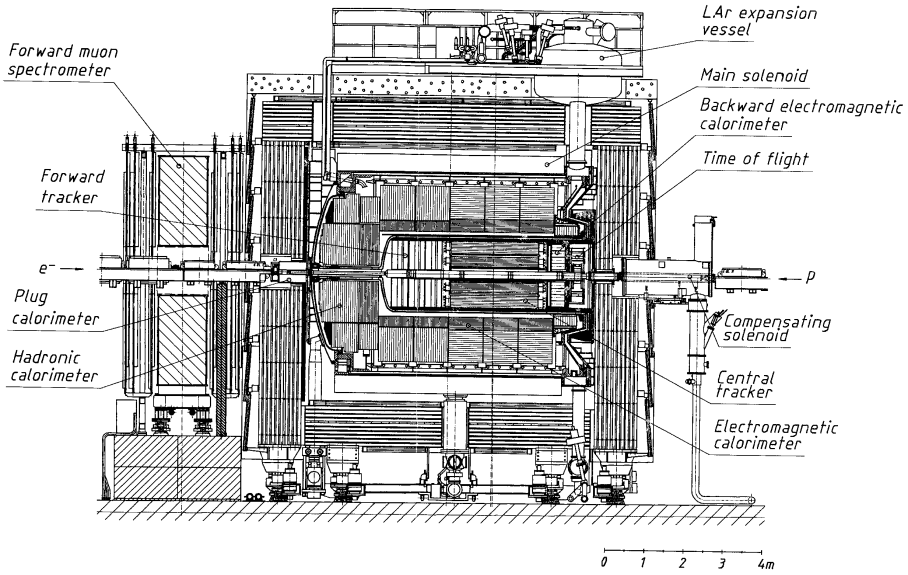
Etienne Augé
Directeur Adjoint Scientifique
Physique des Particules

IN2P3
Institut national de physique nucléaire et de physique des particules

Panorama de la Physique des Particules



H1 à HERA/DESY

CPPM, LAL, LLR

3,8 FTE en 2010

Fin de la prise de données en 2007

Gros effort d'analyse jusqu'en 2013

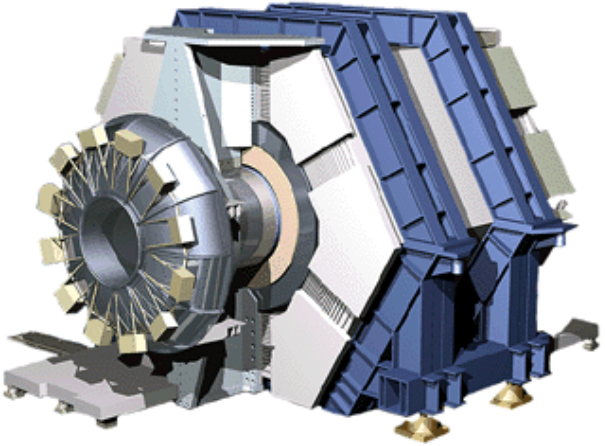
C. Diaconu (CPPM) spokesperson (a succédé à C. Vallée)

Analyses fortement couplées aux progrès théoriques (QCD)

- pdf : HERAPDF1.0 (NLO), puis HERAPDF1.5 (NNLO)

  Ingrédient de première importance pour les prédictions LHC

- QCD non perturbative, topologie de l'état final
- Diffraction
- Saveurs lourdes (c, b)



BaBar à PEP-II/SLAC

LAL, LAPP, LLR, LPNHE

9,4 FTE en 2010

-Forte implication dans l'analyse

période intensive 2009-2010 (spokesperson F. Le Diberder)

période intermédiaire 2011-2012

- Réunion de collaboration à Annecy en 2011

- Mesure des paramètres CKM (conjointement avec BELLE)
- Recherche de nouvelle physique par la mesure de désintégrations rares

par exemple $B^0 \to \gamma\gamma$ $D^0 \to \gamma\gamma$

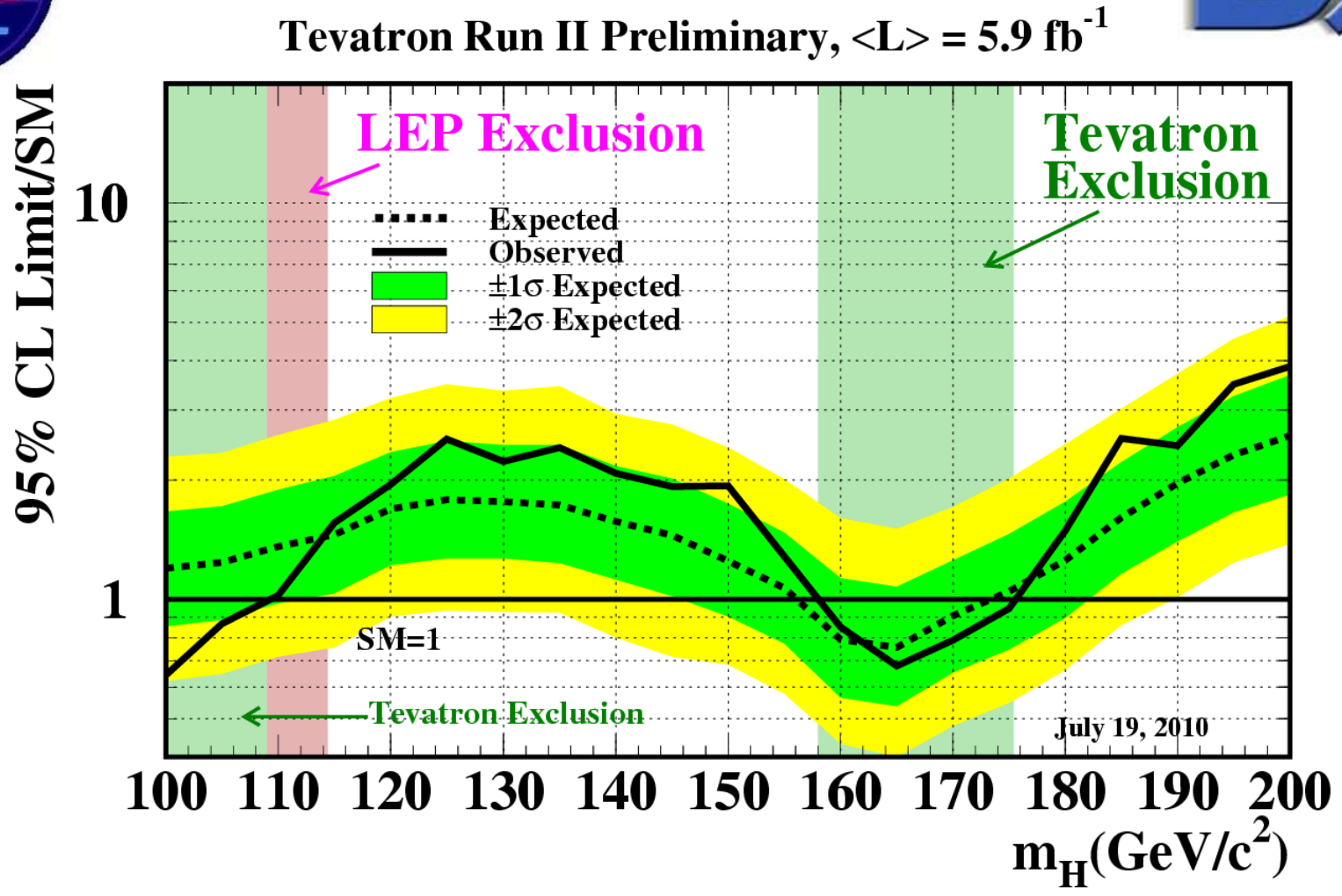
- Spectroscopie du bottomonium: η_b en 2008, h_b en 2010

D0 au Tevatron/FNAL

CPPM, IPHC, IPNL, LAL,
LPC-Cl, LPNHE, LPSC

20 FTE en 2011

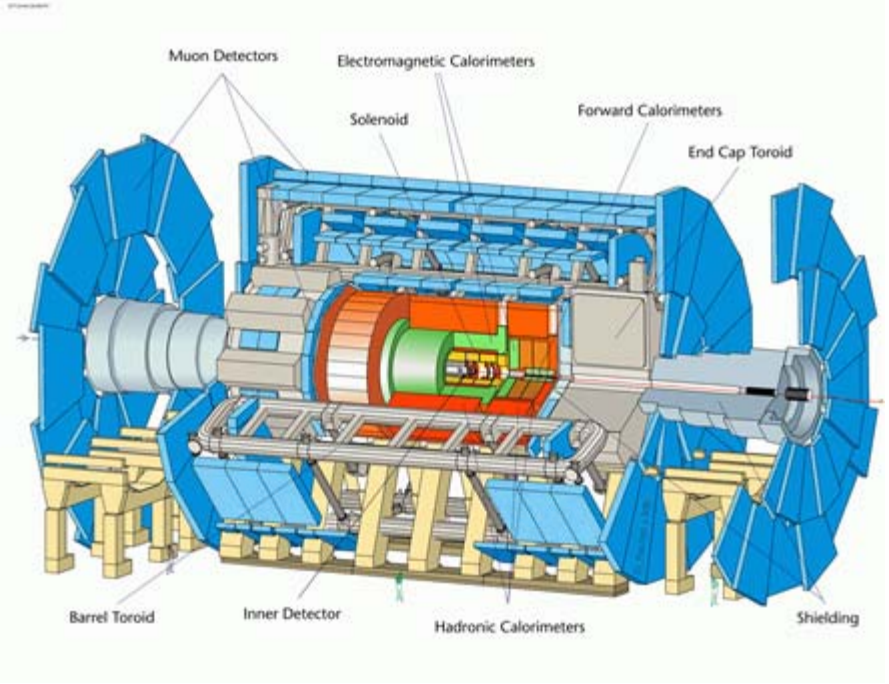
- Implication dans la prise de données (toute l'année 2011)
- Implication dans l'analyse (Higgs, M_W, SUSY et autres searches, top)
- Projet d'extension du run du Tevatron sur 2012-2014 ➔ 16 fb^{-1} par expérience
  pas accepté par le DOE (gros problème budgétaire aux US)



SM Higgs excluded at 95% CL for **$158 < m_h < 173$ GeV**

Expected exclusion at 95%CL **$153 < m_h < 179$ GeV**

(Summer 2010 expected exclusion: $156 < m_h < 173$ GeV)



ATLAS à l'IN2P3

CPPM, LAL, LAPP, LPC-Cl, LPNHE, LPSC

118 PhD equiv (6,5%)

144,5 FTE en 2010, à la hausse

Dont 115 FTE chercheurs

- Forte implication dans la prise de données:

  -Pixels, Larg, Tuiles, Trigger

- Forte présence au CERN

-Forte implication dans l'analyse des données (Higgs, Top, SUSY)

-Insertable B layer : LAPP, CPPM, LAL, LPNHE

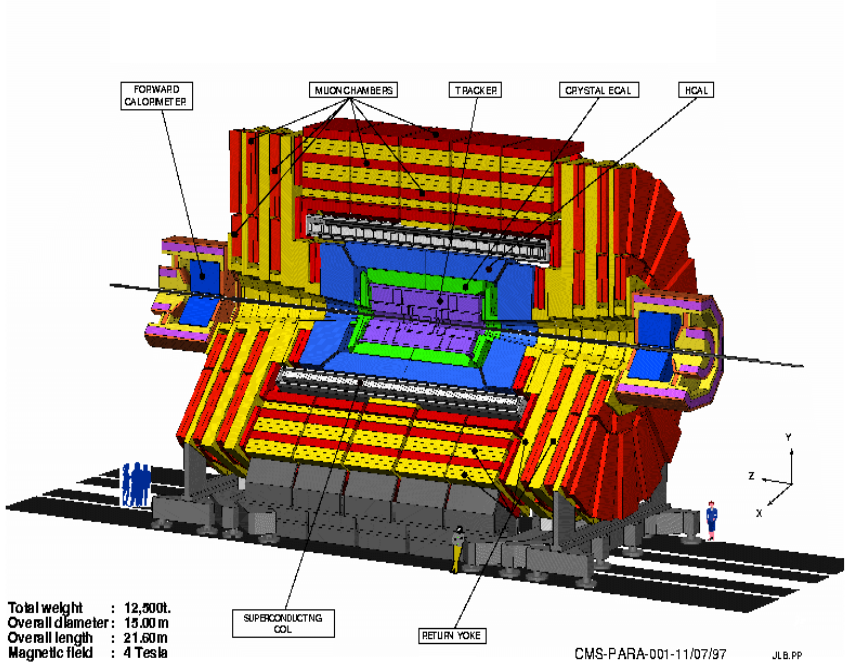
The Collaboration composition did not change since the last RRB

- **38 Countries**
- **174 Institutions**
- **~ 2950 active scientists:**
  - **~ 1840 with a PhD → contribute to M&O share**
  - **~ 1100 students**

Albany, Alberta, NIKHEF Amsterdam, Ankara, LAPP Annecy, Argonne NL, Arizona, UT Arlington, Athens, NTU Athens, Baku, IFAE Barcelona, Belgrade, Bergen, Berkeley LBL and UC, HU Berlin, Bern, Birmingham, UAN Bogota, Bologna, Bonn, Boston, Brandeis, Brasil Cluster, Bratislava/SAS Kosice, Brookhaven NL, Buenos Aires, Bucharest, Cambridge, Carleton, CERN, Chinese Cluster, Chicago, Chile, Clermont-Ferrand, Columbia, NBI Copenhagen, Cosenza, AGH UST Cracow, IFJ PAN Cracow, SMU Dallas, UT Dallas, DESY, Dortmund, TU Dresden, JINR Dubna, Duke, Edinburgh, Frascati, Freiburg, Geneva, Genoa, Giessen, Glasgow, Göttingen, LPSC Grenoble, Technion Haifa, Hampton, Harvard, Heidelberg, Hiroshima IT, Indiana, Innsbruck, Iowa SU, Iowa, UC Irvine, Istanbul Bogazici, KEK, Kobe, Kyoto, Kyoto UE, Lancaster, UN La Plata, Lecce, Lisbon LIP, Liverpool, Ljubljana, QMW London, RHBNC London, UC London, Lund, UA Madrid, Mainz, Manchester, CPPM Marseille, Massachusetts, MIT, Melbourne, Michigan, Michigan SU, Milano, Minsk NAS, Minsk NCPHEP, Montreal, McGill Montreal, RUPHE Morocco, FIAN Moscow, ITEP Moscow, MEPhI Moscow, MSU Moscow, Munich LMU, MPI Munich, Nagasaki IAS, Nagoya, Naples, New Mexico, New York, Nijmegen, Northern Illinois University, BINP Novosibirsk, NPI Petersburg,Ohio SU, Okayama, Oklahoma, Oklahoma SU, Olomouc, Oregon, LAL Orsay, Osaka, Oslo, Oxford, Paris VI and VII, Pavia, Pennsylvania, Pisa, Pittsburgh, CAS Prague, CU Prague, TU Prague, IHEP Protvino, Regina, Rome I, Rome II, Rome III, Rutherford Appleton Laboratory, DAPNIA Saclay, Santa Cruz UC, Sheffield, Shinshu, Siegen, Simon Fraser Burnaby, SLAC, South Africa Cluster, Stockholm, KTH Stockholm, Stony Brook, Sydney, Sussex, AS Taipei, Tbilisi, Tel Aviv, Thessaloniki, Tokyo ICEPP, Tokyo MU, Tokyo Tech, Toronto, TRIUMF, Tsukuba, Tufts, Udine/ICTP, Uppsala, UI Urbana, Valencia, UBC Vancouver, Victoria, Waseda, Washington, Weizmann Rehovot, FH Wiener Neustadt, Wisconsin, Wuppertal, Würzburg, Yale, Yerevan

Israel
Italy
Japan
USA
CERN
JINR

CMS au LHC/CERN



IPNL, IPHC+GRPHE, LAPP, LLR

53 PhD equiv(3,8%) (3,5%)

58,3 FTE en 2010, à la hausse

dont 51,6 FTE chercheurs

- Forte implication dans la prise de données :

  -Tracker Silicium, Cristaux, Trigger

- Forte présence au CERN

- Forte implication dans l'analyse des données (Higgs, SUSY/BSM, top)

-Améliorations du trigger neutre et du trigger de traces (projets ANR)

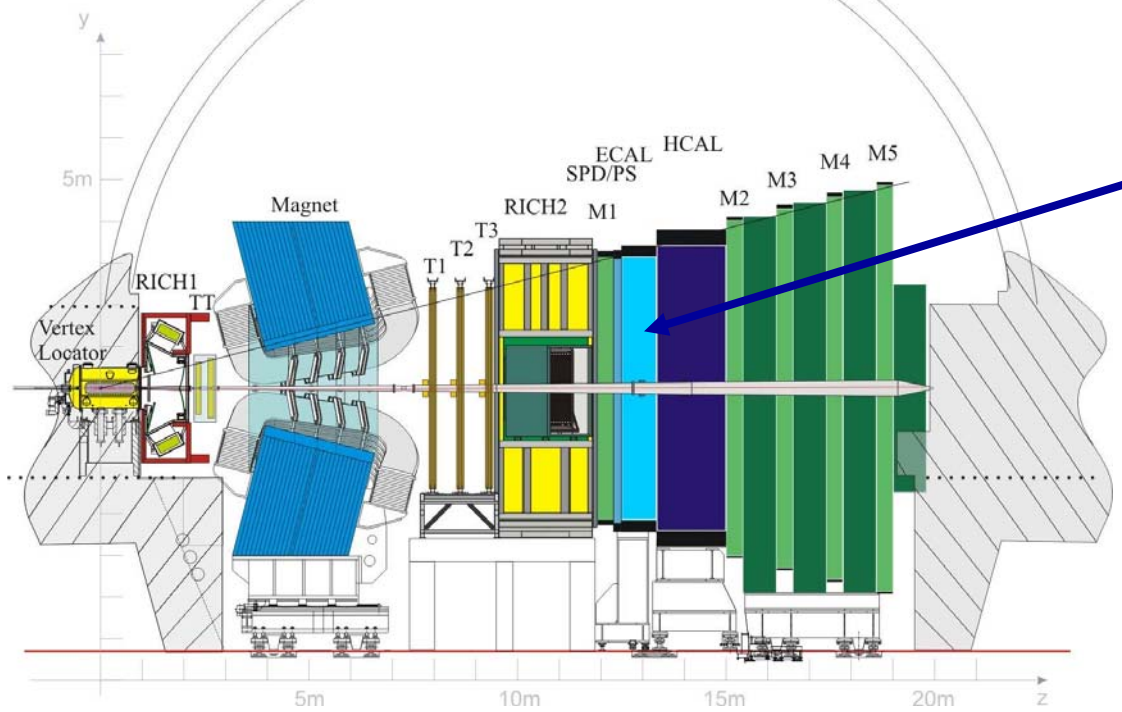
LHCb au LHC/CERN

CPPM, LAL, LAPP, LPC-Cl, LPNHE

44 PhD equiv (12,3%) (12%)

45,4 FTE en 2010

dont 39,8 FTE chercheurs



Calorimètres :

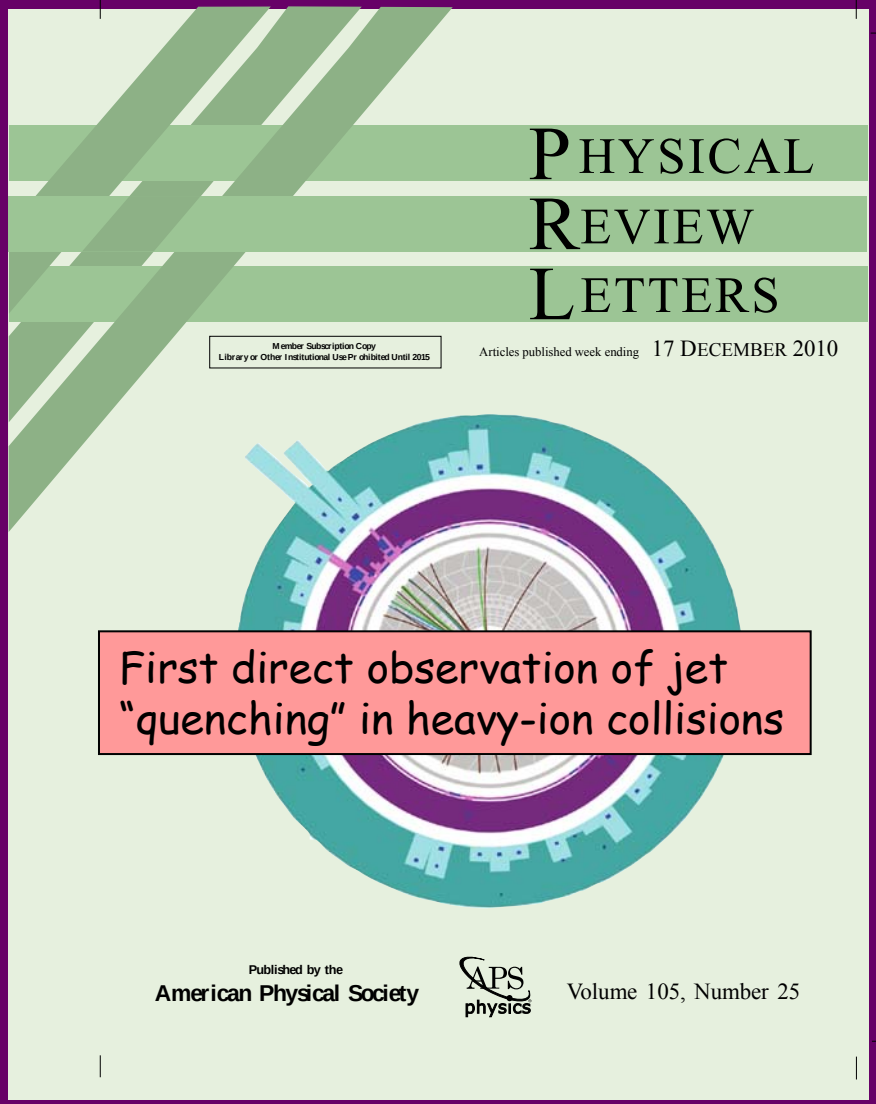
Structure, tests PM, électronique ,L0 Trigger:

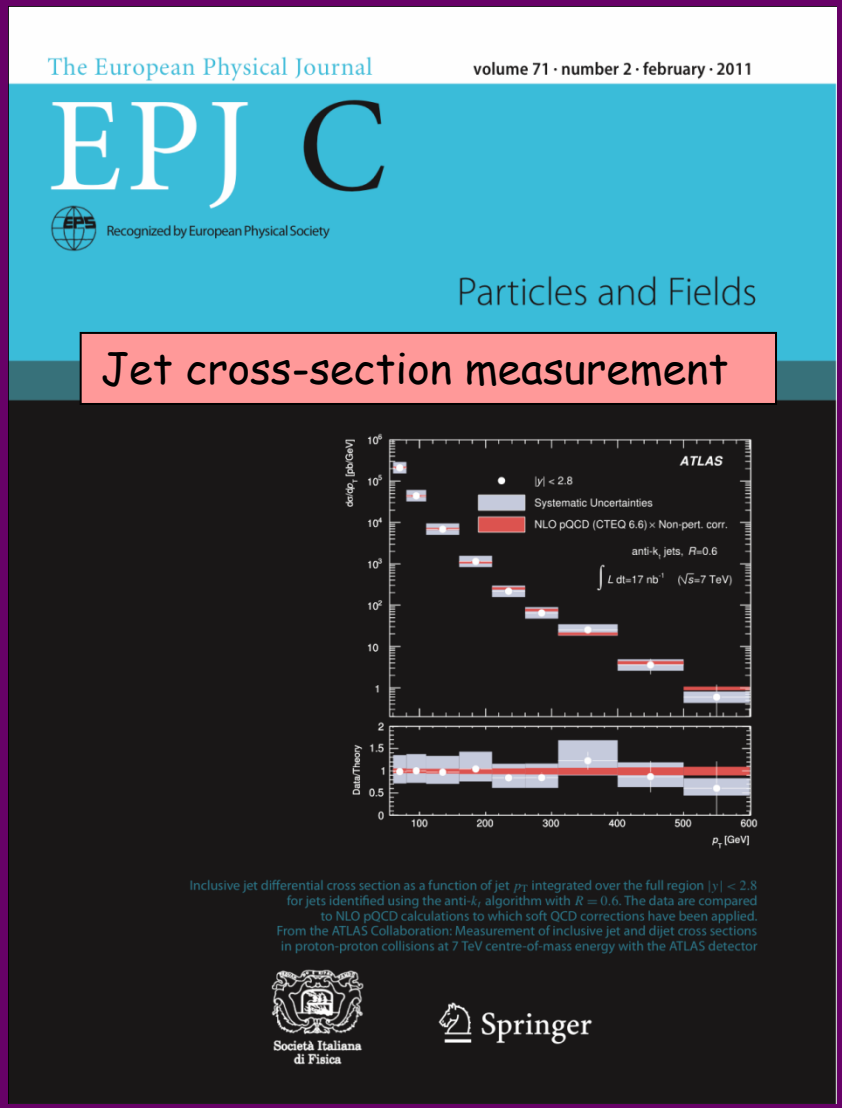
Annecy, Clermont-Ferrand, Marseille, Orsay, Paris

Amélioration de l'électronique (40 MHz)

Based on these data:

- 31 papers submitted for publication (21 published or accepted, 10 under journal's review) and 5 more in the final Collaboration review stage
- Huge number of physics results presented at 2010-2011 Winter Conferences
  → documented in ~150 CONF-notes





CMS papers on Collision Data… so far

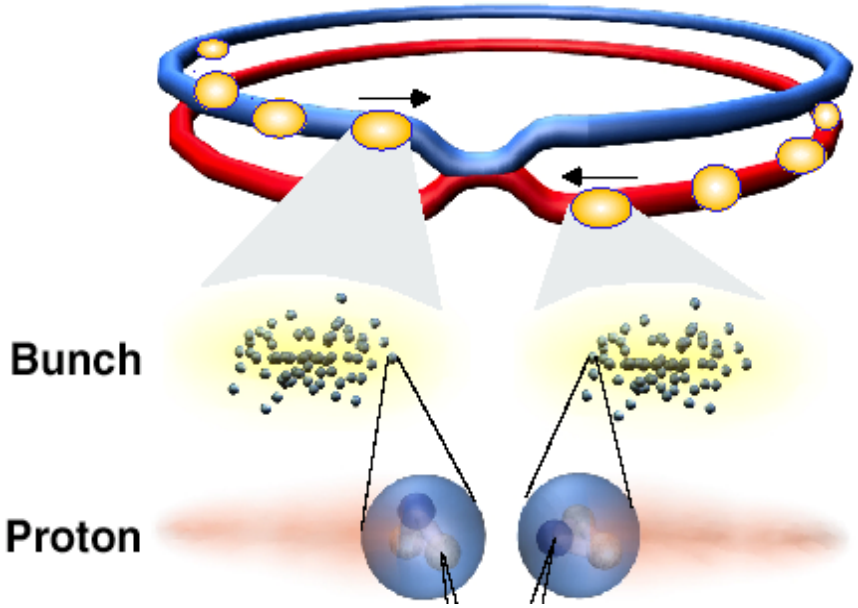
G. Tonelli CMS RRB, 11 avril 2011

1. Measurement of the differential dijet production cross section in proton-proton collisions at sqrt(s)=7 TeV
2. Search for Neutral MSSM Higgs Bosons Decaying to Tau Pairs in pp Collisions at sqrt(s)=7 TeV
3. Measurement of the Inclusive Z Cross Section via Decays to Tau Pairs in pp Collisions at sqrt(s) = 7 TeV
4. Search for Large Extra Dimensions in the Diphoton Final State at the Large Hadron Collider
5. Measurement of the Lepton Charge Asymmetry in Inclusive W Production in pp Collisions at sqrt(s) = 7 TeV
6. Search for Physics Beyond the Standard Model in Opposite-sign Dilepton Events in pp Collisions at √s= 7 TeV
7. Search for Resonances in the Dilepton Mass Distribution in pp Collisions at √s= 7 TeV
8. Search for Supersymmetry in pp Collisions at √s= 7 TeV in Events with Two Photons and Missing Transverse Energy
9. Search for a W' boson decaying to a muon and a neutrino in pp collisions at √s= 7 TeV
10. Study of Z boson production in PbPb collisions at √sNN= 2.76 TeV
11. Measurement of W+W−Production and Search for the Higgs Boson in pp Collisions at √s= 7 TeV
12. Search for Heavy Bottom-like Fourth Generation Quark in tW Final State at CMS in pp Collisions at √s=7TeV.
13. Strange Particle Production in pp collisions at √s= 0.9 and 7 TeV
14. Measurement of BB Angular Correlations based on Secondary Vertex Reconstruction at √s=7TeV in CMS
15. Measurement of Dijet Angular Distributions and Search for Quark Compositeness in pp collisions at √s=7TeV
16. Observation and studies of jet quenching in PbPb collisions √SNN= 2.76 TeV
17. First Measurement of Hadronic Event Shapes in pp collisions at √s=7TeV
18. Dijet Azimuthal Decorrelations in pp Collisions at √s=7TeV
19. Measurement of Bose–Einstein Correlations in pp Collisions
20. Inclusive b-hadron production cross section with muons in pp collisions
21. Search for Heavy Stable Charged Particles in pp collisions
22. Search for Supersymmetry in pp Collisions at 7 TeV in Events with Jets and Missing Transverse Energy
23. Measurement of the B+ Production Cross Section in pp Collisions at √s = 7TeV
24. Search for a heavy gauge boson W' in final states with electrons and large missing ET in pp collisions
25. Upsilon production cross section in pp collisions at √s = 7TeV
26. Search for Pair Production of Second-Generation Scalar Leptoquarks in pp Collisions at √s= *7TeV*
27. Search for Pair Production of First-Generation Scalar Leptoquarks in pp Collisions at √s= *7TeV*
28. Search for Microscopic Black Hole Signatures at the Large Hadron
29. Measurements of Inclusive W and Z Cross Sections in pp Collisions at √s = *7TeV*
30. Measurement of the Isolated Prompt Photon Production Cross Section in pp Collisions at √s= 7TeV
31. Search for Stopped Gluinos in pp collisions at √s= *7TeV*
32. Charged particle multiplicities in pp interactions at √s= 0.9, 2.36, and 7 TeV
33. Prompt and non-prompt J/ production in pp collisions at √s= 7TeV
34. First Measurement of the Cross Section for Top-Quark Pair Production in Proton-Proton Collisions
35. Search for Quark Compositeness with the Dijet Centrality Ratio in pp Collisions at √s= *7 TeV*
36. Search for Dijet Resonances in 7 TeV pp Collisions at √s=7TeV
37. Observation of Long-Range, Near-Side Angular Correlations in Proton-Proton Collisions at the LHC.
38. CMS Tracking Performance Results from Early LHC Operation.
39. First Measurement of the Underlying Event Activity at the LHC with √s = *0.9 TeV*
40. Transverse-momentum and pseudorapidity distributions of charged hadrons inppcollisions ats√= 7 TeV
41. First Measurement of Bose-Einstein Correlations in pp collisions at √s=0.9 and 2.36 TeV at the LHC
42. Transverse momentum and pseudorapidity distributions of charged hadrons at √s=0.9 and 2.36 TeV

+14 in CWR +16 in preparation on results presented at the Winter Conferences.

Conseil Scientifique de l'IN2P3, 5 mai 2011

Collisions at the LHC: counter-rotating, high-intensity bunches of protons or heavy ions.



The rate of **new particle's production** is proportional to the **luminosity**:

$$\mathcal{L} \propto \frac{N_1 N_2 n_b}{\sigma^2}$$

Key parameters:

N_i = bunch intensity

n_b = number of bunches

σ = colliding beam size

*Nominal LHC parameters (7 TeV): **2808** bunches of **1.1x10^{11}** protons, **16** micron size.*

- Nominal bunch intensity
  - 1.15×10^{11}
  - Colliding this bunch intensity is surprisingly easy!

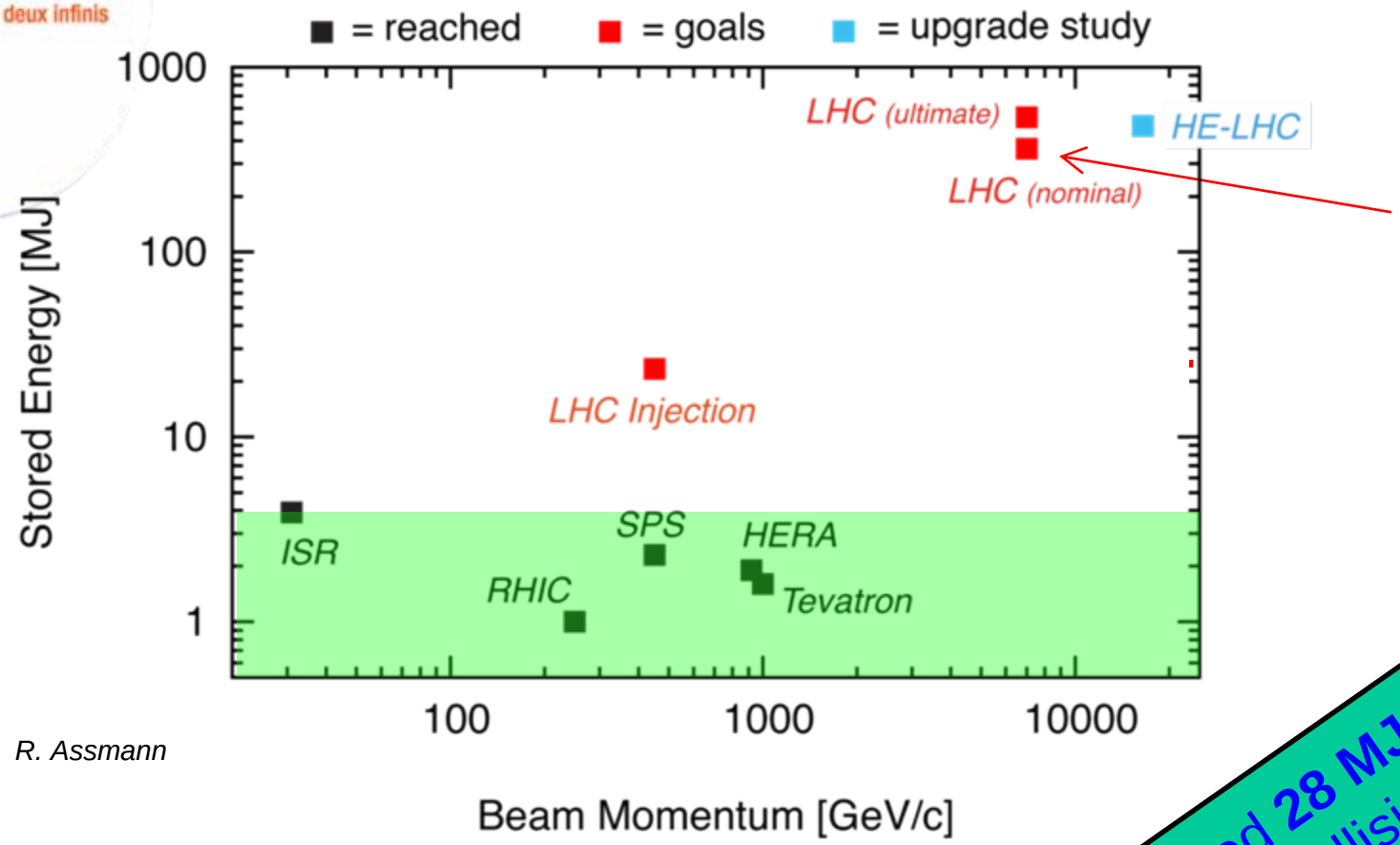
- Nominal number of bunches: 2808
- Nominal bunch spacing: 25 ns (~7.5 m)

- Worked in 2010 with trains of 150 ns
  - up to 368 bunches

- Aim for either 75 or 50 ns in 2011
  - Maximum number of bunches 900 or 1400

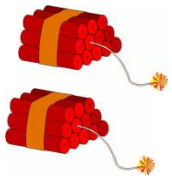
Conseil Scientifique de l'IN2P3, 5 mai 2011

What does this means in practice?



R. Assmann

80 kg TNT



Achieved **28 MJ** (24 MJ with collisions)!

In the first year of operation we needed to achieve:

Factor ~10 above state-of-the-art.

Factor ~15 above the Tevatron.

Estimated Peak and Integrated Luminosity

Energy	3.5 TeV
Beta*	1.5 m
Bunch spacing	75 ns
Bunch intensity	1.2 x 10^{11}
Stored beam energy	75 MJ
Days at peak luminosity	135
Hübner factor	0.2

Emittance [mm.mrad]	Beam-beam parameter	Peak Luminosity [cm^{-2} s^{-1}]	Integrated Luminosity [fb^{-1}]
2.5	0.006	1.3 x 10^{33}	~2.7
2.0	0.007	1.6 x 10^{33}	~3.3

Conseil Scientifique de l'IN2P3, 5 mai 2011

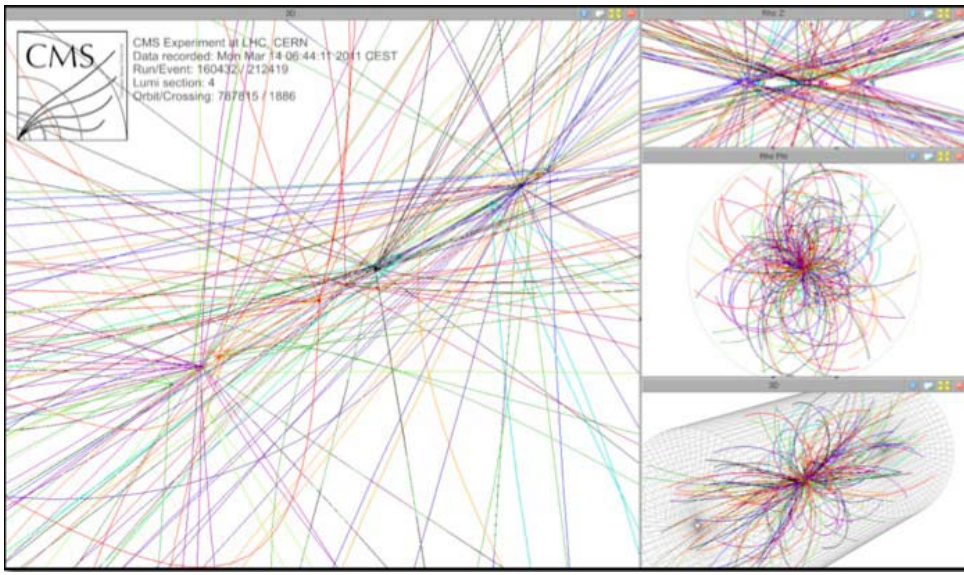
Computing: Challenges for 2011/12 and Resources

Run in 2012: dataset+30%

– In 2010 we collected ~1.5B events. Expect more than 2B in 2010 and 2011

• **Events in 2011-12 are more complicated**

– At 10 interactions per crossing we have factors of 2-3 increase in RECO time. Factor of 2 in RECO size and AOD size



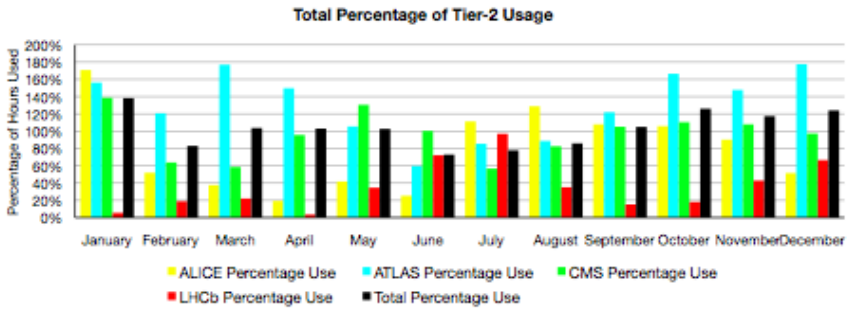
50% increase on Tier-2 resources for 2011
Larger increase in size and processing time from pile-up

Resources

– Resource utilization for analysis was high in 2010 and increasing

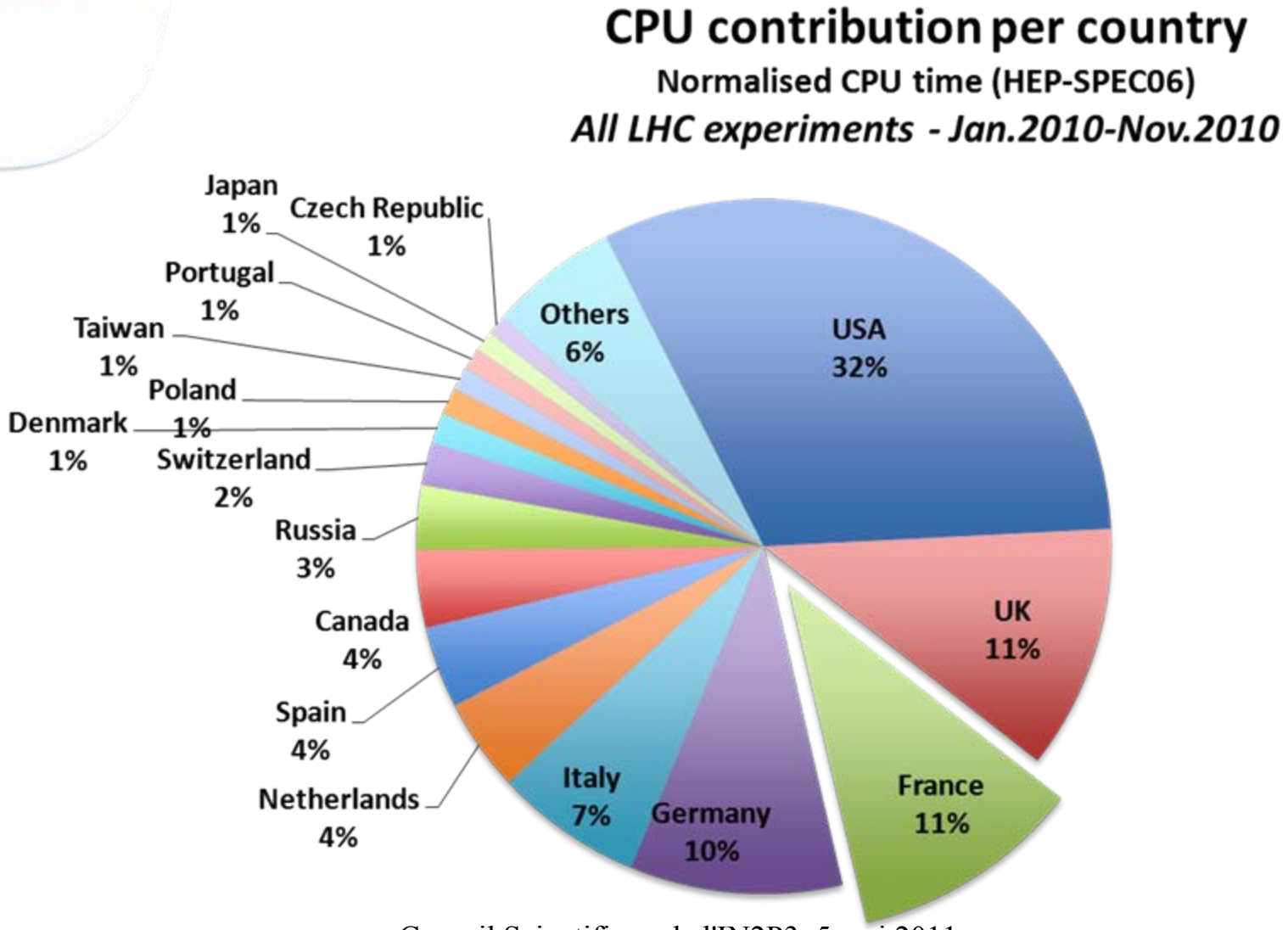
– Significant increases in Tier-1 and Tier-2 resources are available for 2011, but even with these we will have to prioritize activities

2010 T2 Usage by VO



G. Tonelli CMS RRB, 11 avril 2011

Calcul LCG en France



Source: EGEE Accounting Portal
https://www3.egee.cesga.es/gridsite/accounting/CESGA/country_view.html

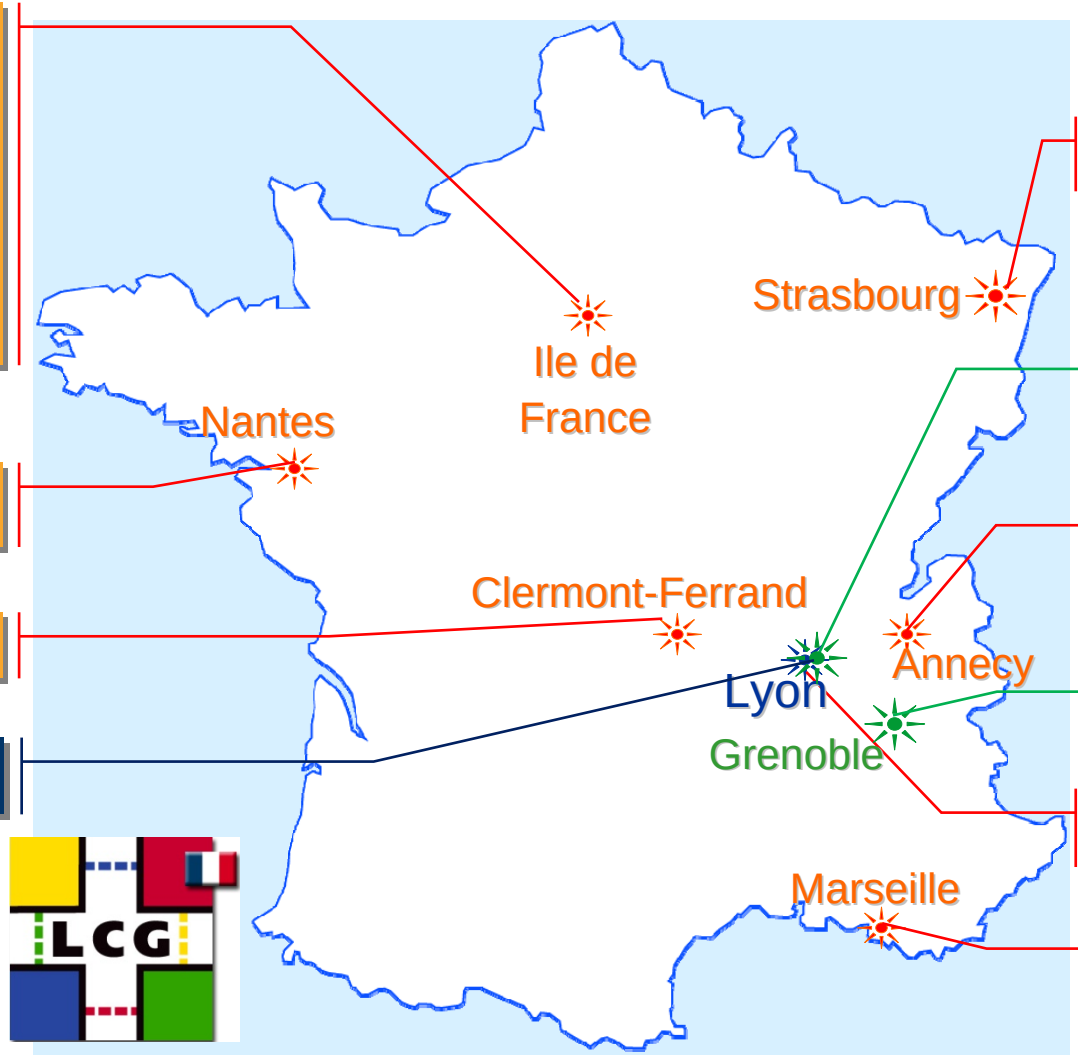
Sites LCG-France 2010

Tier-2: GRIF
- CEA/IRFU
- LAL
- LLR
- LPNHE
- IPNO

Tier-2: Subatech

Tier-2: LPC

Tier-1: CC-IN2P3



Tier-2: IPHC

Tier-3: IPNL

Tier-2: LAPP

Tier-3: LPSC

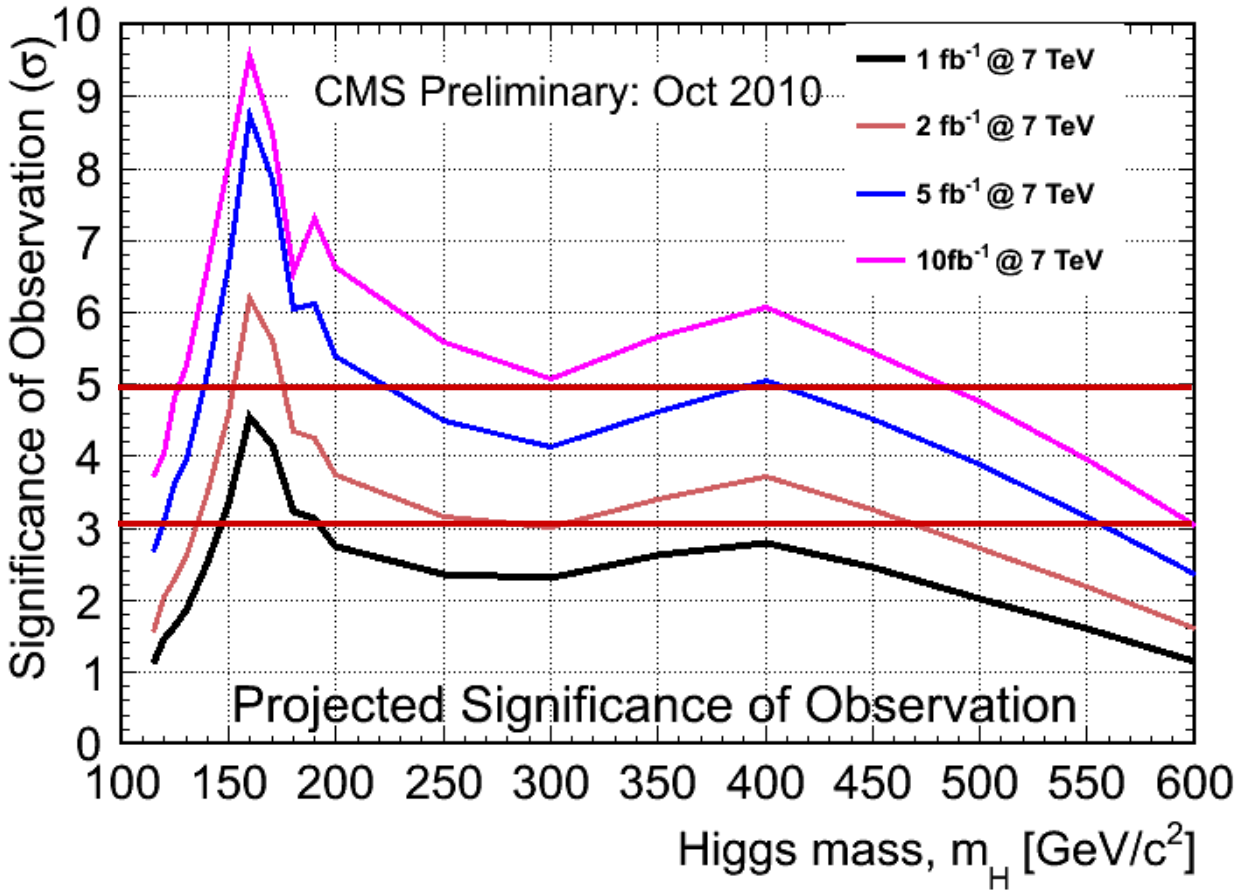
AF: CC-IN2P3

Tier-2: CPPM

Sept.10

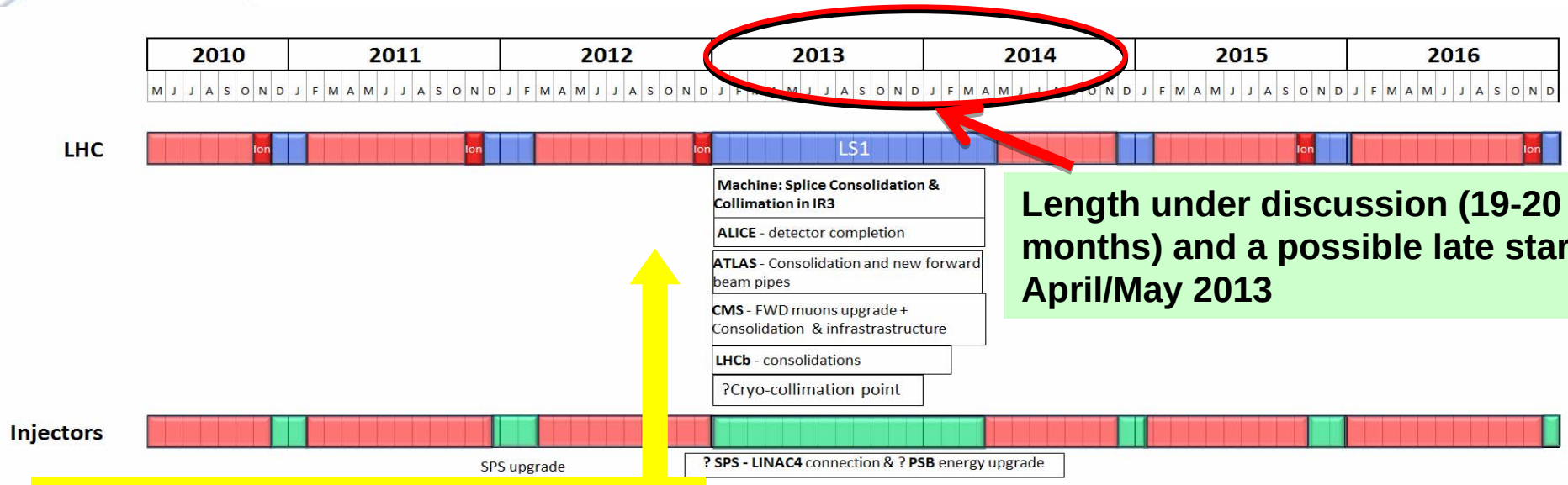
CMS sensitivity vs Higgs mass

G. Tonelli CMS RRB, 11 avril 2011



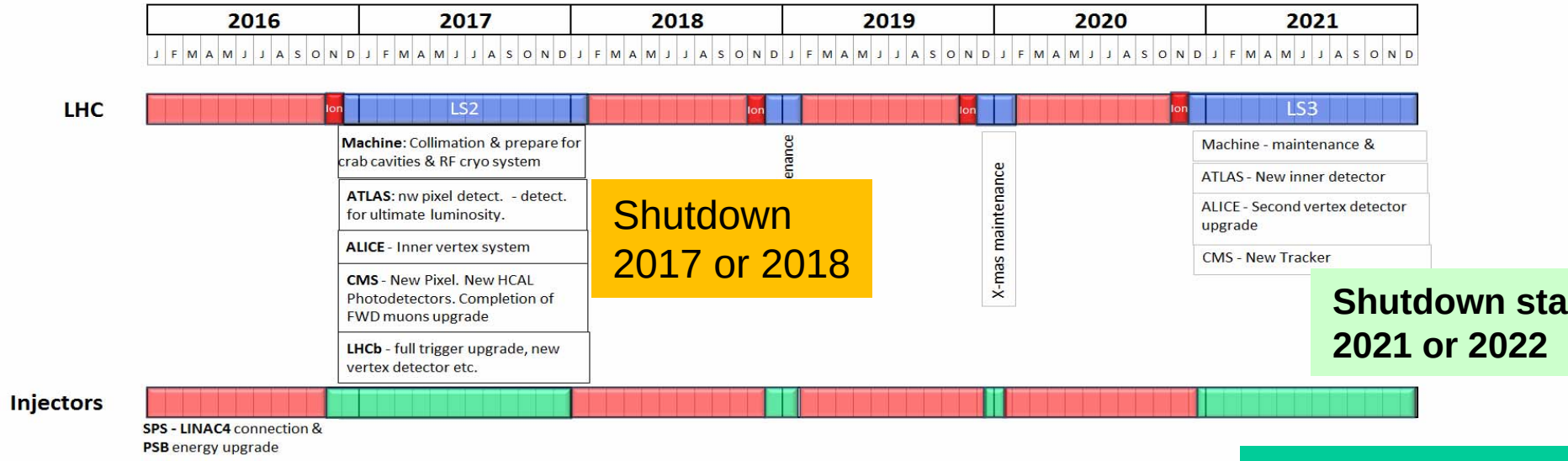
We have recently re-evaluated the reach of CMS in 2011-12:

with $10fb^{-1}$ we can have at least a 3σ significance for the discovery of the Higgs boson over the mass range between ~115 and ~600GeV/c^2.



Length under discussion (19-20 months) and a possible late start April/May 2013

update of European HEP Roadmap



Shutdown 2017 or 2018

Shutdown start 2021 or 2022

Plan to continue until around 2030

- 2013/2014 shutdown (LS1):
  - **long list of maintenance/consolidations/repairs that we are preparing since a few years**
  - **Anticipate IBL installation ….. 2018 installation would be to late!**
  - **Prepare detector for optimal data taking at nominal Luminosity !!!**
- 2017/18 shutdown (LS2):
  - **Prepare detector for ultimate luminosity, upgrade mostly the LVL1 trigger components**
  - **Possible additional consolidations/repairs after ~10 years of detector readiness**
  - **LOI ready + physics motivation + realistic cost estimation by fall 2011**
  - **RRB/LHCC involvement fall 2011, TDRs/MOUs 2012/13**
- 2021/22 shutdown (LS3=HL-LHC):
  - **ID aged mostly by radiation, complete construct of a new ID to be tested on surface in 2021**
  - **Upgrade the detector where technology will be obsolete (mostly electronics)**
  - **Prepare the detector for HL-LHC and 8-10 years of additional running**
  - **TDRs/MOUs 2014/2015 once LHC physics established**

The CMS Upgrade Project

G. Tonelli CMS RRB, 11 avril 2011

The Technical Proposal for the Upgrade of CMS will be published in May.
The 64.5MCHF project covers the next 6 years and contains major upgrades for:
MUON FORWARD SYSTEM
NEW PHOTOTRANSDUCERS FOR OUR HADRON CALORIMETERS
NEW-4 LAYER-LOW MASS PIXEL DETECTOR

IMPROVED DAQ AND TRIGGER
IMPROVED INFRASTRUCTURES

+ many other, although smaller, very important items.

Shutdown 2017-2018?

G. Tonelli CMS RRB, 11 avril 2011

Date still under discussion and LHC schedule can change again in the next 5+ years.

After the LS 2013-14 three major installation/replacements will be still pending: **1) 4-layer, low mass pixel tracker; 2) HB/HE photo-trasducers replacement; 3) Trigger.**

R&D and construction efforts for these two activities will bring us to 2015-16.

Strategical decision taken by CMS. We'll profit of the CMS modularity to build scenarios in which we might be able to perform some of these activities in one extended winter technical stop (4 months).

This flexibility would also allow us to cope with further changes in the LHC schedule.

Work on details is ongoing.

Preparations towards LHCb upgrade

A. Golutvin, LHCb RRB, 13 avril 2011

Purpose of upgraded LHCb detector

- *collect ~50/fb with a general purpose detector in the forward region*
- *Which requires:*
  - ***running at luminosity of L ~ 1x1033 cm-2 s-1***
  - ***with full software trigger (40 MHz)***
- *Physics program will include:*
  - ***Quark flavour physics (CORE program!)***
  - *Lepton flavour physics*
  - *Electroweak physics*
  - *Exotic searches*
- ***Aim***
  - *Run with current detector and collect ~5/fb till second long shutdown*
  - *Upgrade to 40 MHz in ~2018 and collect ~50/fb thereafter*

- ***Submitted upgrade LOI to LHCC beginning of March***
- ***Physics case well received!***

Detector upgrade to 40 MHz requires:

A. Golutvin, LHCb RRB, 13 avril 2011

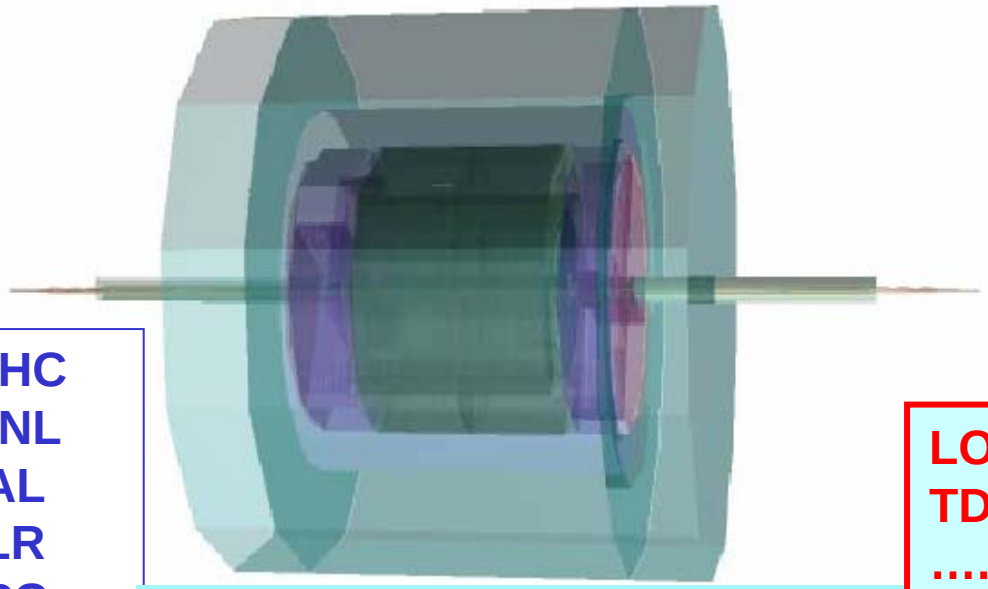
- ***Readout detector at 40MHz to run full software trigger***
- ***Replacement of all sub-detector Front-End electronics to 40 MHZ readout; RICH photo-detectors***
- *Replacement of all Si detectors directly attached to the current 1MHz electronics*
- *VELO, IT, TT*
- *Remove some detectors due to increased occupancies at higher luminosity*
- *RICH1-aerogel, M1, possibly PS&SPD*
- *Eventually improve PID at low momenta by introducing TORCH*

R&D has started and is expected to ramp-up significantly this year towards producing TDRs in time for installing the detectors & electronics in 2018

2 concepts de détecteur

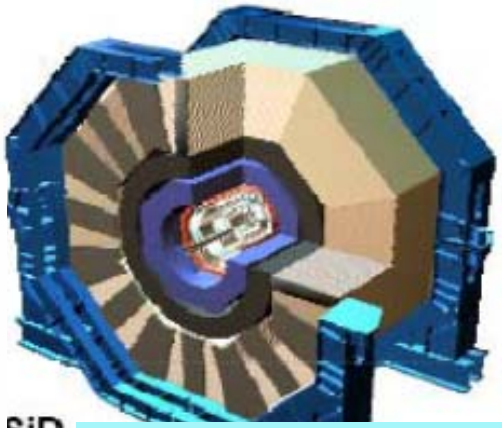
ILD

exGLD+exLDC



H.Videau,membre du JSB de l' ILD

IPHC
IPNL
LAL
LLR
LPC
LPNHE
LPSC



SiD

LAPP
LPNHE

Y.Karyotakis,membre du SB de SiD

LOI évaluées par IDAG
TDP intérimaire en 2010, DBD en 2012
…. Et après ???

En France: R&D Physique & Détecteurs

IN2P3 Institut National de Physique Nucléaire et de Physique des Particules

irfu cea saclay

Worldwide Study of the Physics and Detectors for Future Linear e+ e- Colliders

http://flc.in2p3.fr

-A) Calorimétrie

Collaboration CALICE, Spkp. Jean-Claude Brient

IPNL, LAL, LAPP, LLR, LPC-Ct, LPSC

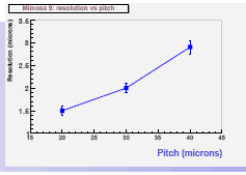
CALICE Calorimeter for LC

EMCal (LAL, LLR)

SDHCAL (IPNL)

DHCAL/Micromegas (LAPP)

CMOS-VD



-B) Dét. de Vertex: CMOS, 3DIT

Collaborations bilatérales, Resp. Marc Winter

IPHC JLAB, RHIC, sLHC

SiLC International Collaboration

-C) Dét. de Traces: Silicium

Collaboration SiLC, Spkp. Aurore Savoy-Navaro

LPNHE

-Financement Européen: EUDET (**6**ème PCRD)
-Financement ANR pour le SDHCAL
-Financement Européen: AIDA (**7**ème PCRD)

SuperB

- TDR (machine + physique + détecteur) en 2011
- R&D accélérateur à Frascati (Daphné)
- Financement italien assuré à partir de 2011
  - 764 M€ sur 10 ans: inclus des coûts d'utilisation sur 4 ans
- Inauguration le 30 mai à l'Ile d'Elbe

- Mise en évidence indirecte de nouvelle physique
- Mesure de paramètres de la nouvelle physique vue au LHC

- Infn is very proud of starting such an ambitious program where basic science is the driving force
- The Institute is aware of the challenge represented by the merging of basic science and material/bioscience communities
- The Government support is there
- We look forward to an increasing support by the international community

Autres projets

- Geant 4: examiné en mars 2009 (G4-DNA)
  - Une période mouvementée – Soutien du CERN
  - M. Verderi (LLR), co-spokesperson
  - Chairman de l'Oversight board
- nEDM:examiné en juillet 2007
  - Phase 1: utilisation du détecteur RAL-Sussex à l'ILL
  - Phase 2: déménagement à PSI
  - Phase 3: nouvelle collaboration, nouveau détecteur à PSI
- AEGIS

Possibles discussions en CS

- Upgrades LHC: 2012 ? Début 2013 ?
  - Demandes de financement TGIT
- LCG (déjà examiné en 2007)
- SuperB
  - Participation au TDR approuvée en juin 2009
  - 2011 ?
- nEDM
  - Phases 1 et 2 approuvées en juillet 2007
  - 2011 ?
- ILC et R&D instrumentation post 2012
  - en 2013
- Geant4: plus tard
- AEGIS ?