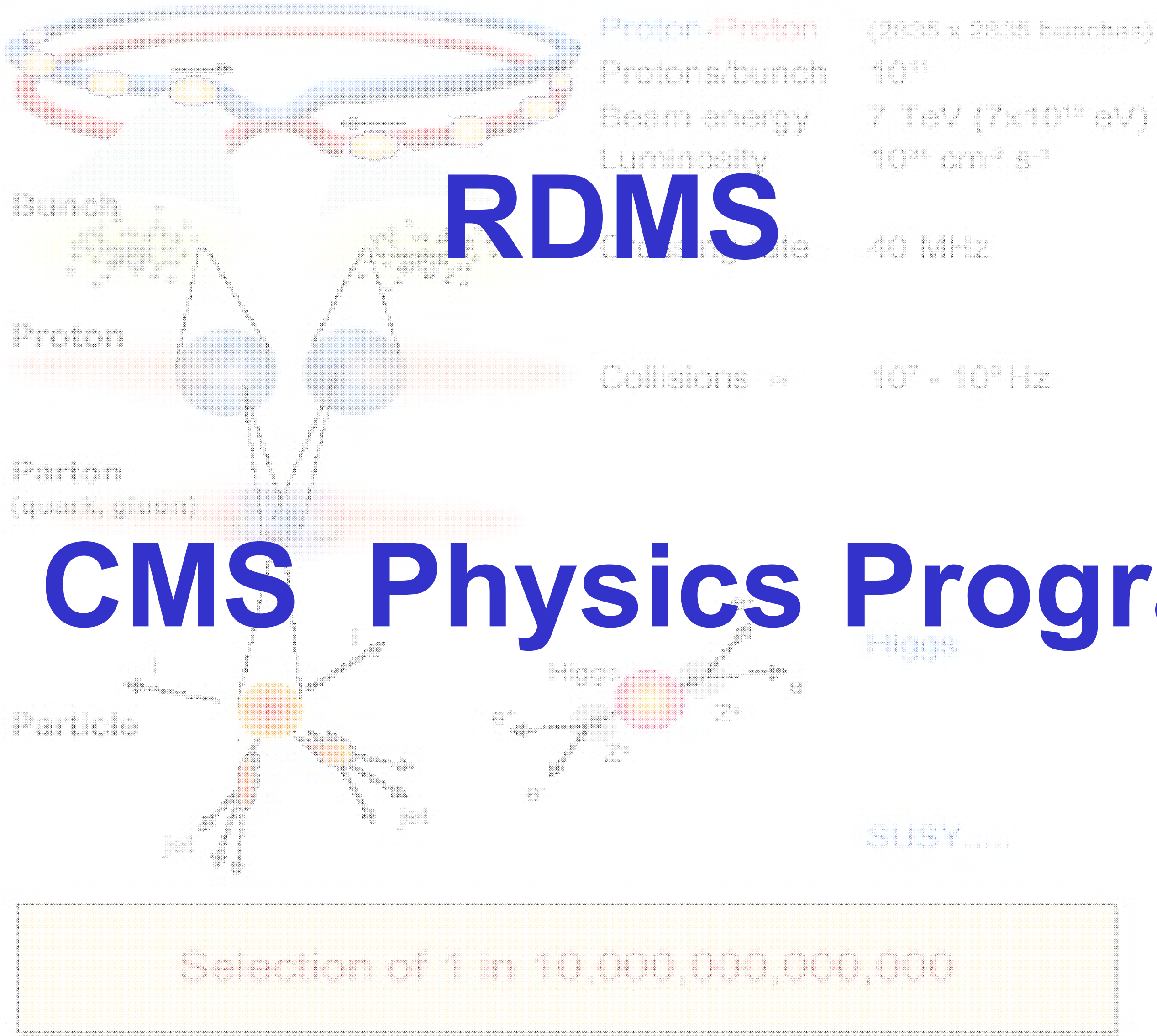
Planning for future facilities would benefit a lot from quick determination of scale of New Physics. With ~ 1 fb^{-1} LHC could tell if "standard" SUSY accessible to $\sqrt{s} \leq 1$ TeVILC

LHC reach for gluino mass

∫LdtDiscovery of well understood data	
0.1-1 fb^{-1} (2010)	~1.1 TeV
≥1 fb^{-1}(2010-2011)	~1.7 TeV
300 fb^{-1} (ultimate)	2.5-3 TeV

RDMS

in CMS Physics Program



The main tasks and goals RDMS groups

- RDMS Strategy:
  - Full Integration in CMS Physics Program
  - Concentration on physics topics, where RDMS physicists already contributed significantly in preparation of CMS physics program

RDMS contributed significantly into Physics Objects Groups and Detector Performance Groups:

- HF, HE, EE, CSC calibration, HE+EE+ES test beam, DQM, overall detector performance studies
- core software development
- development, optimization and validation of algorithms and event processing software
  - to reconstruct and to analyze muons, jets, electrons, MET etc, high-mass objects (di-muons, di-jets), decay chains
  - to study reconstruction efficiency of physics objects from data, trigger performance, misalignment effect

RDMS CMS Physics Tasks

Forward Physics	
• Study of 2 jet production in hard single diffraction	IHEP, SINP MSU, Erevan
• Study of 2 jet production in central diffraction	IHEP, ITEP, SINP, Erevan
Higgs	
• Search for Higgs bosons in decays into 2 photons, 4 leptons, 2 leptons and 2 jets, 2 leptons and 2 neutrinos	JINR, ITEP, MSU, Kharkov
QCD	
• Measurement of the gamma+jet cross-sections	JINR, ITEP, SINP
• Measurements of α_S	JINR
• Search for BFKL effects at jet production	PNPI, ITEP
• Study of jet shapes	JINR, ITEP, SINP
• Study of jet fragmentation	SINP MSU
EWK	
• Measurement of DY muon pair production	JINR, Minsk, Gomel
• Measurement of forward-backward asymmetry in muon pair production	JINR
• Measurement of triple boson couplings	Minsk
Top physics	
• Observing the t-channel single top process	IHEP, SINP
SUSY	
• Search for sleptons and lepton flavor number violation	INR
Exotics	
• Search for heavy neutrino and W_R	INR
• Search for new resonances (extra dimensions and Z') in DY	JINR
• Search for non-resonance di-muon signals from ADD and compositeness	JINR
Heavy Ion	
• QGP hard probes (heavy quarkonia and jets) and soft probes (eliptic flow)	SINP MSU

RDMS Participation in Physics Analysis

2009

start-up of 10 TeV data taking at low luminosity $2\times10^{30\div32}$ cm^{-2}s^{-1}

HCAL, ECAL, ES and ME1/1 calibration, tuning, testing of muon and jet reconstruction algorithms, s/w for Data Quality Monitoring and express analysis

2010

0.2 fb^{-1}

- The first physics analysis of Drell-Yan samples and inclusive jet production (comparison with Tevatron data) at ~TeV region.
- Diffraction events.

2011

start-up of 14 TeV data taking at low luminosity 10^{32} cm^{-2}s^{-1}

1-10 fb^{-1}

2012

start-up of 14 TeV data taking at high luminosity 10^{34} cm^{-2}s^{-1}

- Expected Higgs signals
- Physics analysis of Drell-Yan processes and looking for signals of Higgs bosons and/or new physics in the invariant mass region uncovered so far (~1.5 - 3 TeV).
- Jet data in the new region of x and Q^2 (QCD and diffraction)
- measurements of the triple and quartic boson couplings

2013

100-120 fb^{-1}

~ 300 fb^{-1}

- Further Higgs and Top studies
- Physics analysis of Drell-Yan processes and looking for signals of higgs bosons and/or new physics in the inv. mass region uncovered so far(~1.7 – 5.6 TeV).
- Jet data in the new region of x and Q^2
- BEC of identical gauge bosons ZZ, W^+W^+, W^-W^-)

Example: RDMS in CMS PAG (EWK & Exotica)

Joint activity within EWK and Exotic PAG, Muon POG and DPG

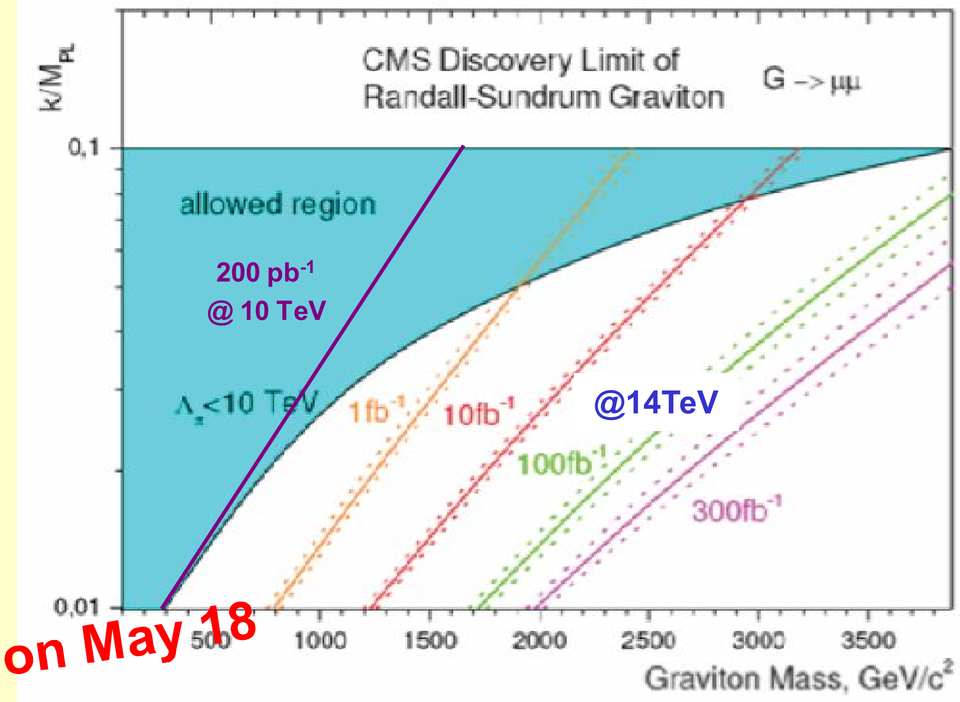
The field of special interest of RDMS is study of **Drell-Yan processes** in the large invariant mass region inaccessible at other accelerators

- cross-section measurements
- extraction of muon forward-backward asymmetry
- exploration of helicity structure of these process

Goal – to test Standard Model (SM) predictions precisely and to look for the new physics beyond the Standard Model (BSM)

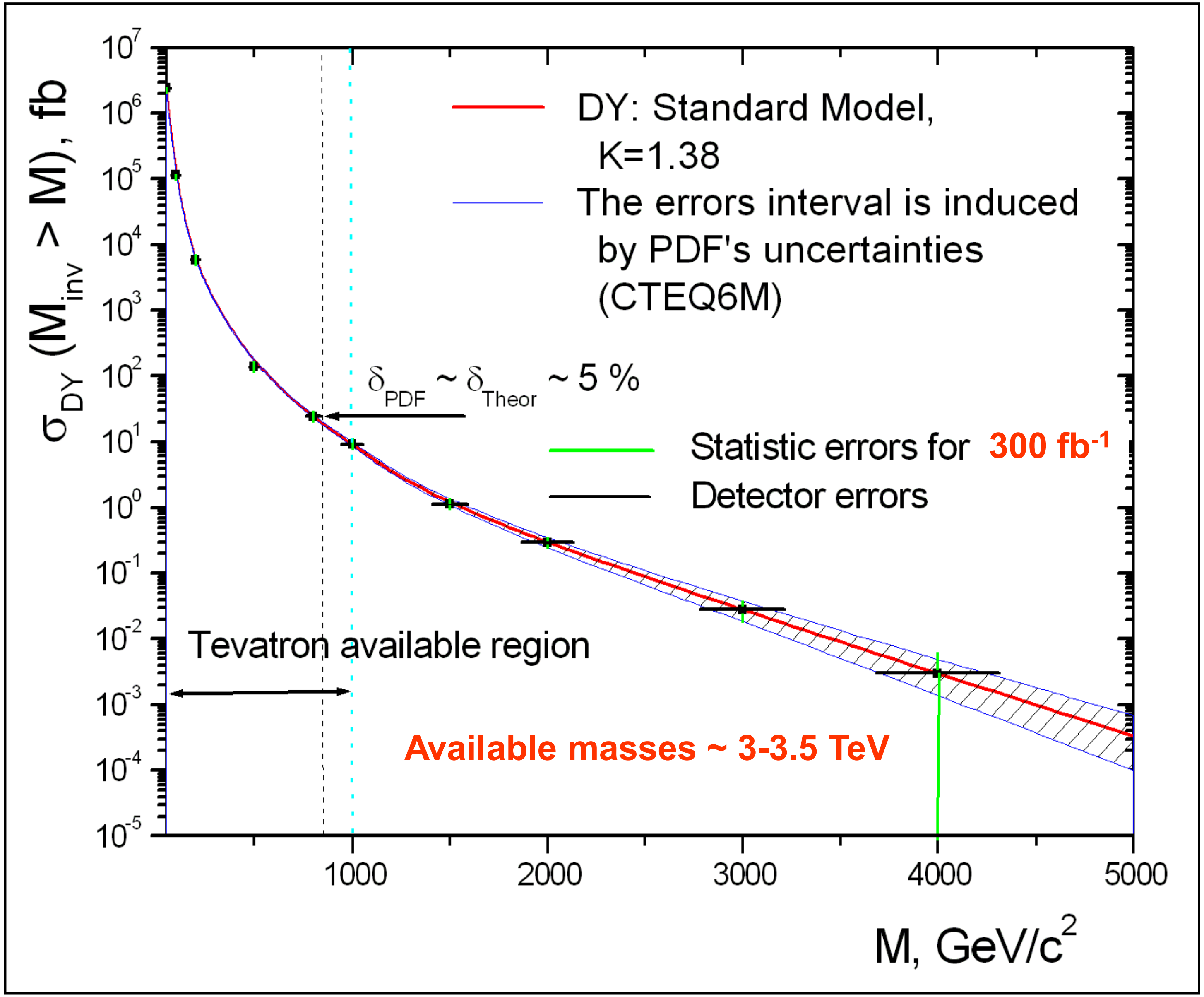
- search for heavy resonances from extended gauge models (**Z'**), TeV-scale gravity scenarios (**RS1** Randall-Sundrum graviton, Kaluza-Klein excitations $\mathbf{Z_{KK}}$) in mu+mu- events
- search for non-resonant signal from TeV-scale gravity scenarios of **ADD** (Arkani-Hamed-Dimopoulos-Dvali) model and compositeness models in mu+mu- events

Mass reach for new conditions:
5 TeV beams and 10^{30}-10^{32} $cm^{-2}s^{-1}$ luminosity (x-sextion and lumi normalization)

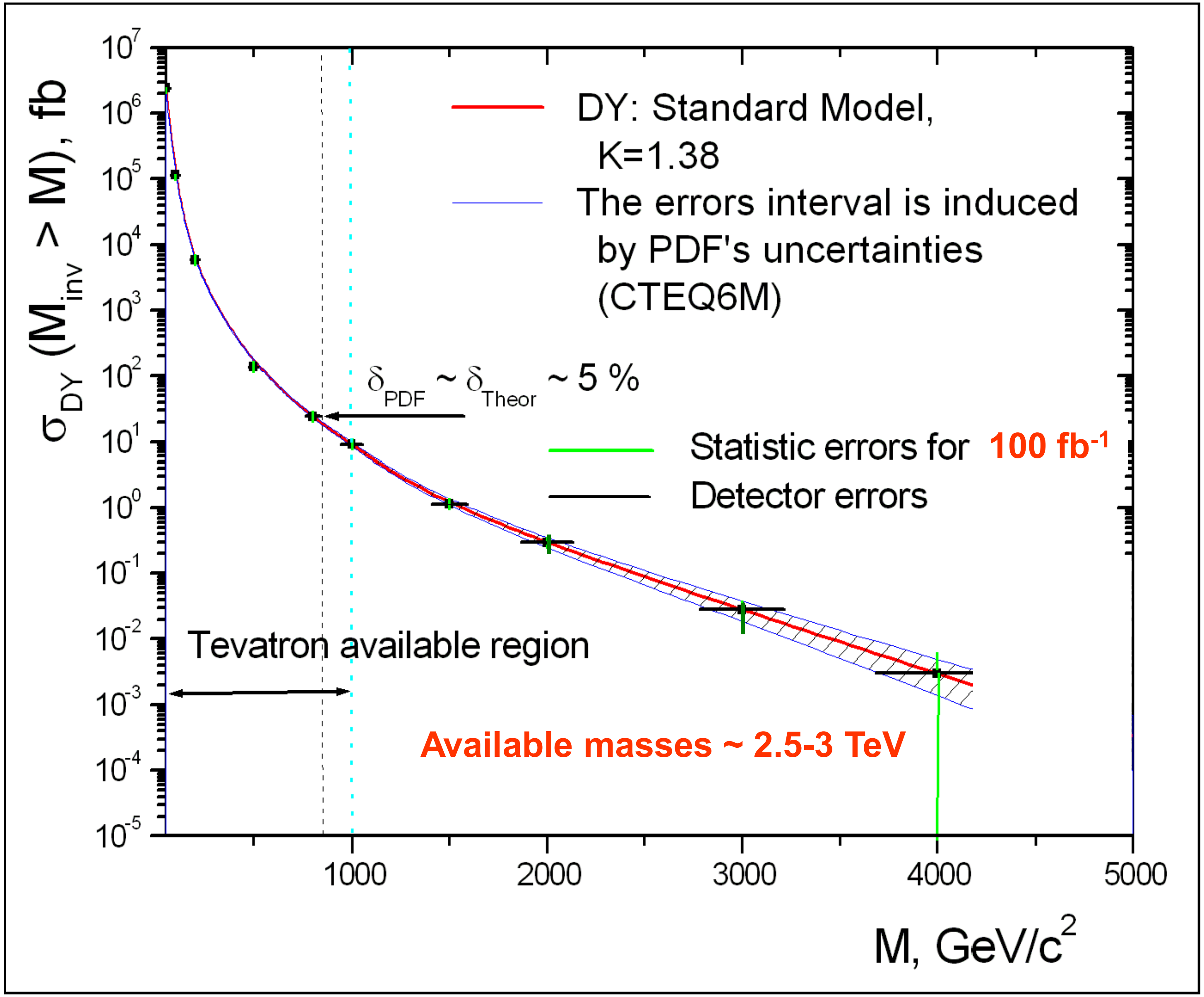


Talk was given by I.Belotelov on May 18

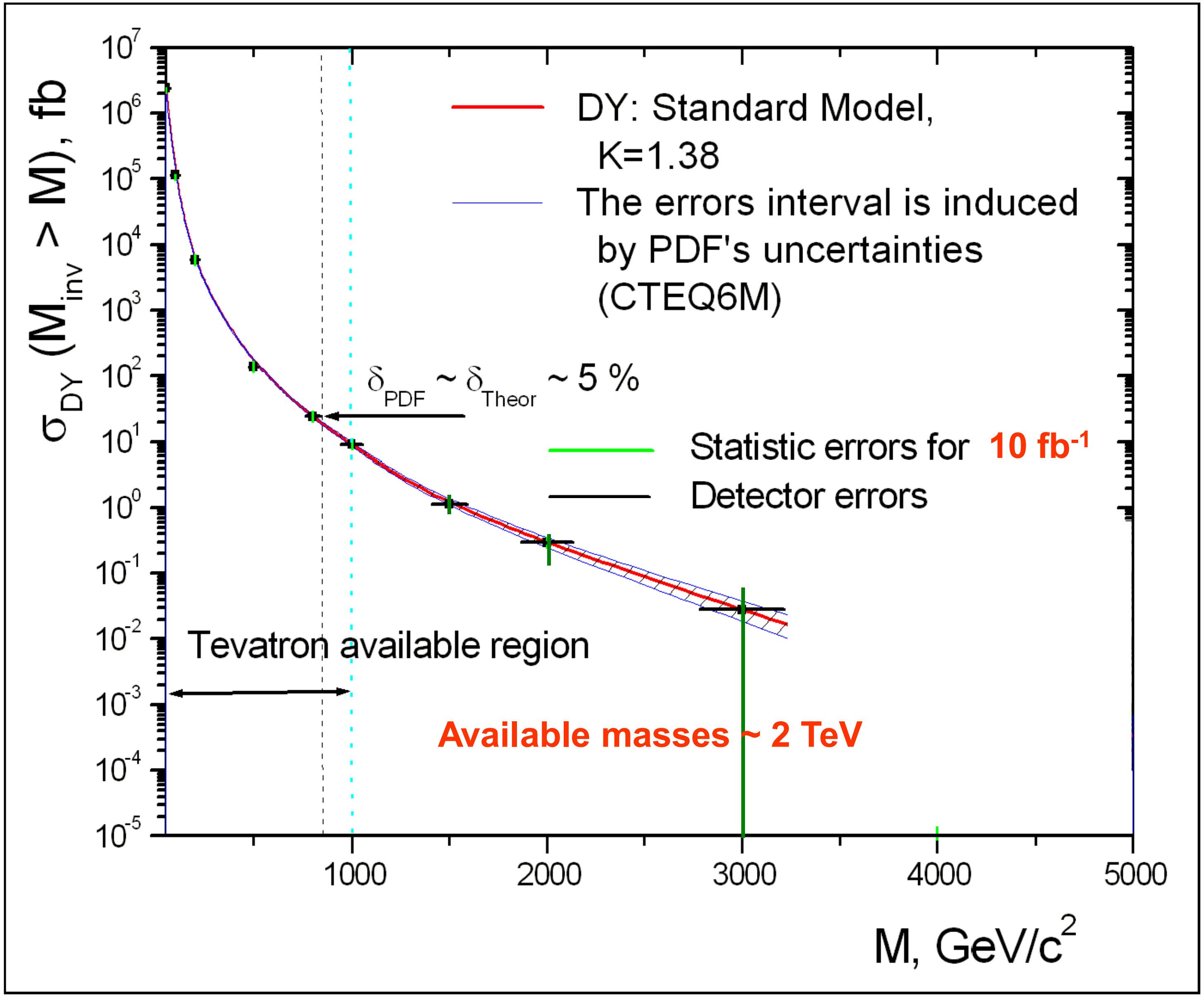
Muon Drell-Yan Studies: 3 years of LHC at High Lumi



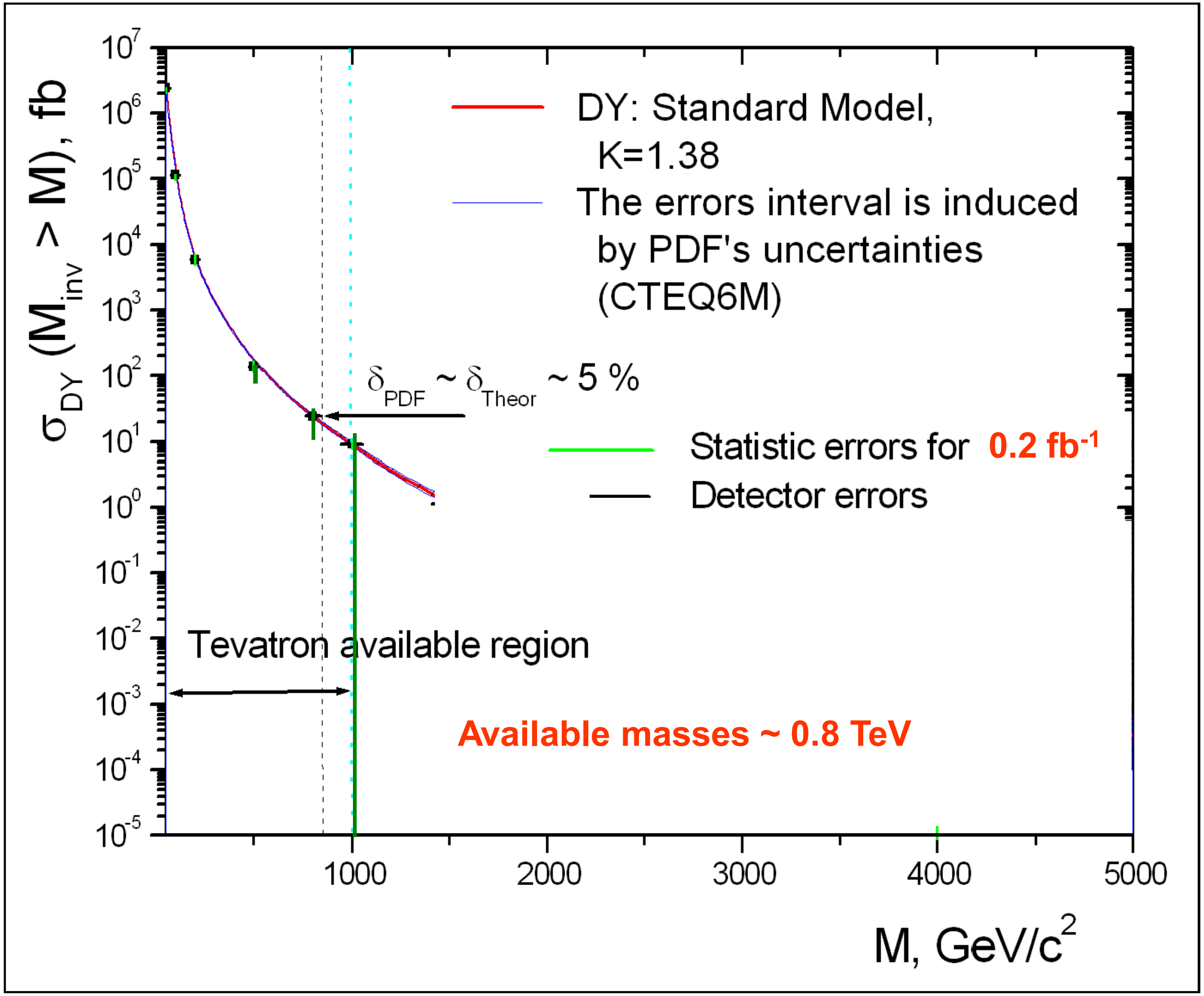
Muon Drell-Yan Studies: 1 year of LHC at High Lumi



Muon Drell-Yan Studies: 1 year of LHC at Low Lumi

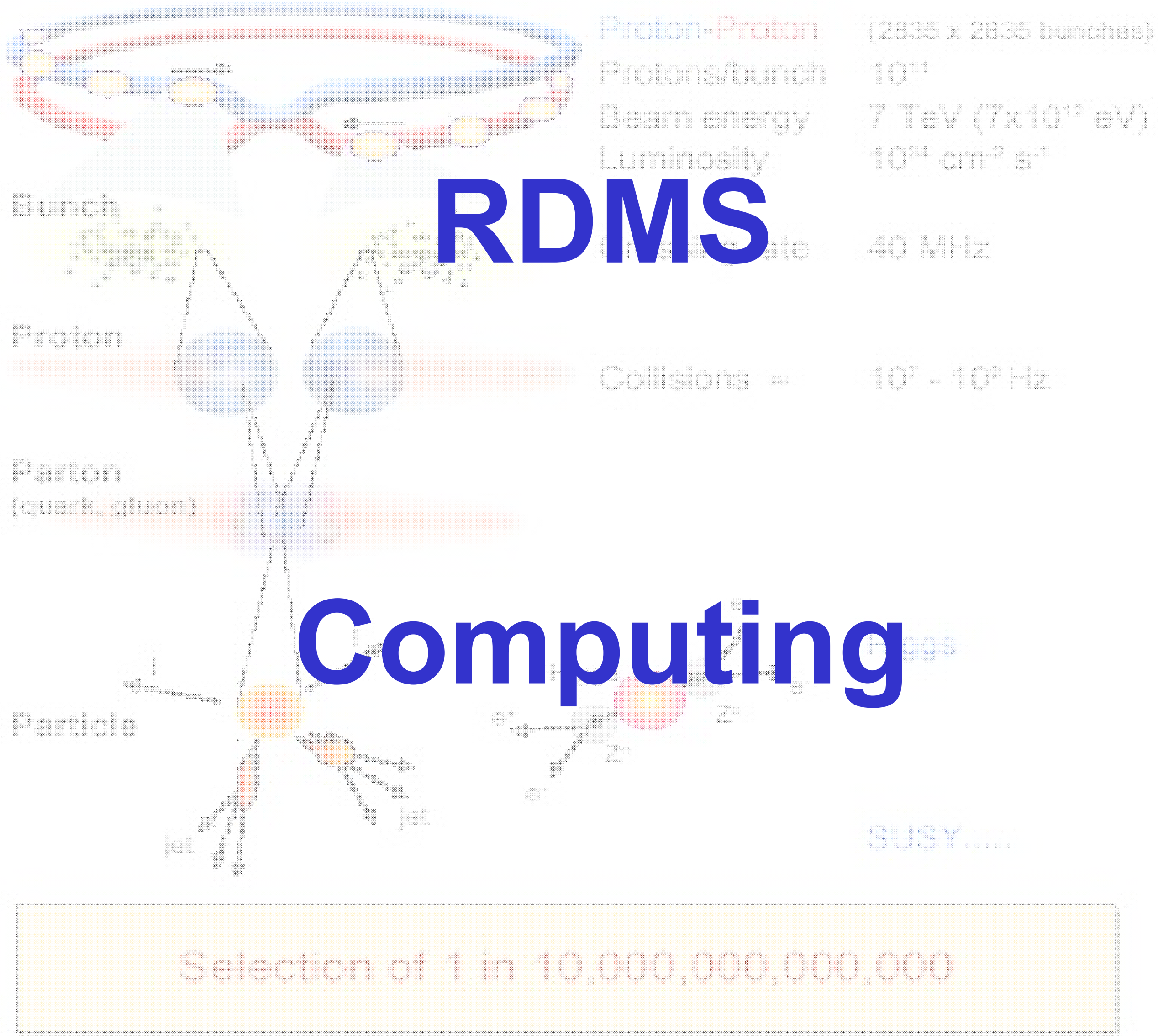


Muon Drell-Yan Studies: LHC operation in 2009-2010

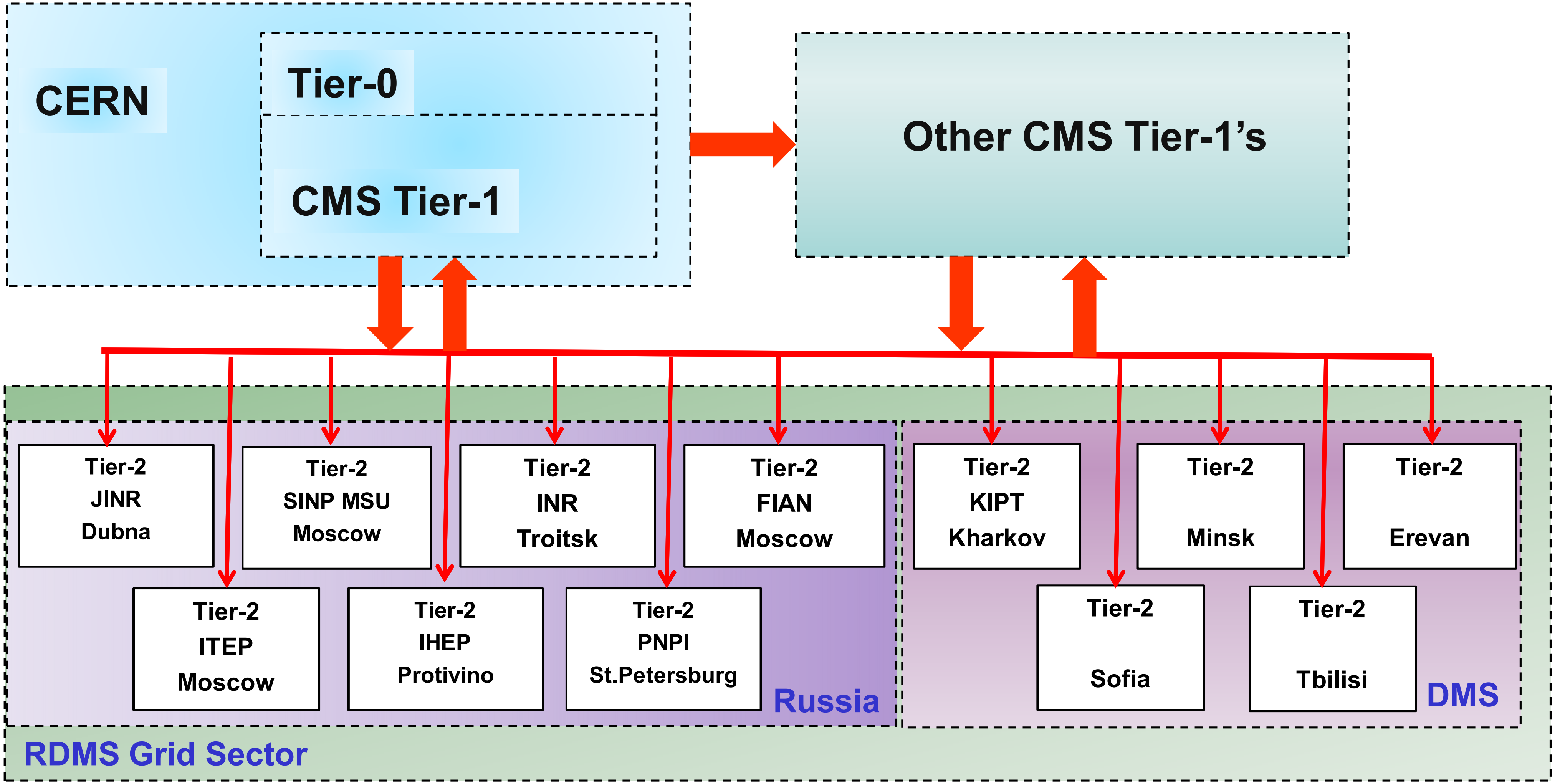


RDMS

Computing



RDMS CMS Grid Sector



Integration into CMS physics program means also integration in CMS computing

Data Processing in CMS

Tier 0

- Data taking (RAW)
- Data Quality Monitoring
- Calibration
- Express Analysis (including selective reconstruction)
- Data packing to transfer to Tier-1
- Data management for Tier 1

RAW

CERN

Tier 1 RDMS CMS

- Store of RAW data
- Reconstruction:
  RAW → RECO → AOD

Pre-reconstruction:
  RAW → RECO

RECO: events with information on physics objects – clusters/hits, global tracks, vertexes, information on type of particles (particle identification), i.e. muons, photons, jets etc.

Reconstruction of physics objects:
  RECO → AOD

AOD: final physics objects – tracks with associated hits, clusters in calorimeters, kinematics characteristics of particles- jets, muons, photons etc.

- Data management for Tier 2 RDMS CMS

MC

AOD

Calibration const.

RAW

Tier 2 CMS

- Simulation (Monte Carlo)
- Physics Analysis
  including:
- Calibration and tuning with data
- Development of algorithm for reconstruction and analysis and its testing with RAW and RECO data

Home

RDMS Tier-2 association

- Experimental data for physics analysis will be transferred to CMS Tier-2s
- CMS strategy – is association of Physics Tasks with certain Tier-2s
- The goal of RDMS groups – to maximise participation of RDMS Tier-2s in CMS physics Program

RDMS Tier-2 association

Today:	in near Future:
PAG	
Exotica: T2_RU_JINR	Exotica: T2_RU_INR
HI: T2_RU_SINP	QCD: T2_RU_PNPI
	Top: T2_RU_SINP
	FWD: T2_RU_IHEP
POG/DPG	
Muon: T2_RU_JINR	e-gamma-ECAL: T2_RU_INR
JetMET-HCAL: T2_RU_ITEP	

Requirements for CMS Tier-2 is quite high

RU Site Readiness status

T2_RU_IHEP

	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Site Readiness Status:								NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Daily Metric:	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
Maintenance:	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up
Job Robot:	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SAM Availability:	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
T2::uplinkT1s:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2::downlinkT1s:	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

T2_RU_JINR

	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Site Readiness Status:								R	SD	R	R	R	R	R	R	R	R	R	R	R	R	R
Daily Metric:	E	E	E	O	O	O	O	O	SD	O	O	O	O	O	O	O	O	O	O	O	O	O
Maintenance:	Up	Up	Up	Up	Up	Up	Up	Up	SE-SD	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up
Job Robot:	98%	96%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	96%	100%	100%	90%	100%	100%	97%	96%
SAM Availability:	0%	0%	60%	100%	96%	100%	88%	96%	92%	100%	100%	100%	96%	100%	96%	100%	100%	100%	92%	100%	100%	96%
T2::uplinkT1s:	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
T2::downlinkT1s:	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

T2_RU_INR

	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Site Readiness Status:								NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Daily Metric:	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
Maintenance:	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up
Job Robot:	100%	94%	83%	51%	54%	100%	100%	97%	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%	98%	96%	99%	75%
SAM Availability:	100%	100%	52%	0%	32%	96%	100%	96%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	84%
T2::uplinkT1s:	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
T2::downlinkT1s:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

T2_RU_PNPI

	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Site Readiness Status:								NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	SD
Daily Metric:	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	SD
Maintenance:	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	SD
Job Robot:	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SAM Availability:	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
T2::uplinkT1s:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2::downlinkT1s:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

T2_RU_ITEP

	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Site Readiness Status:								NR	NR	NR	NR	NR	R	R	R	R	R	R	R	R	R	R
Daily Metric:	E	E	E	E	E	E	E	E	E	E	E	O	O	O	O	O	O	O	O	O	O	O
Maintenance:	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up
Job Robot:	99%	99%	100%	100%	100%	99%	100%	100%	100%	100%	98%	100%	100%	100%	100%	100%	100%	99%	100%	99%	100%	100%
SAM Availability:	88%	0%	60%	100%	100%	76%	100%	100%	100%	96%	84%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	84%
T2::uplinkT1s:	2	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4
T2::downlinkT1s:	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

T2_RU_SINP

	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Site Readiness Status:								NR	SD	SD	SD	W	W	W	W	NR	NR	NR	NR	NR	NR	R
Daily Metric:	SD	SD	E	E	E	E	E	E	SD	SD	SD	E	E	E	E	E	E	E	E	E	O	O
Maintenance:	SD	SD	Up	Up	Up	Up	Up	Up	SD	SD	SD	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up	Up
Job Robot:	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	25%	100%	100%
SAM Availability:	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	28%	100%	100%
T2::uplinkT1s:	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
T2::downlinkT1s:	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

- **It is important to work on improving the Site-Commissioning-Status.**
- **Progress for RU T2: 3 sites are "Commissioned" (JINR, ITEP, SINP MSU)**

from M.Kasemann - CMS Computing PM

Summary

- **LHC repairs after an incident on Sept. 19 are progressing well.**
  - The 53rd final replacement magnet was lowered into the accelerator tunnel on 30 April.
  - Next steps are connecting the magnets together and installing much improved LHC monitoring and safety system.
  - Finally extra pressure relief valves will be installed
- **The LHC is scheduled to restart in autumn and to run continuously until October 2010**
- **CMS are well prepared for physics.**
  - Excellent detector quality has been demonstrated using cosmic rays and LHC beams.
  - This should be further improved with the first collisions data

Summary

- **Ambitious Goals for 2009/2010 Run (at least ~200 pb-1)**

- **Direct searches for new physics:**

  - Hints for SUSY up to gluino masses of ~ 1 TeV
  - Discover Z' up to masses of ~ 1 TeV
  - Surprises ???

- **CMS is ready to produce results**

- **RDMS physicists are ready for data taking, processing and analysis**