

LPC



CMS 101: Overview

Sarah Eno

(thanks to people I stole slides from: Dan Green, P. Foka, Y. Schutz, R. Forty, F. Ferro, M. Szaeckowski, public CERN web pages

LPC

Purpose/Overview of Course



General Introduction: Sarah Eno (30')

Introduction to the Detector: Jim Freeman (30')

Introduction to the Software: Yuri Gershtein (30')

Introduction to the FNAL UAF: Hans Wenzel (10')

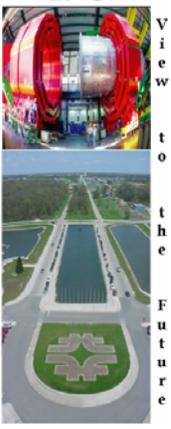
Introduction to the Trigger Table: Darin Acosta (30')

- Learn enough CMS jargon to understand many CMS week talks
- Learn who's who in CMS

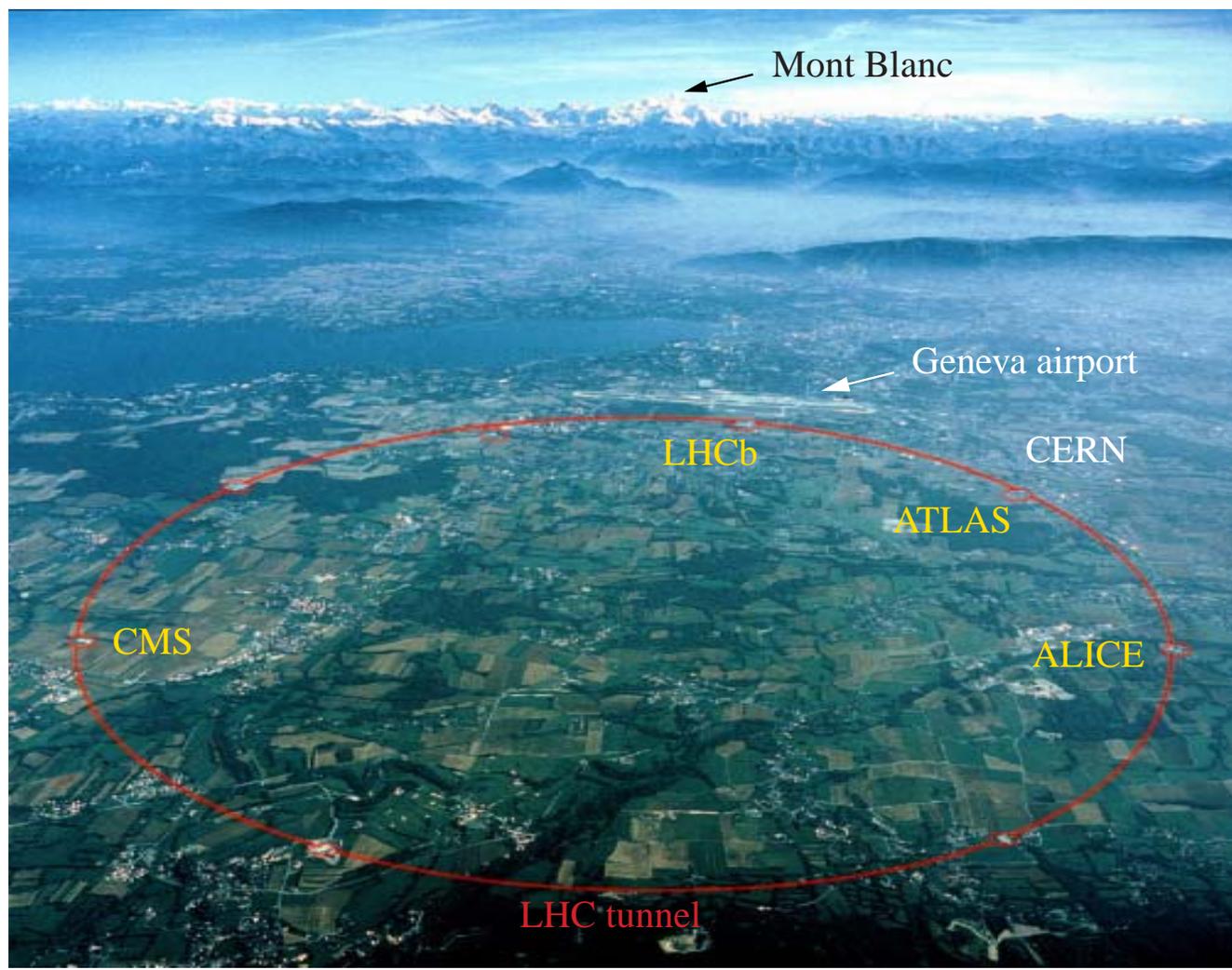


Outline

- Some basics on the LHC accelerator/detectors
- Some basics on physics at 14 TeV
- International CMS
- Life at CERN
- US CMS
- The LPC



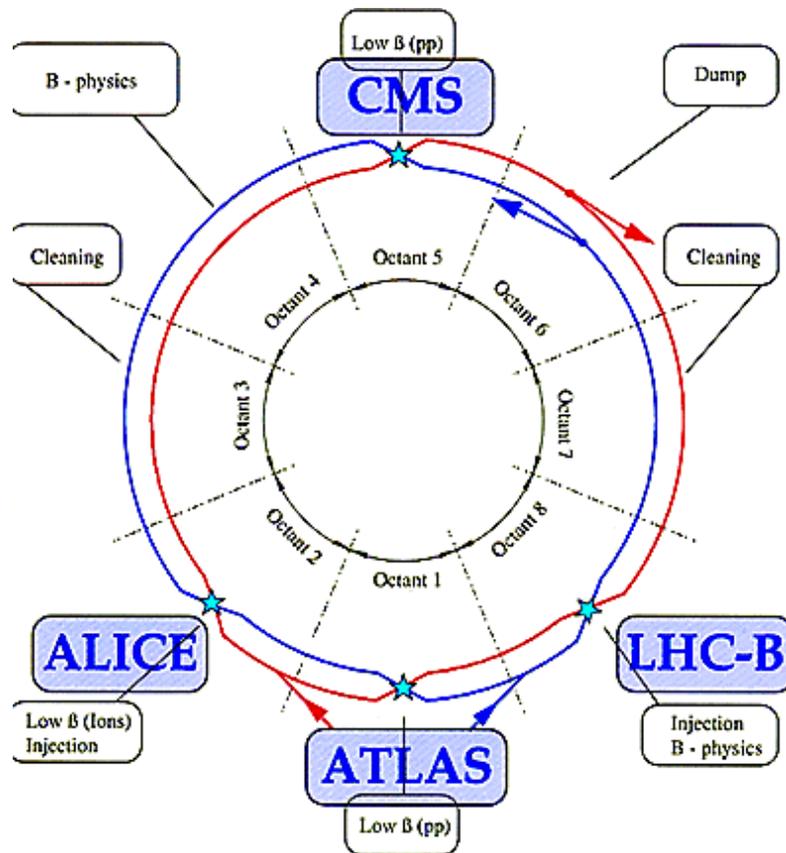
The Accelerator



In the LEP tunnel



Accelerator Parameters



$$\sqrt{s} = 14 \text{ GeV}$$

$$\text{Design Luminosity: } 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$$

$$\langle \bar{n} \rangle = 17$$

$$\text{Starting Lum: } 2 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$$

$$\langle \bar{n} \rangle = 3.5$$

crossing time: 25 ns

Tevatron

$$\sqrt{s} = 1.96 \text{ TeV}$$

$$\text{luminosity} = 0.5\text{-}1 \cdot 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$$

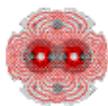
$$\langle \bar{n} \rangle = 1.25\text{-}2.5$$

crossing time = 396 ns

<http://lhc-new-homepage.web.cern.ch/lhc-new-homepage/>



Status of Accelerator



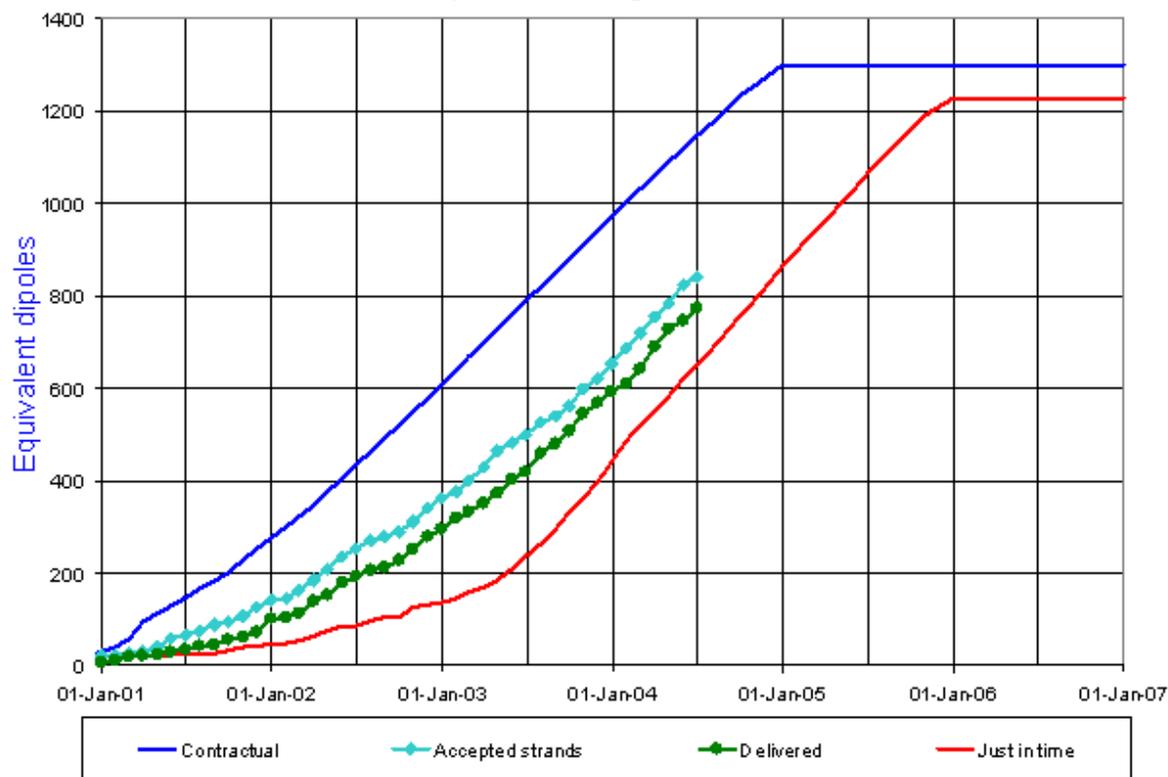
LHC Progress
Dashboard

Construction



Accelerator
Technology
Department

Superconducting cable 1



Easy to see if the accelerator is falling behind. So far, its not.

Updated 30 Jun 2004

Data provided by A. Verweij AT-MAS

<http://lhc-new-homepage.web.cern.ch/lhc-new-homepage/DashBoard/index.asp>

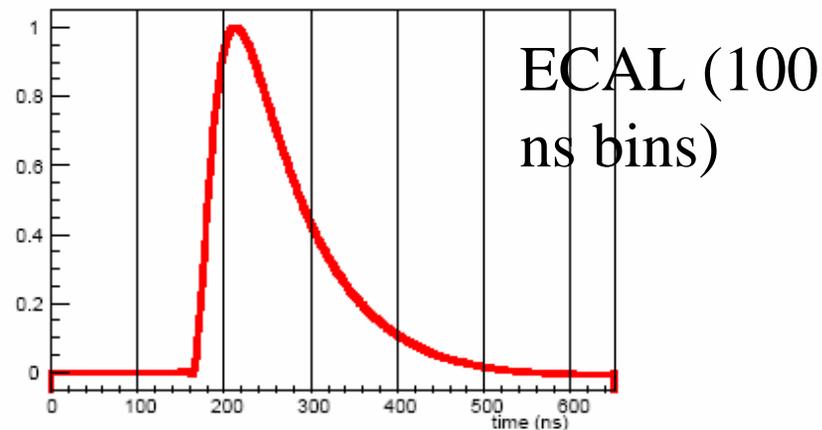


Short Crossing Time

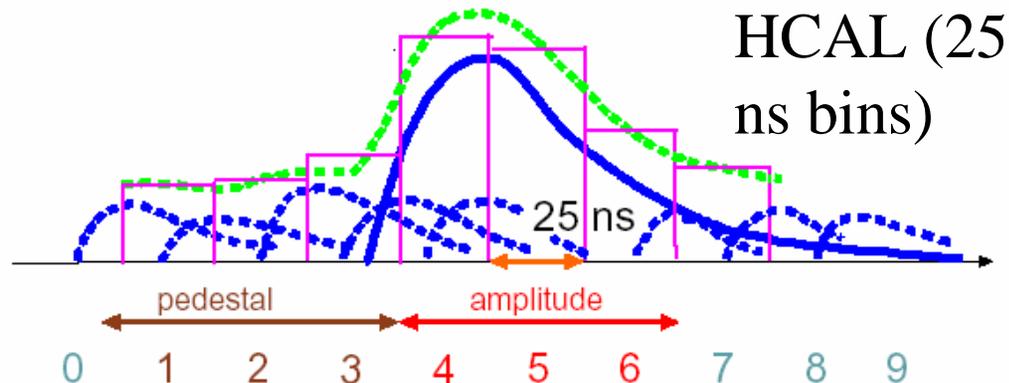
time-of-flight to:

	$\eta=0$	$\eta=2.4$
ECAL:	4 ns	10 ns
HCAL:	6 ns	13 ns
Coil:	10 ns	-
Muon 1:	13 ns	25 ns
Muon 4:	24 ns	36 ns

(signal shape in ecal)

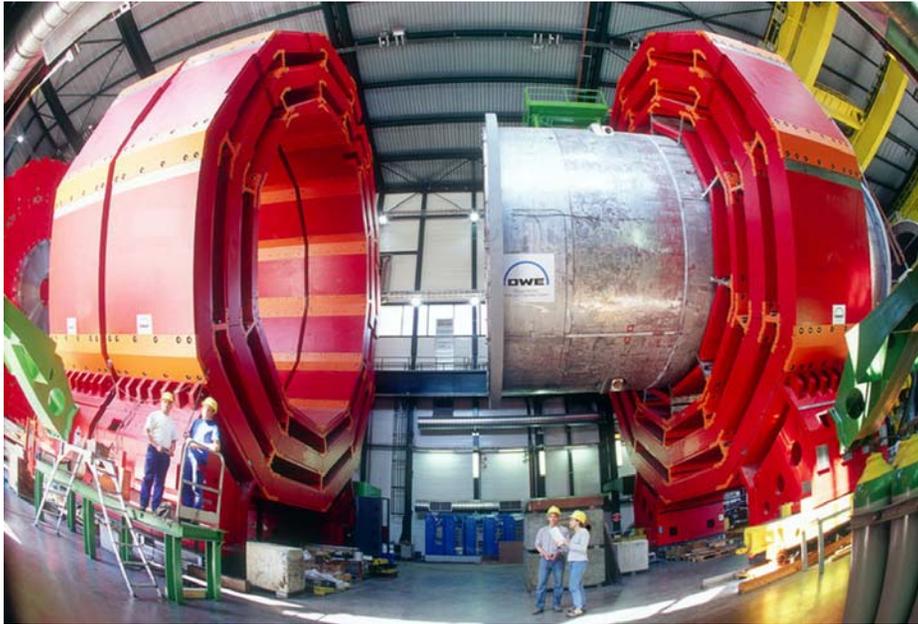


from preamplifiers attached to photodetectors for ECAL crystal readout.





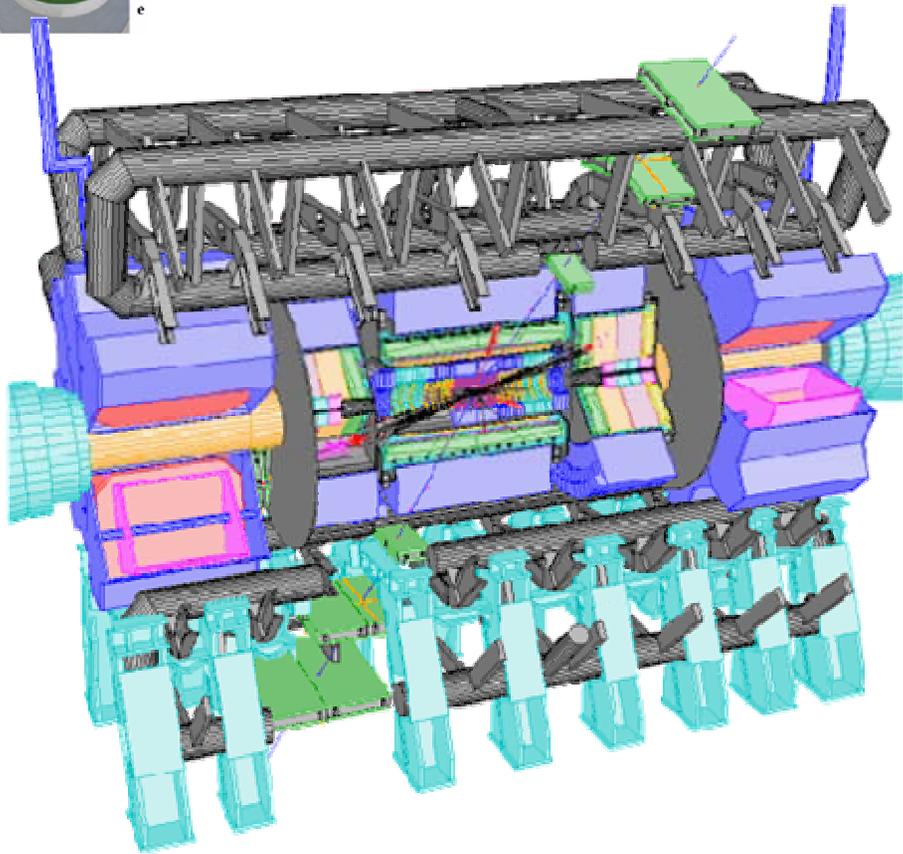
Detectors



If you don't know which detector this is, then I'm glad you are here!



Other LHC Experiments: ATLAS

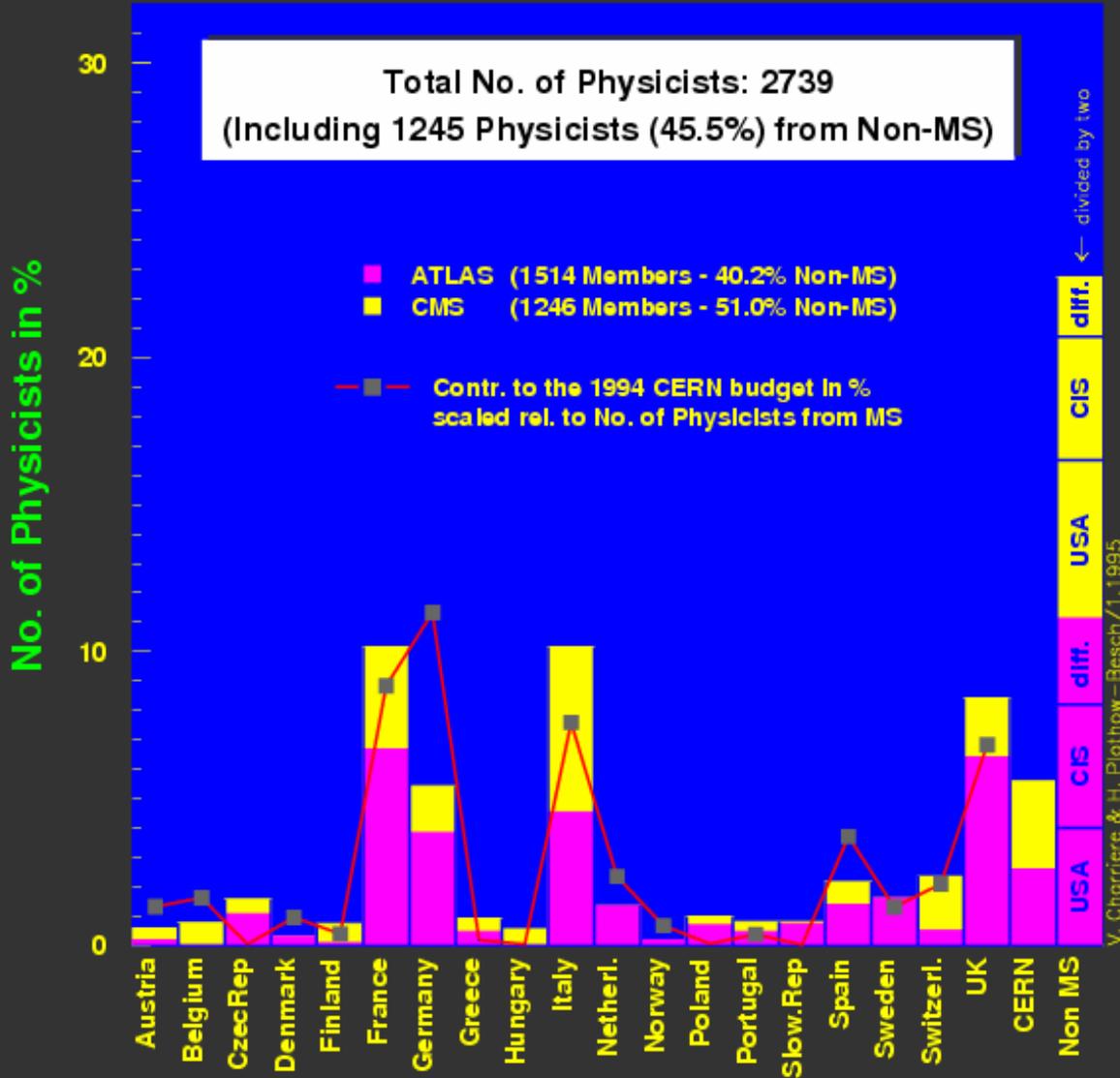


- CMS is 14.6 m tall, ATLAS is 20 m tall.
- CMS has its solenoid outside its ECAL, ATLAS has ECAL outside the solenoid
- Tracking: CMS has 4T over 1.3 m radius, ATLAS has 2 Tera over 1.2 m radius.

ATLAS



TPs - LHC pp collider option - Dec. 1994



Atlas has lots of French, Brits, Italians, and Germans.

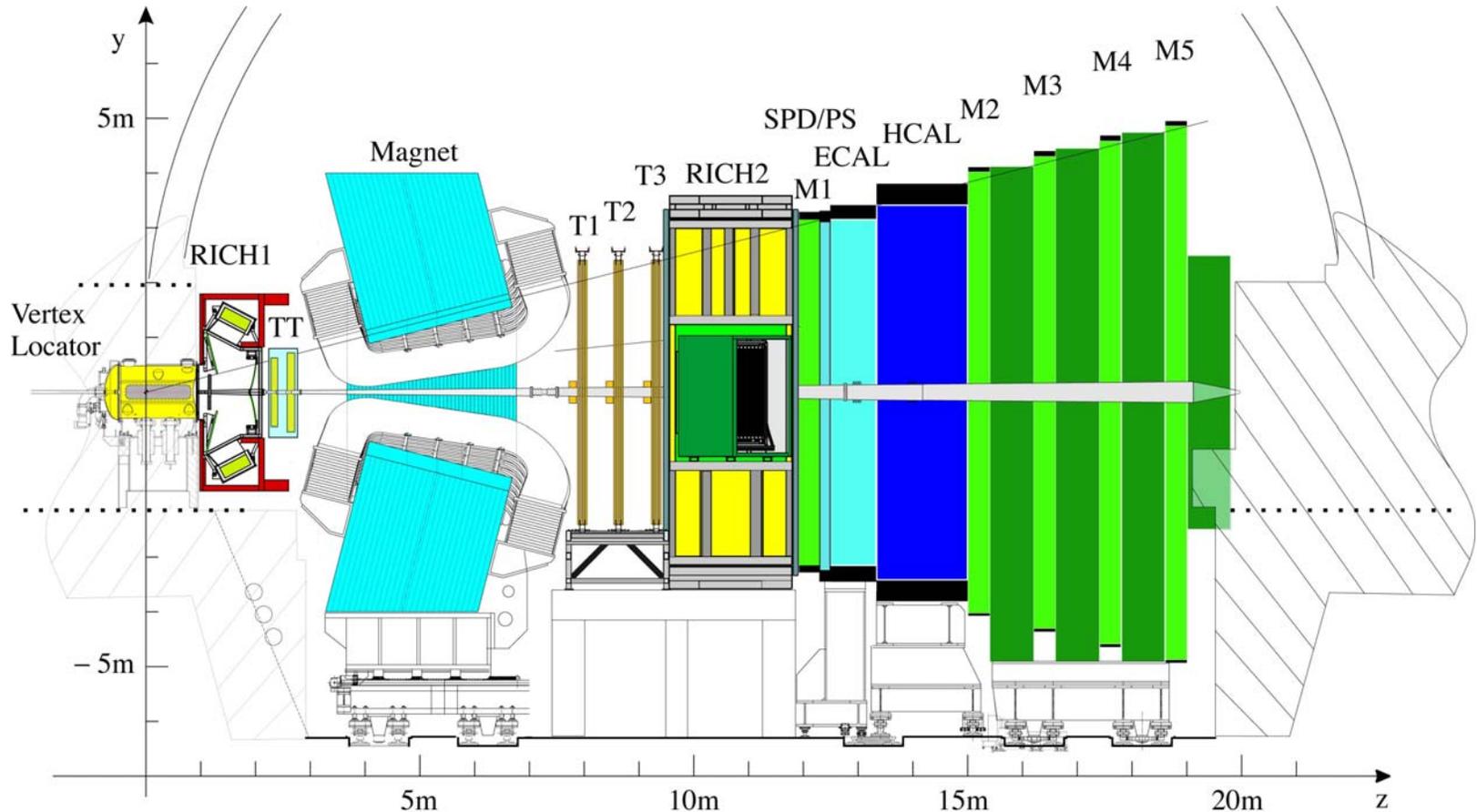
CMS has Italians, Russians, French, Germans

From the time the US was just joining LHC, so ignore the US numbers/

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Other LHC experiments: LHCb



Turns on at the same time as ATLAS and CMS

Looks like a fixed target experiment: covers $1.9 < \eta < 5.3$

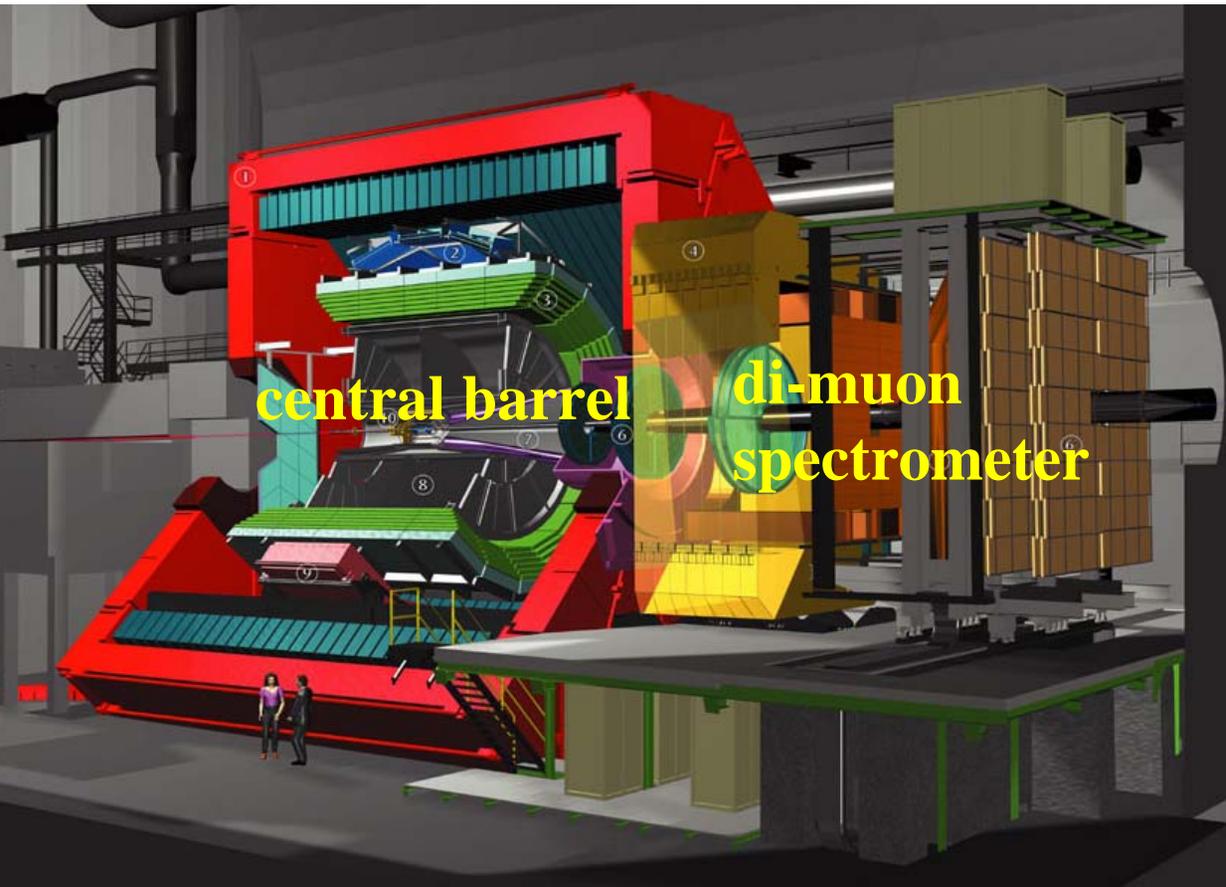


Other LHC experiments: Alice

Heavy ions (CMS will also do heavy ions)

◆ pp and pA

- for comparison with PbPb
- for their own merit



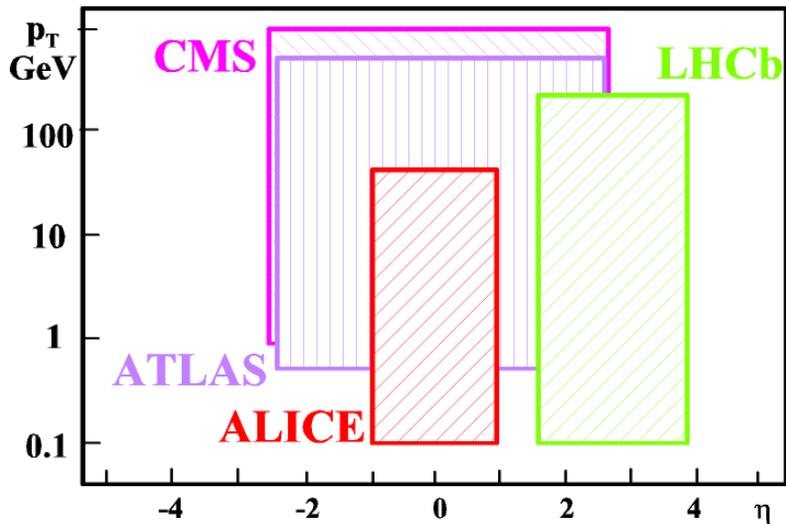
- global pp properties
- jet physics
- diffractive physics

Starts up at same time as ATLAS, CMS, running pp. Nominal first run for heavy ions: 2008

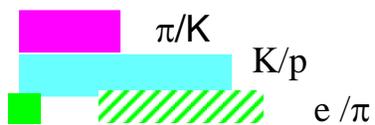


Alice

Tracking with low P_T cutoff
and Particle ID



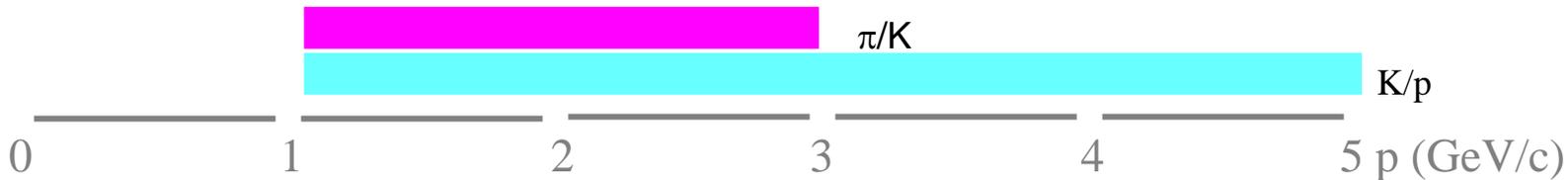
TPC + ITS
(dE/dx)



TOF



HMPID
(RICH)



TRD

e/π



PHOS

γ/π^0



MUON SPECTROMETER



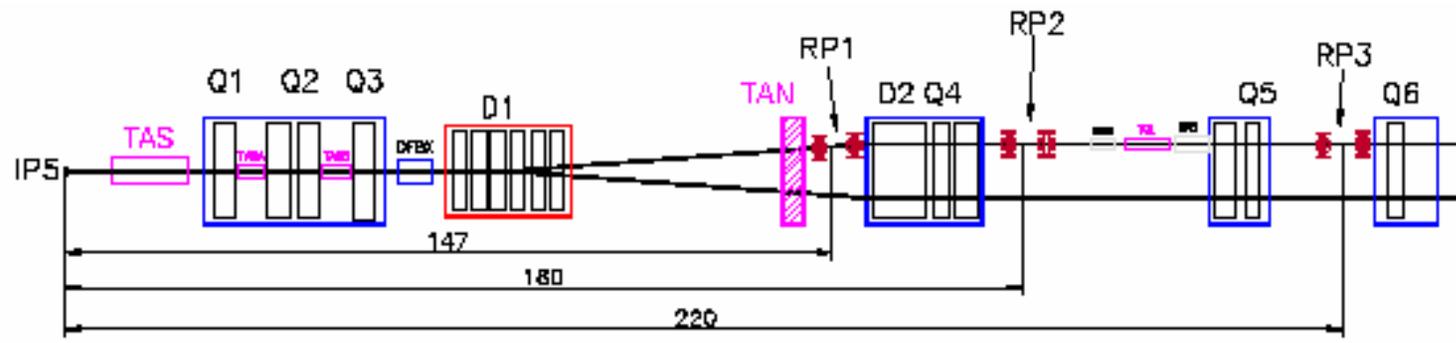
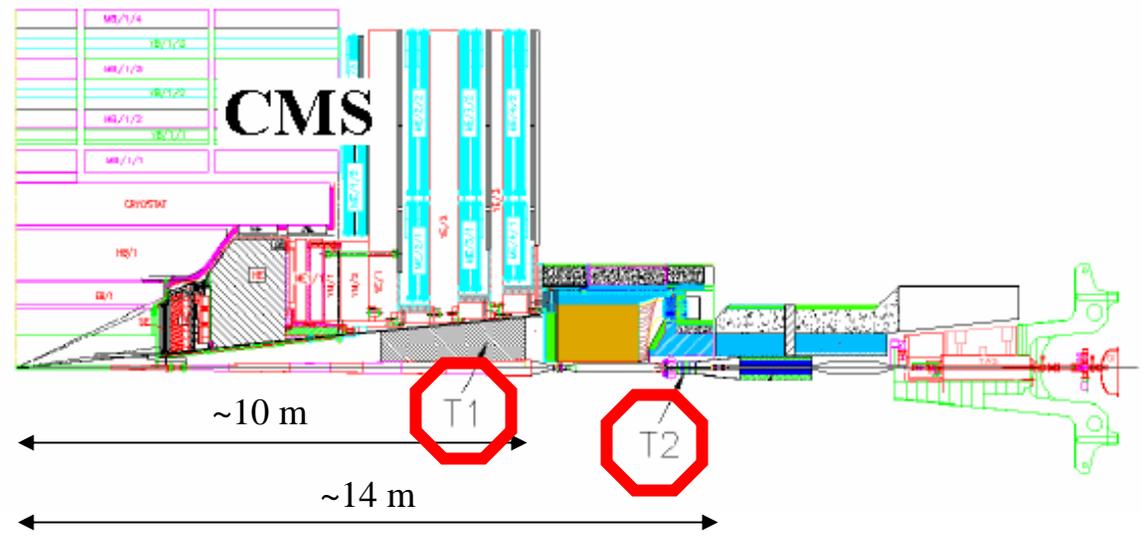


View
to
the
Future

TOTEM

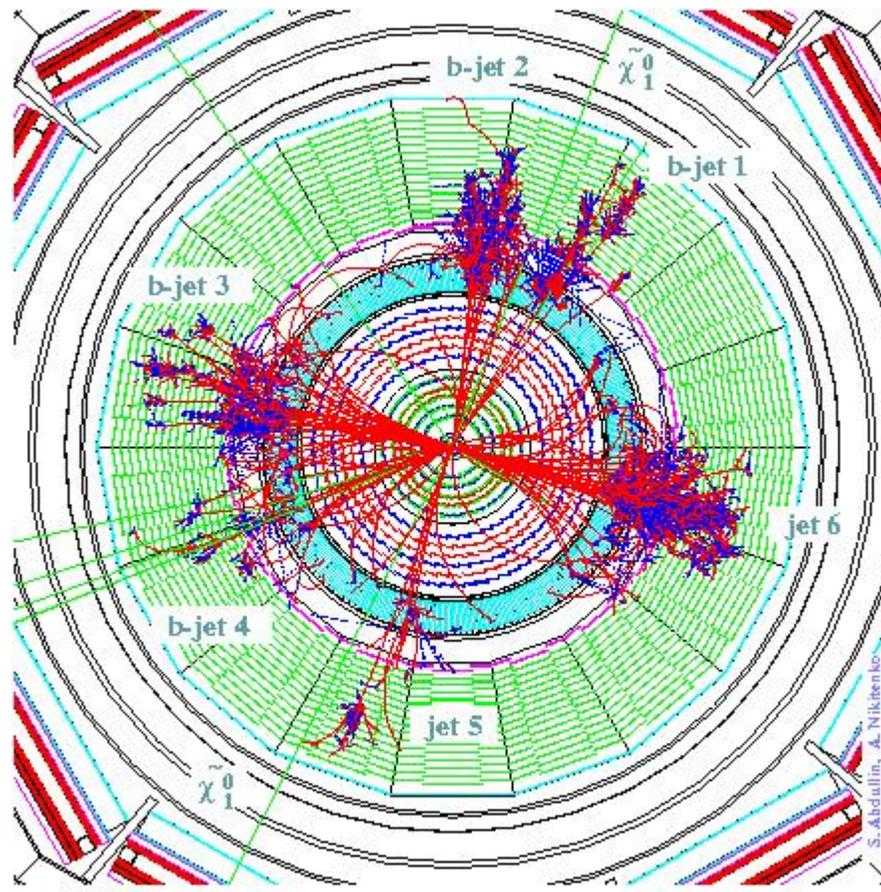
Elastic scattering experiment.

Really part of CMS





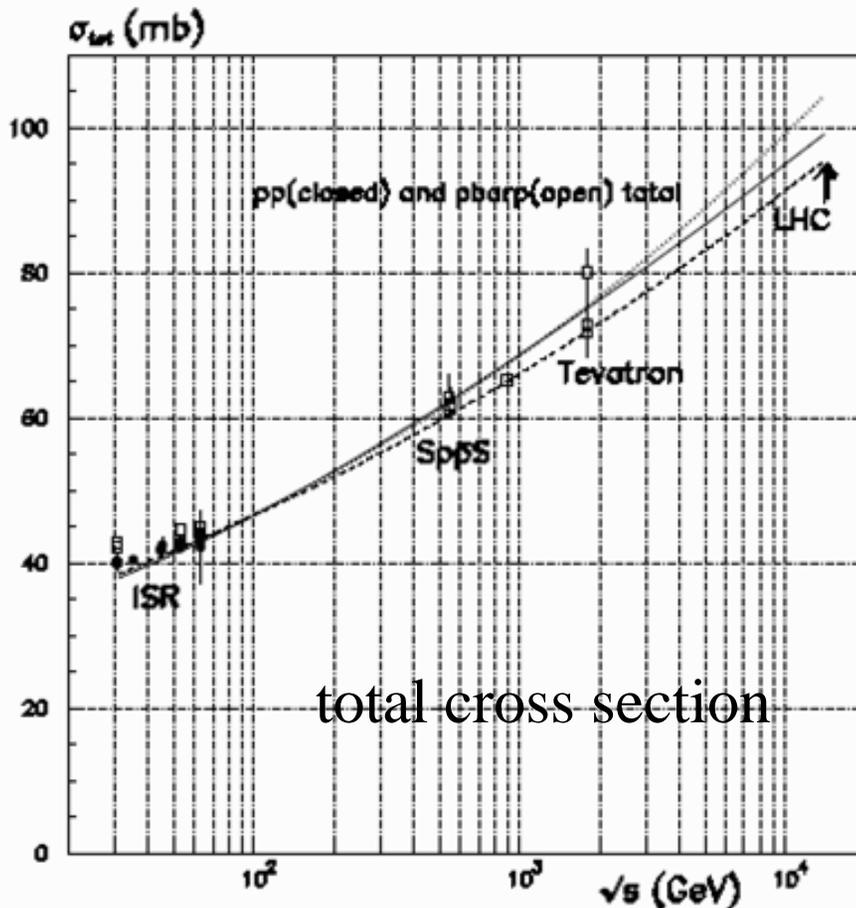
Basic Physics





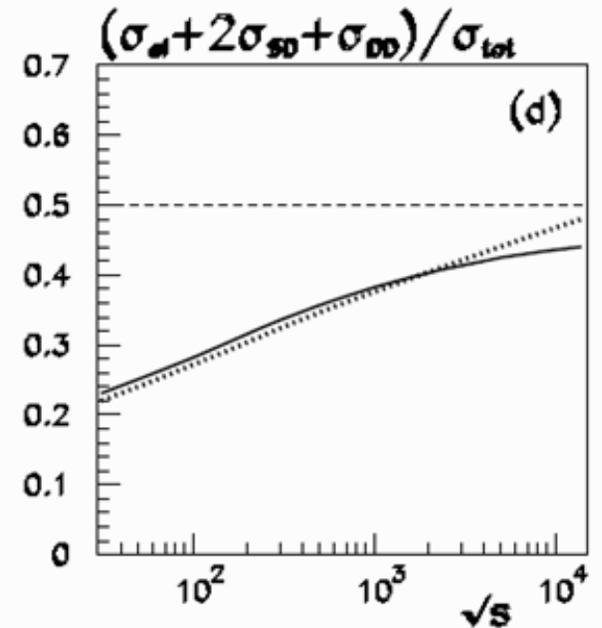
$dN/d\eta$

Khoze, Martin, Ryskin hep-ph/0007359



Total cross section 70 mb at Tevatron (inelastic is 46), 100 mb at LHC (50-60).

Fraction elastic, diffractive



Range comes mostly from the difference between the CDF and E710 cross sections at 1.8 TeV.



$dN/d\eta$

Mean number of inelastic interactions per crossing at $2E33$ is 3.5. At 10^{34} , it's 17.

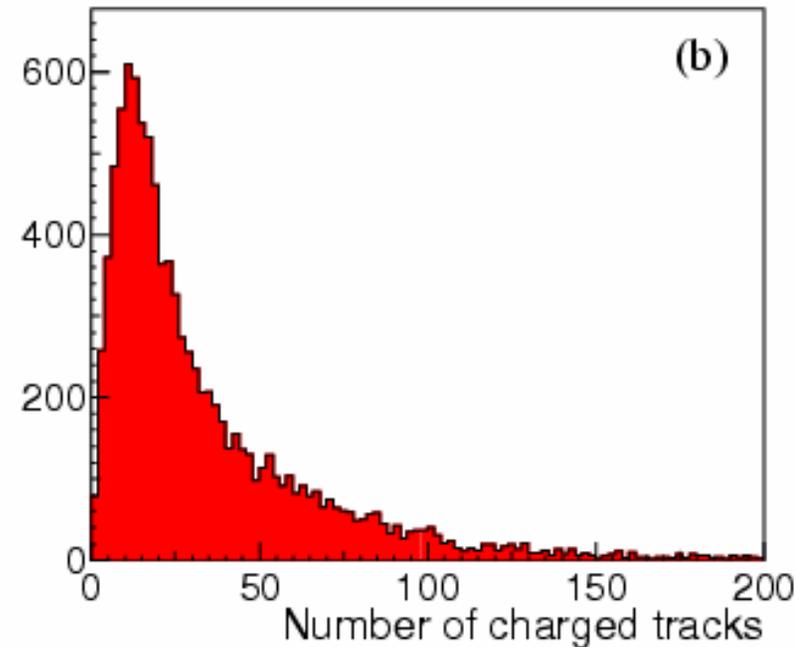
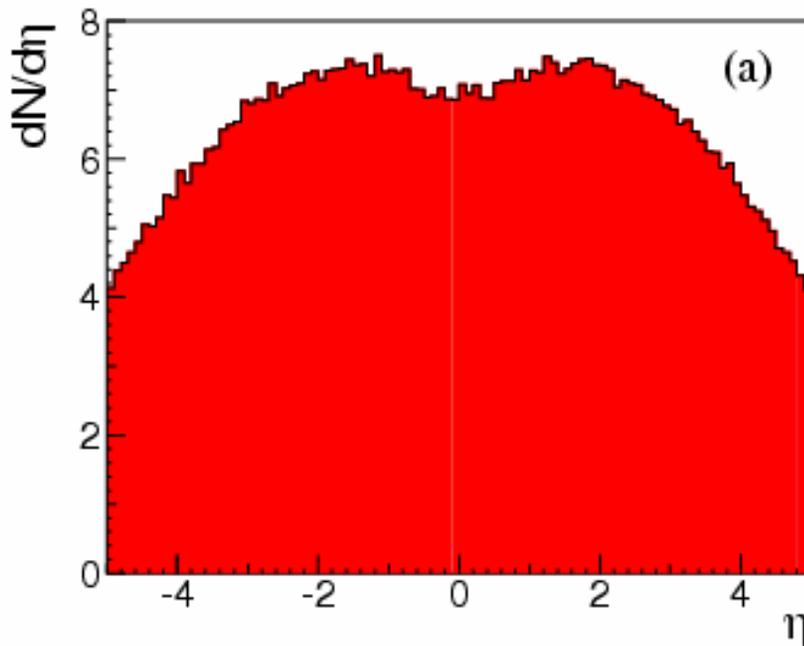
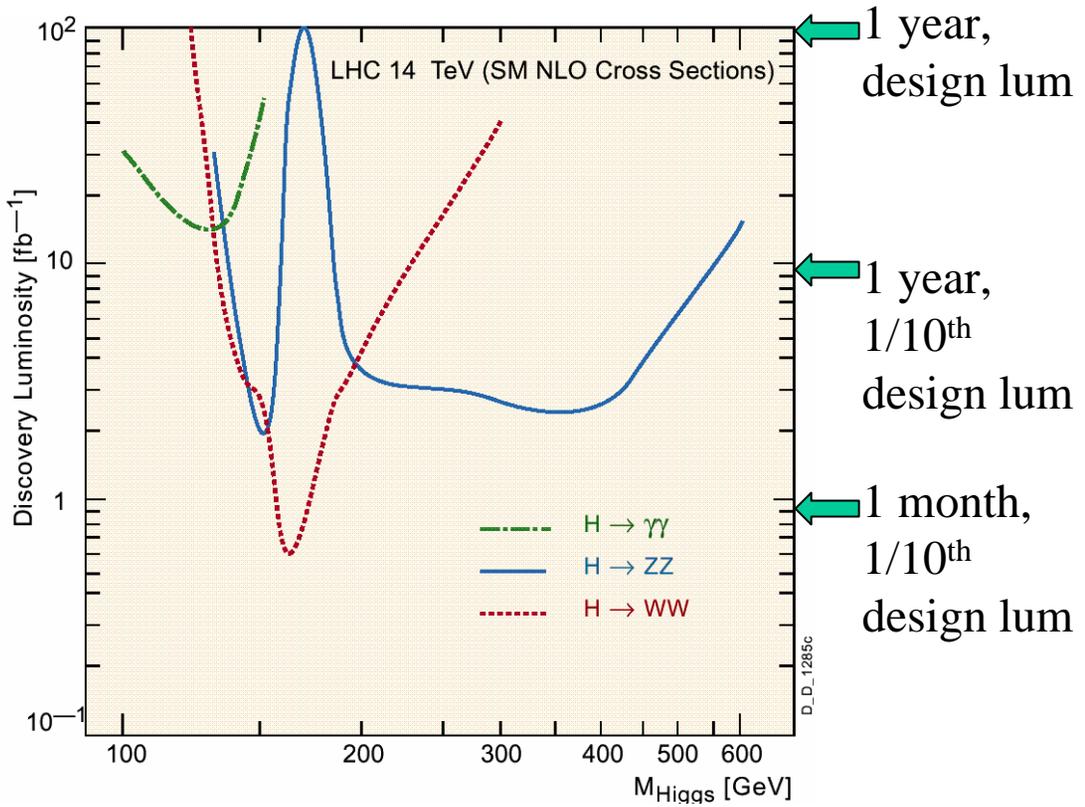
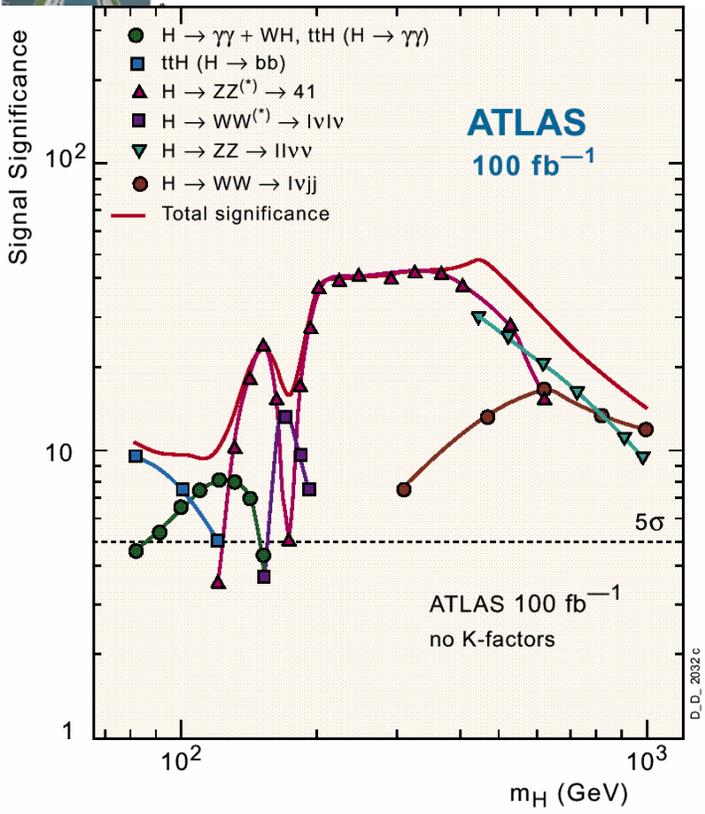


Fig. 2: PYTHIA 5.7 with 'standard' settings. For charged tracks with $p_T > 150$ MeV, (a) mean multiplicity per unit of pseudorapidity as a function of pseudorapidity, (b) total multiplicity inside $|\eta| < 2.5$.

Higgs Reach/Time Scales

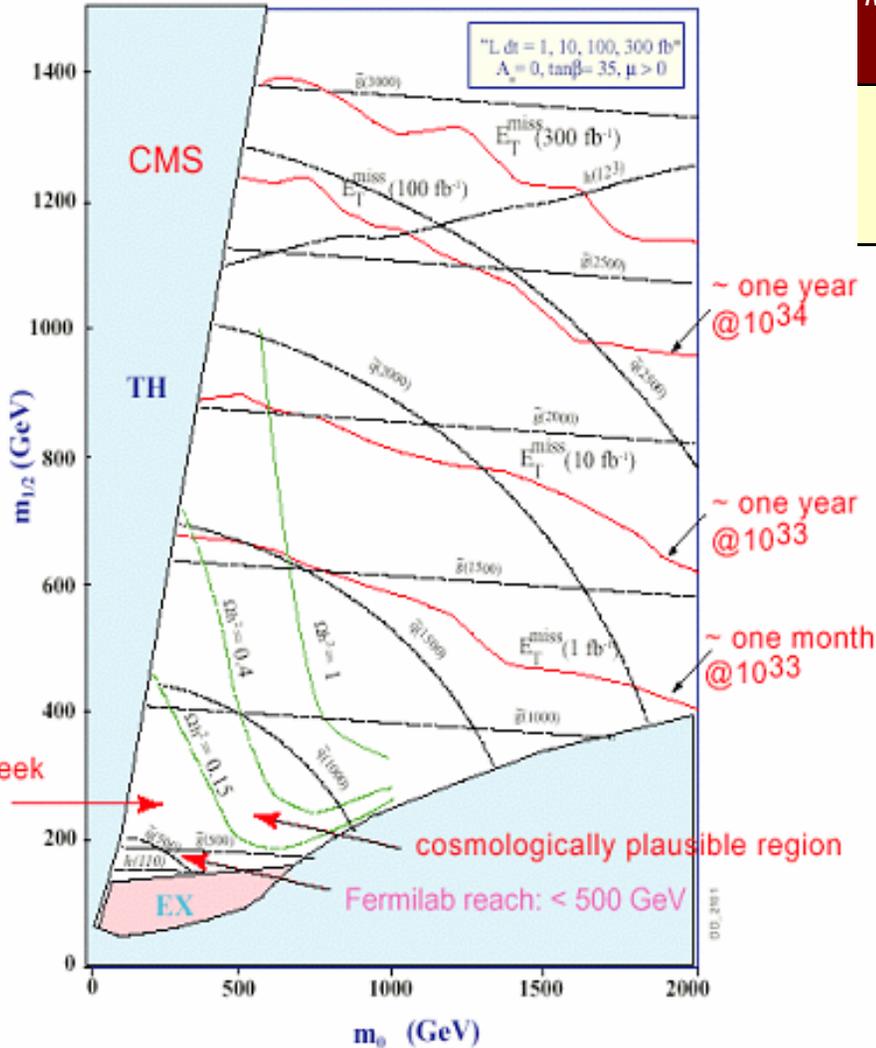


If we can start up at 1/10th design luminosity, we'll discover a Higgs with mass greater than 130 GeV **within 1 year**. Will cover entire theoretically allowed range with 1 year of design luminosity.



SUSY reach/ TimeScales

CMS \tilde{q}, \tilde{g} mass reach in $E_T^{\text{miss}} + \text{jets}$ inclusive channel for various integrated luminosities



Mass (GeV)	σ (pb)	Evts/month Low lum - high lum
500	100	$10^5 - 10^6$
1000	1	$10^3 - 10^4$
2000	0.01	$10^1 - 10^2$

Cosmologically plausible region of parameter space covered within 1 year 1/10th design luminosity. 1 year of design luminosity covers all regions interesting for EWK symmetry breaking



View
to
the
Future



International CMS



Who are these two men?

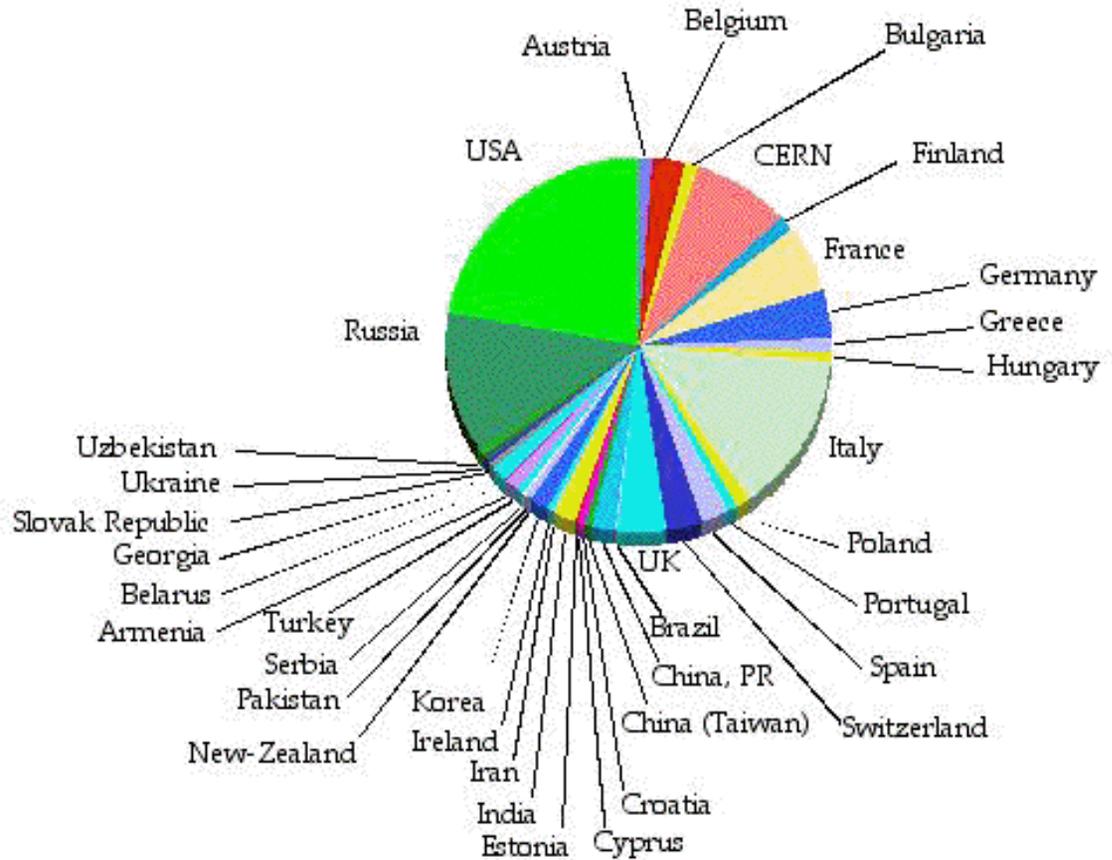
The CMS Collaboration



	Number of Laboratories
Member States	58
Non-Member States	56
USA	38
Total	152

	Number of Scientists
Member States	989
Non-Member States	510
USA	436
Total	1935

Associated Institutes	
Number of Scientists	73
Number of Laboratories	10



1935 Physicists and Engineers
36 Countries
152 Institutions

October 03, 2003/gm

Ordered by size: USA (503 collaborators), Italy (373), Russia (333), CERN (197), France (138), Germany (100)

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Countries by Detector

ECAL: UK, France, USA, ...

HCAL: USA, Russia, ...

Muon: Italy, USA, ...

Track: Italy, USA, ...

DAQ: Italy, USA



International CMS Organizational Structure

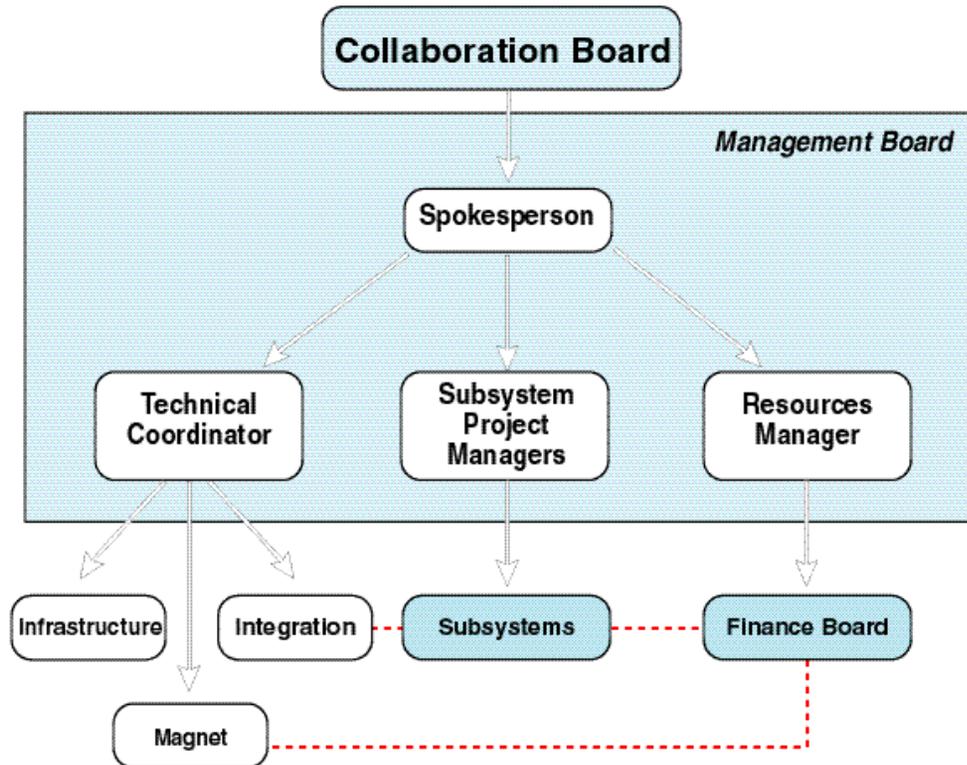
<http://cmsdoc.cern.ch/docofficial.shtml>

<http://cmsdoc.cern.ch/CMSstructures/organization.html>

Hierarchical Relationship between the CMS Federal Bodies

Rather complex...

- collaboration board
- management board
- finance board
- technical coordination group





Collaboration Board

Chair: L. Foa (Pisa), Deputy: F. Pauss (Zurich)

Contains the institution reps and others

Collaboration Board Advisory Group:

Ingram (PSI), Brown (RAL), Pauss, Foa



Management Board

- Spokesman: Della Negra
- Deputy spokesman: Virdee
- Collab Board chair : Foa
- Collab board deputy: F. Pauss
- Resources Manager: Petrilli
- Technical Coordinator: Herve
- Deputy technical coordinator: Ball
- Electronics coordinator: Sharp
- Conference Committee Chairperson: Muller
- Management Board secretary: Ingram
- Collab board secretary: Ingram
- Advisors to spokesperson: Castaldi, Flugge
- Physics Advisor: Denegri
- GLIMOS: Schaefer
- Technical advisors to technical coordinator: Campi, Faber, Rykac

Plus “regional reps”

CERN: Foeth

France: Gaure

Germany: Schael

Italy: Tonelli

Russia: Matveev

Swiss: Tauscher

UK: Brown

USA: **Newman**

Other MS: Wulz

Other non-MS: Chen, **Baarmand**



Steering Committee

Spokes: Della Negra

Deputy: T. Virdee

Tracker: Rolandi, Hall

EM: Bloch, Rander

HCAL Barrel: **Green**

HCAL Endcap: Golutvin

Muon Barrel: Gasparini

Muon, Endcap: **Mitselmakher**

DAQ: Cittolin

Trigger: **Smith**

Physics: Sphicas

Computing: **Stickland**

Technical coordinator: Herve

Deputy: Ball

Electronics: Sharp

Resources: Petrilli

Collab board chair: Foa



Others

- Finance board
- Technical Coordination Group
- Committee for Nomination of Speakers
- Editorial Board
- Annual Review Committee



Typical Meeting Schedule

CMS CALENDAR 2004

Week	Monday	CMS Meetings			Non-CMS Meetings/Hols			Week	Monday	CMS Meetings			Non-CMS Meetings/Hols		
1	29-Dec				NY			27	28-Jun	Release			LHCC(30,1), Summer(CH)		
2	5-Jan				ME(FL)(9-10)			28	5-Jul	TCM	ECAL		US(4)		
3	12-Jan							29	12-Jul	SC	FB(13)				
4	19-Jan	SC	FB(20)		US MLK(19)			30	19-Jul		Tracker				
5	26-Jan	Release			LHCC(28,29)			31	26-Jul						
6	2-Feb	TCM			RB(5)			32	2-Aug						
7	9-Feb		Tracker					33	9-Aug						
8	16-Feb	TCM			Half Term(CH,F)			34	16-Aug						
9	23-Feb	SC	FB(24)		ATLAS,LHCb			35	23-Aug						
10	1-Mar				GVA mt. show(4)			36	30-Aug	SC	FB(31)		FB(2)		
11	8-Mar	TCM			GVA mt. show(14)			37	6-Sep				US lab day(6), J.G.(6)		
12	15-Mar	CMS Week			ALICE,SPC,...CC			38	13-Sep	CMS Annual Review			LECC, Boston (13-17), SPC,...CC		
13	22-Mar	Release			LHCC(24,25)			39	20-Sep	CMS Week/Annual Review			ALICE		
14	29-Mar							40	27-Sep	Release			LHCC(29,30), LHCb(Sardinia)		
15	5-Apr	TCM	Moon		RB(8), Spr. Bk(CH)(5-16), GF(09)			41	4-Oct	TCM			ATLAS(Freiburg)		
16	12-Apr				East.Mon(12), ME(CH)(16-17)			42	11-Oct	MB/FRB	FB/FRB		ME(CERN)(15-16)		
17	19-Apr	MB/FRB	FB/FRB	Tracker				43	18-Oct		ECAL		CERN: 50th Ann(19)		
18	26-Apr			ECAL	FRB(26-28), Mayday(1)			44	25-Oct		Tracker		FRB(25-27)		
19	3-May	TCM	Elec week	TrIDAS	SPC(3)			45	1-Nov	MBAR		CPT Week	FC(3)		
20	10-May	Release	FB(11)	CPT Week	LHCC(12,13)			46	8-Nov	TCM	Elec week	TrIDAS	RB(11)		
21	17-May				Ascens.(20)			47	15-Nov	SC	FB(16)				
22	24-May	TCM			LHCb			48	22-Nov	Release			LHCC(24,25), TG(26,26)		
23	31-May				US mem. Day(31), Whitun(31)			49	29-Nov	TCM			LHCb		
24	7-Jun	CMS Week			RB(10)			50	6-Dec	CMS Week					
25	14-Jun				SPC,...C			51	13-Dec				SPC,...C		
26	21-Jun	TCM			ATLAS, ALICE(Est)			52	20-Dec				Xmas		
								1	27-Dec				XmasNY		

SC: Steering Committee
 MB: Management Board
 FB: Finance Board
 TCM: Technical Coordination Meet. (always on Monday)
 CPT: Core Software/Computing/FRS/TRIDAS
 ME: CMS Endcap Moon Group Meet.
 FRB: Resources Review Board
 LECC: LHC Electronics Coordinating Committee

Holidays at CERN during this week

SPC: Scientific Policy Committee
 FC: Finance Committee
 CC: Committee of Council
 C: Council

RB: Research Board

25-Nov-03

CMS and CPT weeks are of general interest. Each detector system also has “weeks”.





International CMS web page

<http://cmsdoc.cern.ch/cms.html>

Ugly, but if you poke around long enough, you'll find what you need.

International CMS Agenda Server



<http://agenda.cern.ch/displayLevel.php?fid=2176>

Quite useful. Find talks from most meetings.



Acronyms

CPT: computing, physics, trigger

PRS: physics, reconstruction, selection

MB: management board

CCS: computing, core software, production

TriDAS: Trigger and data acquisition system

PROM: PROject Management (projects that cross between various CMS subgroups)

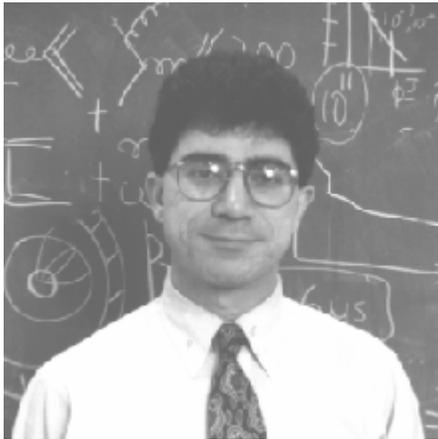


PRS

Physics, Reconstruction, and Selection:

Where the analysis action is at.

<http://cmsdoc.cern.ch/cms/PRS/www/prs.php>



Paris Sphicas, the PRS leader, 10 years ago



PRS Structure

Physics, Reconstruction and Selection.

Run by: Paris Sphicas (Athens, ex-CDF)

ID groups:

ECAL/e/gamma: Chris Seez (London) and Yves Sirois (Ecole Polytechnique)

HCAL/jet/met: Chris Tully (Princeton) and Jim Rohlf (Boston)

Muon/mu/: Ugo Gasparini (Padova) and Darin Acosta (Florida)

Tracker/b/tau: Marcello Mannelli (CERN) and Lucias Silvestris (Bari)

Physics Groups

Heavy Ions: Bolek Wyslouch (MIT)

Higgs: Sasha Nikitenko (London, ITEP)

Standard Model: Joachim Mnich (Aachen)

SUSY/BSM: Luc Pape (CERN)

Steering committee: also includes Denegri, Stickland (CCs), and Cittolin (TriDAS)



PRS Meeting Schedule

Alternate Tuesdays 16:00 (cern time of course)

muon, tracking

Alternate Wednesdays 16:00

e/gamma, jet/met

Most of the physics groups only meet during CPT weeks

Easy to attend via VRVS



VRVS

CMS uses VRVS for video conferencing. Get over it!

- go to radio shack and buy a headset. If you feel rich, buy a video camera. Don't use a table mike, etc unless you get expensive hardware. Instead, use a cheap headset.
- go to www.vrvs.org and download the software
- MUTE WHEN YOU ARE NOT TALKING!!!

Getting a CERN computer account



http://cmsdoc.cern.ch/comp/comp_quick_guide.html#AccountCreation



Getting onto International CMS mailing lists

First, you need a CERN mail account and password.

Then go to <http://www.listbox.cern.ch/>

And log onto SIMBA using this account/pass

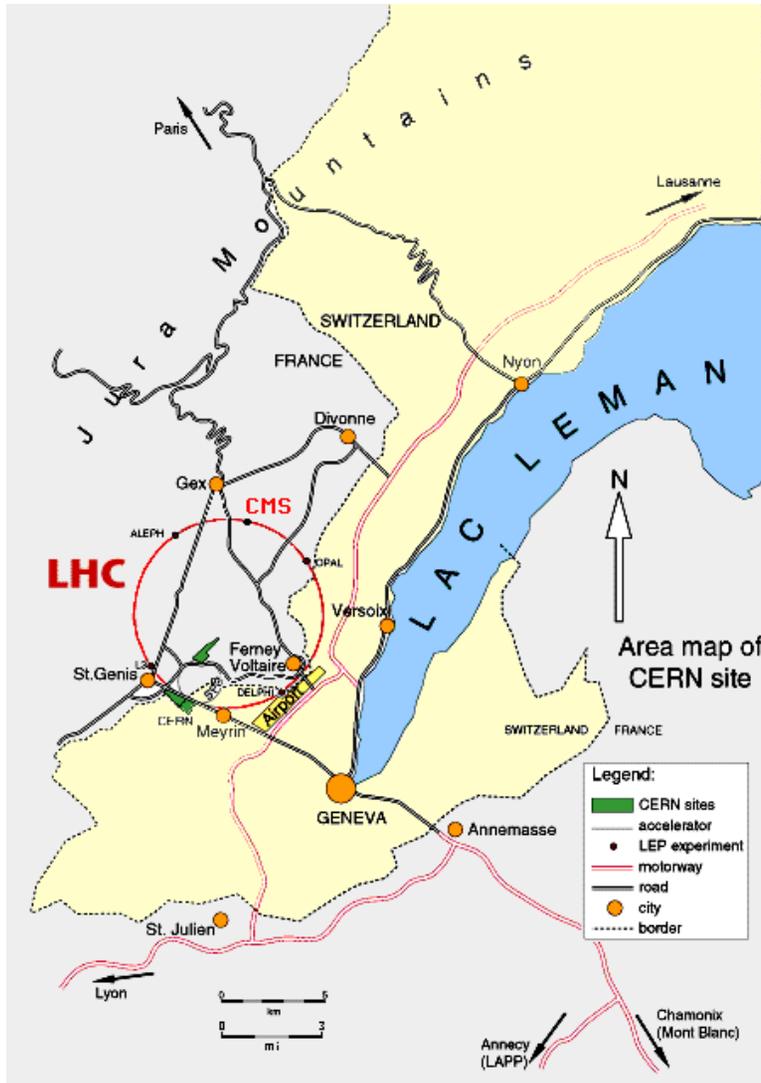
You might try searching on lists containing “cms”

Life at CERN





Where is CMS?



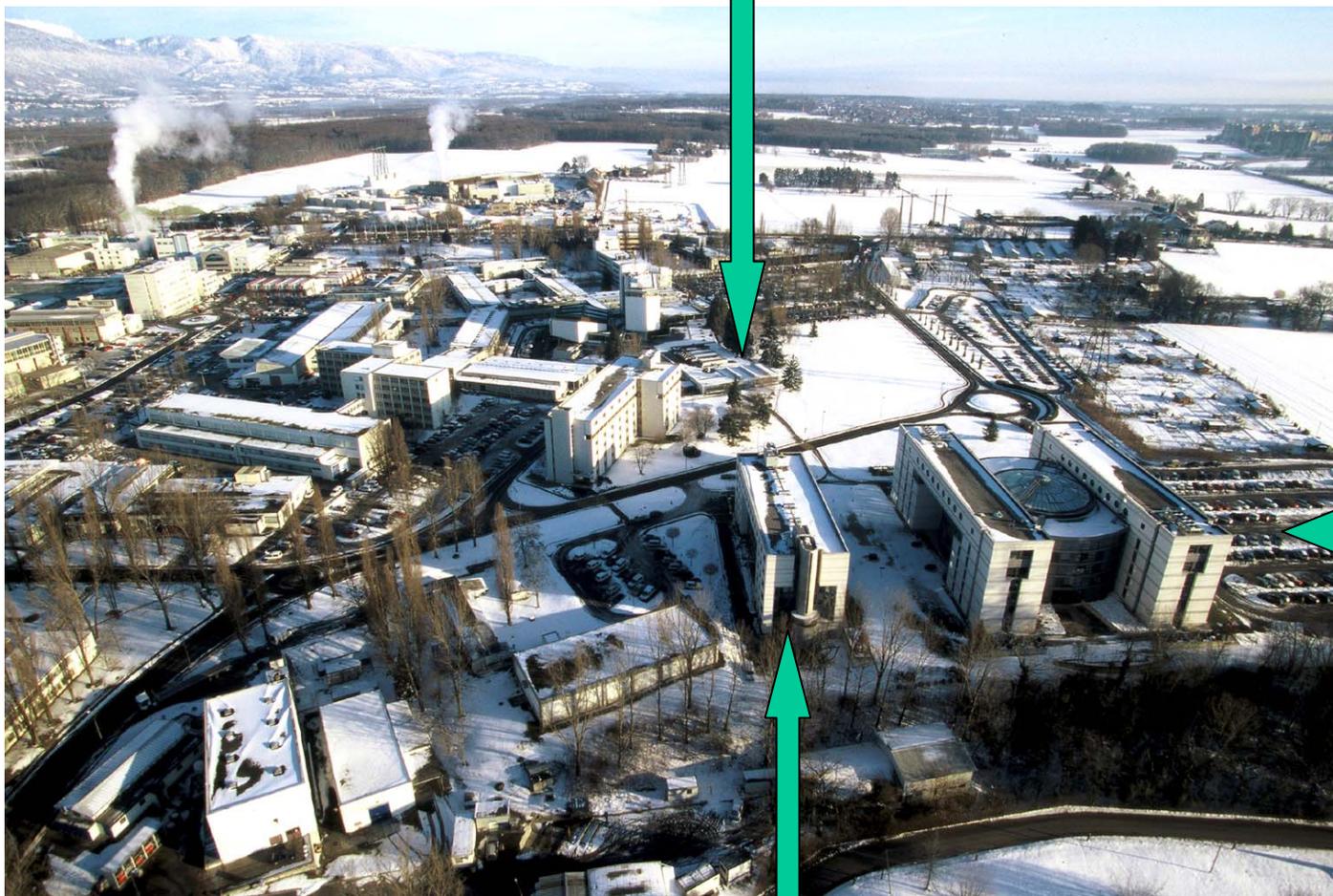
Need to cross the border to get from the cafeteria/building 40 to CMS. Carry your passport! Slow down, but only stop if they ask you to.



View to the Future

The Lab: Useful things

cafeteria



Building
40

The "nice" hostel

The Bermuda triangle of CERN



Building 40

Main building for CMS/ATLAS offices



Office space in building 40? Good luck!!!

LPC



View
to
the
Future

Coffee and pastries?



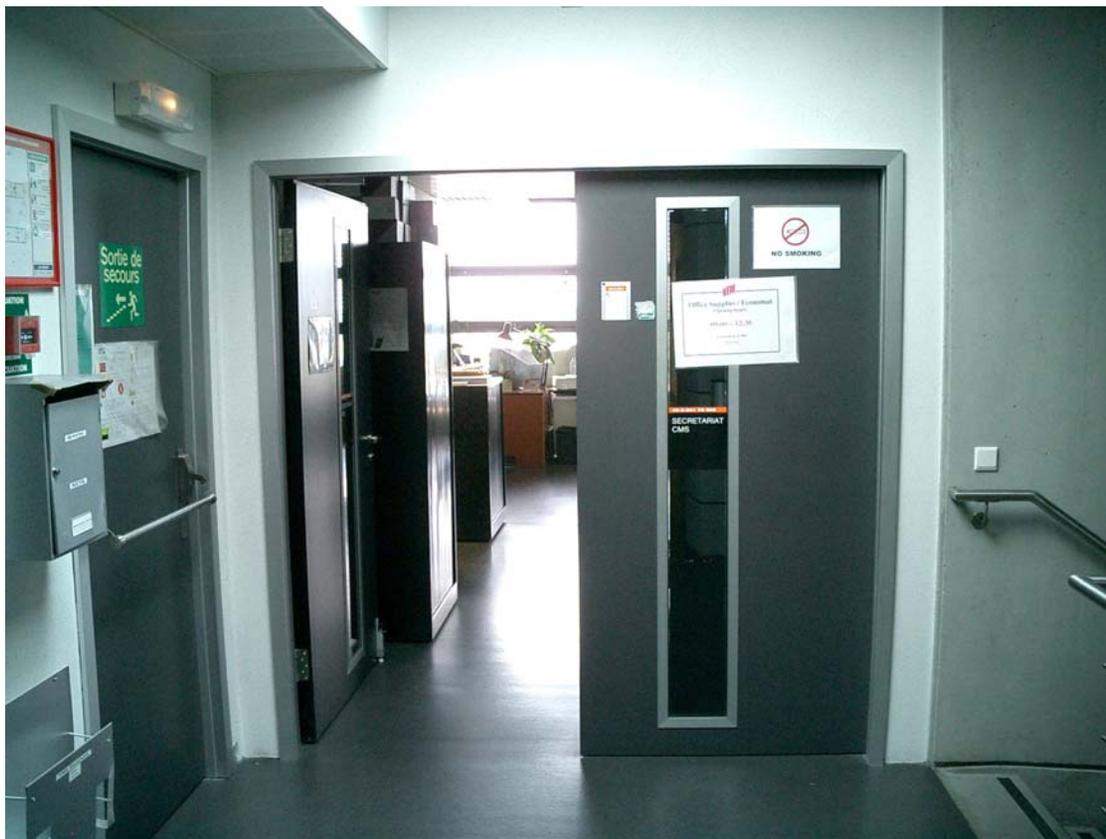
6. 8. 1999

LPC



CMS Secretariat

<http://cmsdoc.cern.ch/peoplesecr.shtml>



Paper supplies, pens, cute folding cubes of CMS pictures, cute calenders with CMS pictures, etc.



Salavat Abdullin



Official contact person at CERN for the LPC.

He's your man on the ground, when only that kind of help will do!

Salavat.abdouline@cern.ch (russian names tend to have english and french spellings)

Tami Kramer



Can help with various things.
Rentals, room reservations
when building 40 is full,
hostel reservations, all kinds
of useful things...



<http://uscms.web.cern.ch/uscms/>

Many useful hints on life at CERN!!!!!!!!!!!!!!!!!!!!

LPC

LPC



View
to
the
Future



the Cafeteria Patio



LPC



Arriving at CERN

- Swiss and French electricity adaptors have slightly different sizes. Both have 2 round prongs.
- rental cars usually have manual transmissions

If you are staying at the hostel and arrive on the weekend, the guards will have the key. Ask the drive to go to the CERN gate with the flags.

Very hard to get “hostel” room in summer. Registration begins April 1. Sometimes (especially for FNAL employees) Tami Kramer and Terry Read can get you rooms, as they get priority to reserve, and reserve a block.



Hotels

There aren't any particularly nice ones left at reasonable prices. Anything less than \$100/night is not air conditioned (can be a problem in July and August). If you want eggs for breakfast you have to pay the \$100/night.

I usually stay at the Chateau de Farges (but I understand its closing soon) And its very hot in the summer. Its 10km by car. But the price is right (35 euros/night at a CERN rate).

The Bois Joli is also OK but noisy until midnight (its got a big restaurant) (45 euros a night). It is probably 8 km from the Meyrin site but only 5 km to the Test Beam.

The hotels in St. Genis are pretty bad. Hotel Sofia may be OK, but its pretty expensive for what you get (about 65 euros/night).

The hostel (if you can get in) is the only place within walking distance.

Advice from Andris Skuja



CERN Users Office

Where to get attestation and ID card.
In the building with the cafeteria.

ID needed to get into CERN after hours





Useful French Phrases

L'addition, si vous plait.

Cote du rhone

LPC



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Fun

Take the bus into Geneva. (20 minutes)



pictures

Who makes the nice pictures on the CMS TDR covers?

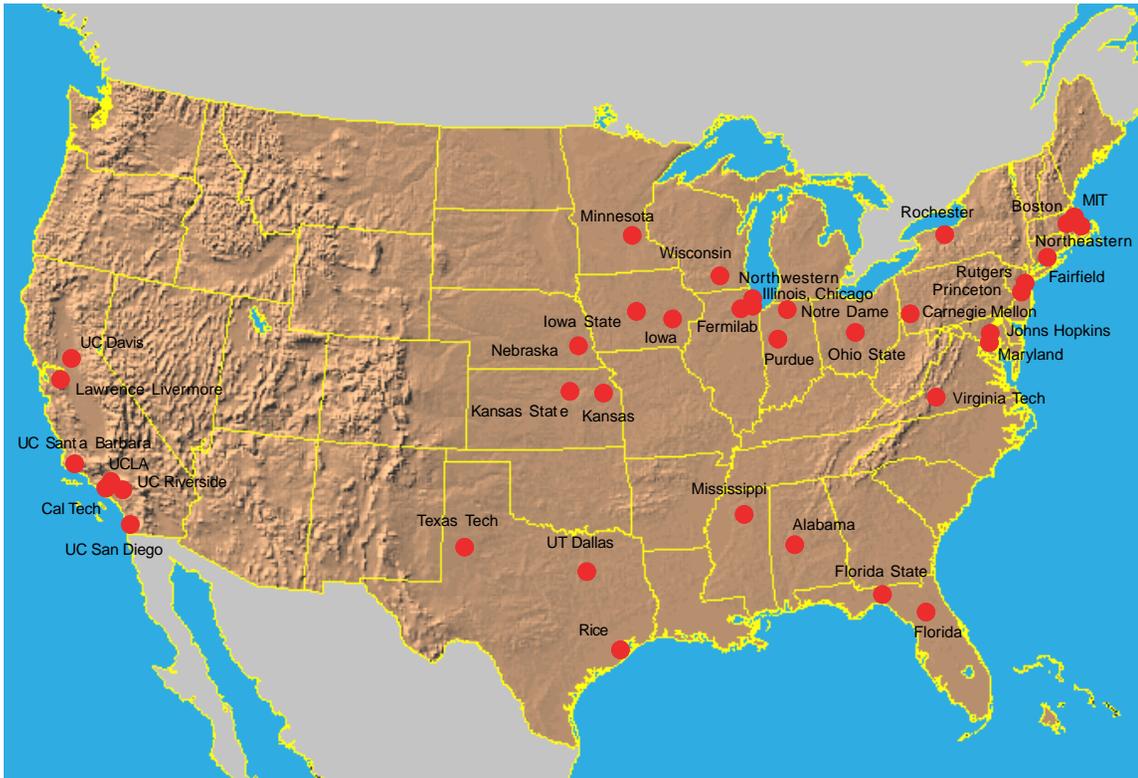
Sergio Cittolin

CMS



**Data Acquisition and
High-Level Trigger
Technical Design Report**

US CMS



November 10, 2000

By size

FNAL: 72

Cal Tech: 32

Florida: 27

UCLA 24

Wisc. 23

Purdue 19



US CMS: non-elected bureaucrats

Research Program Manager: Dan Green, Deputy: Bob Cousins

Level 2 managers:

pixels: Bruno Gobbi (Northwestern). **tracking:** Joe Incandela (UCSB) **Endcap Muons:** Dick Loveless (Wisconsin), Gioglio Apollinari (FNAL) **DAQ:** Vivian O'Dell (FNAL) **ECAL:** Roger Rusack (Minnesota) **HCAL:** Andris Skuja (MD) **Trigger:** Wesley Smith (Wisconsin)

Software Management: Lothar Bauerdick

(level 2 Bob Clare, UCR and Ian Fisk, FNAL)

CMS Maintenance and Operations: Jim Freeman (FNAL)



US CMS: Elected Bureaucrats

<http://uscms.fnal.gov/uscms/organization/organization.html>

Very elaborate elected structure

- US CMS Collaboration Board: chair: [Harvey Newman](#) (cal tech), deputy chair: [Vasken Hagopian](#) (FSU) members: 1 rep per institution.
- US CMS Advisory Board: chair and deputy the same, + 1 elected rep per system + US physics coordinator + outreach coordinator + software/computing manager + construction project manager
- US CMS Advisory software and computing Board (6 elected positions)
- US CMS election committee (2 elected positions)
- US physics coordinate (1 elected position) [Jim Branson](#) (UCSD)
- various subsystem institutional boards (1 rep per institution)



US CMS Meetings

1 per year in late spring, place rotates. Good place to network.

Make sure you are on the us cms mailing list by contacting (???)

LPC



V
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Life in the US



US CMS Web page

<http://www.uscms.org/>

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US CMS
The Compact Muon Solenoid

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Outreach

World Clock

USCMS is a collaboration of US scientists participating in the Compact Muon Solenoid (CMS) experiment at the Lepton Hadron Collider (LHC) at CERN in Geneva, Switzerland. The collaboration is organized into two primary efforts, one to lead the US role in the physical construction of the detector and provide for its ongoing operation, the other to develop the software and computing elements to facilitate physics data analysis at academic institutions across the United States.

Getting an account at FNAL



<http://www.uscms.org/scpages/general/uaf/accounts.html>



The LPC: our mission

An attempt to reproduce the benefits of being at the lab in our time zone, on our side of the Atlantic.

- a **critical mass** (clustering) of young people who are actively working on software (reconstruction, particle identification, physics analysis) in a **single** location (11th floor of the high rise)
- one stop shopping for your analysis questions
- analysis tools such as large meeting rooms, video conferencing, large scale computing, “water cooler”
- virtual control room for active participation in the running and quality control of the experiment



LPC Org Chart/Working Groups



LPC Working Groups

One of the main goals of the LPC is to have a place in the U.S. where CMS Physicists can find experts in all areas of CMS software and reconstruction. Our current working groups and their conveners are:

[Agenda Server for LPC Meetings](#)

[LPC Offline Coordinators](#): Liz Sexton-Kennedy and Hans Wenzel

[Tracking](#): Kevin Burkett and Sasha Khanov

[Electron/Photon](#): Yuri Gershtein and Heidi Schellman

[Muon](#): Eric James and Martijn Mulders

[Jet/Met](#): Rob Harris and Marek Zielinski

[Trigger](#): Sridhara Dasu and Stephan Lammel

[Simulation](#): Daniel Elvira and Boaz Klima

Please click on the link to get to each group's web page.



Support within CMS

I did a survey of all US CMS Universities.

Will your university have somebody stationed permanently at the lab, working on software on the 11th floor, in the years

Year	probably	hopefully	%
2004	11	1	30
2005	11	11	55%
2006	9	18	68%



Finding a Seat at the LPC

Move in date
end of October

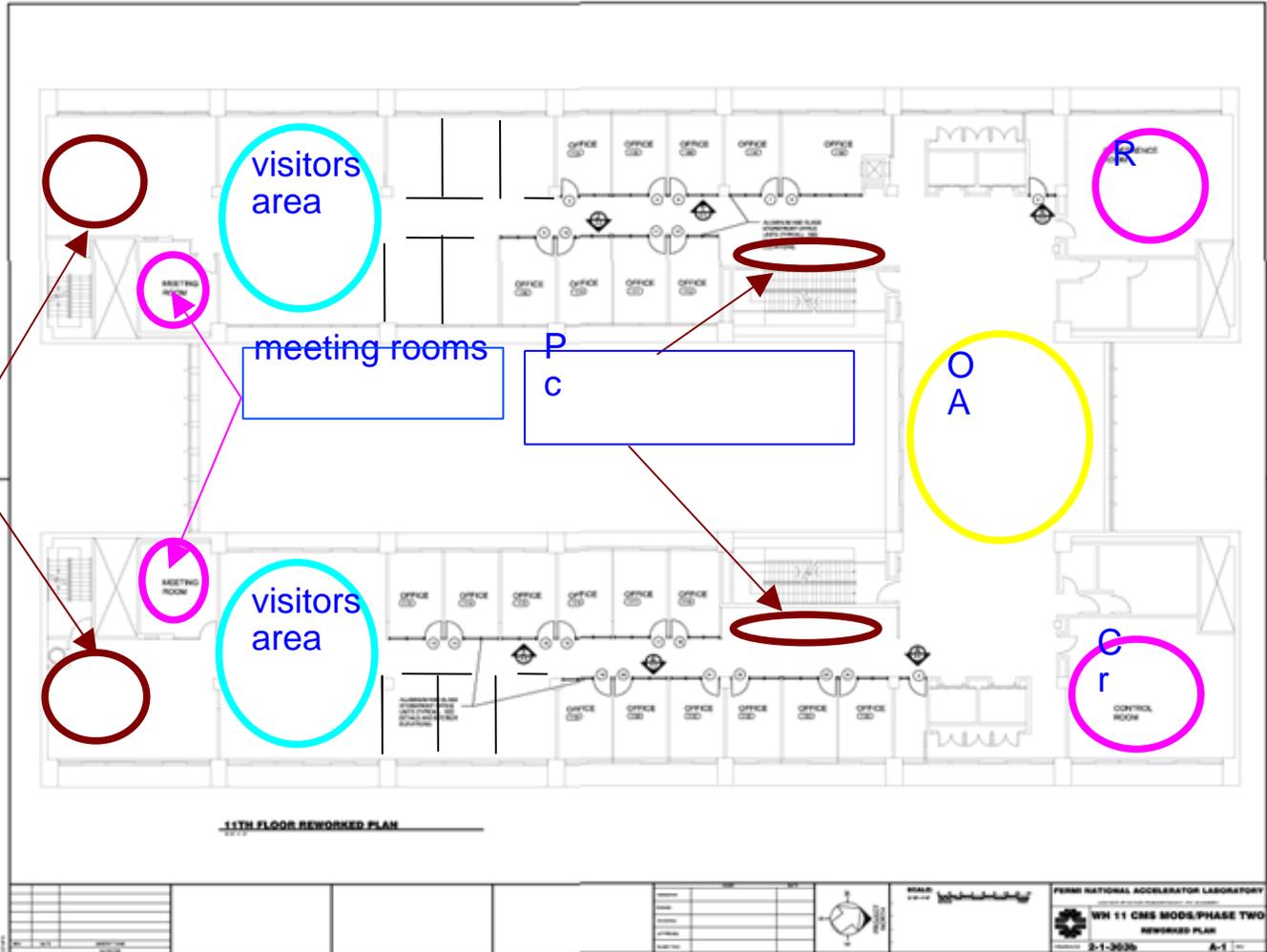


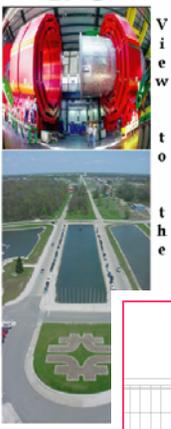
- high speed internet access
- transient area on cross over
- lockers for transients
- 1 large and 2 small meeting rooms
- secretary support, printers, etc
- Italian espresso machine
- remote control room
- offices for permanent workers



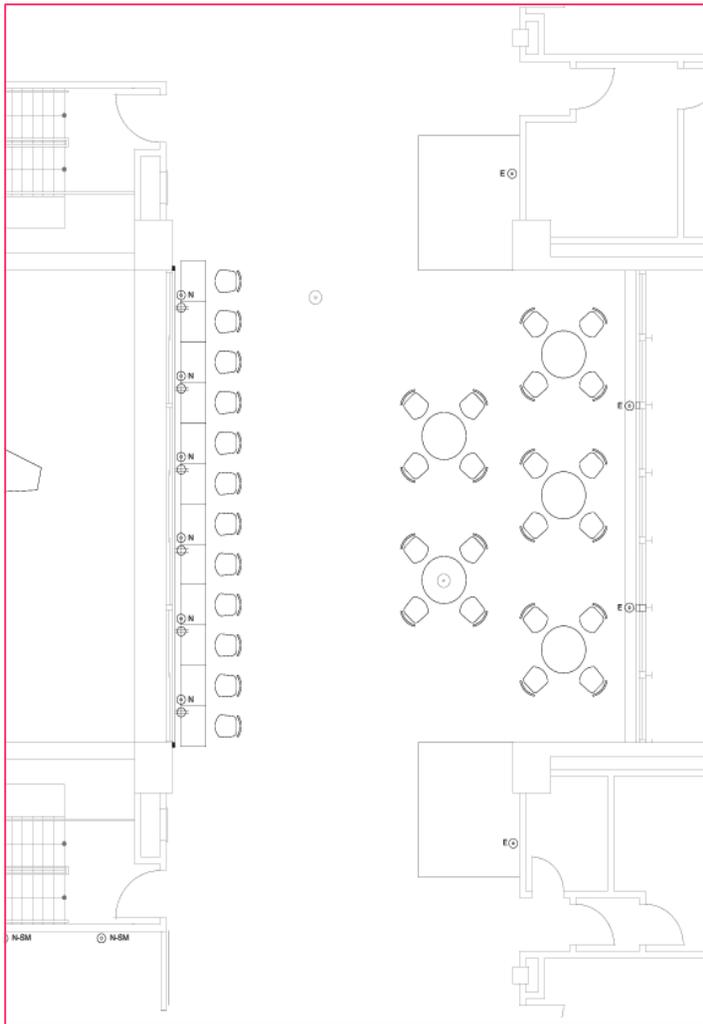
11th Floor General Plan

Printers & Storage



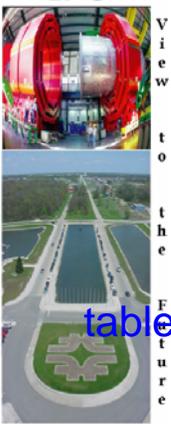


11th Floor X-Over: Open Area



note: This x-over arrangement is a plan.
 ---> still waiting for an approval from the director's office.



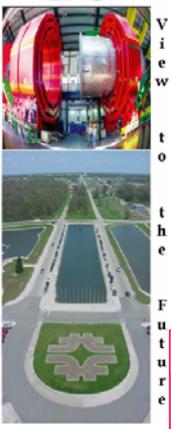


View to the Future

11th Floor X-Over: furniture examples

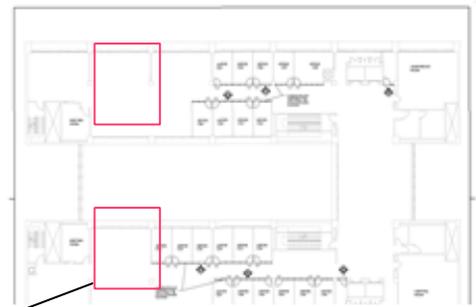
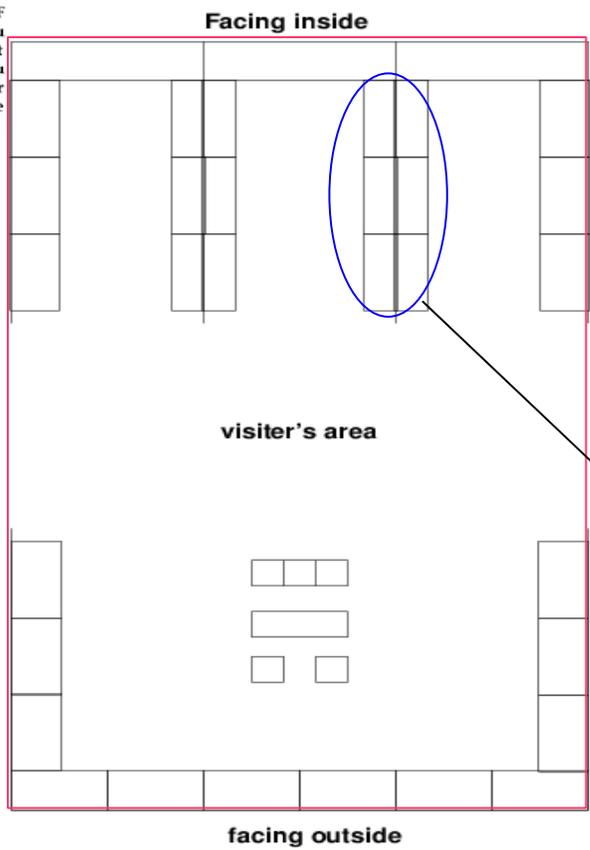
tables to sit around,
but also they are
DISPLAY for our experiment





View
to
the
Future

11th Floor: Visitor's Area



permanent desks were not assigned.
Lockers for visitors.

e-mail center WH ground floor





LPC Web Page

<http://www.uscms.org/LPC/LPC.htm>

LPC



The LHC Physics Center at FNAL

The LHC Physics Center (LPC) at FNAL was established in April 2004 by Mike Witherell and Dan Green for the following purposes:

- a "brick and mortar" location for CMS physicists to find experts on all aspects of data analysis, particle ID, software, and event processing within the US, working during hours convenient for U.S.-based physicists
- a center of physics excellence within the US for LHC physics
- a place for workshops/conferences/gatherings on LHC physics
- a place for the training of graduate and postgraduate scientists from URA Universities.
- a "remote control room" that CMS physicists can use to participate in data taking and quality control for the CMS experiment in the U.S.
- a tool to help provide a graceful transition between the Tevatron and LHC experiments for those physicists participating in both, maximizing the manpower available to each during the transition time.

The center is run by [Avi Yagil](#) (FNAL) and [Sarah Eno](#) (UMD) and is located on the 11th floor of the FNAL hi-rise. The level-2 manager is [Kaori Maeshima](#). The members of our advisory board can be found [at this link](#). Our milestones can be found [at this link](#). The LPC makes use of the promoximity of the [FNAL "Tier-1" computing center](#) and the Tevatron experiments. To learn more about our center, choose one of the following options.

[Working Groups](#)



LPC & You

There are many different modes to use this center

- your postdoc who is stationed at FNAL work on both CMS and a Tevatron experiment can have a desk on the 11th floor and be near people from both accelerators
- station a CMS postdoc at FNAL permanently for the same kind of advantages you get in the D0/CDF trailers
- send a postdoc stationed at your university for a month, to get up to speed on analysis basics and to form personal connections that will help his/her later work
- send students for the summer to give them a richer experience by having them interact with more people
- come every other week to help you feel connected to the experiment (who knows! The US is the biggest country on CMS. We'll get the data in real time. Maybe the center-of-mass of analysis for CMS will somewhere in the middle of the Atlantic.
- come for a day for help with a particularly knotty software or analysis problem