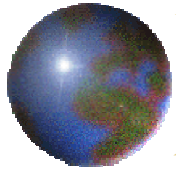


APS, May 2009

The Role of US Groups in LHC Physics

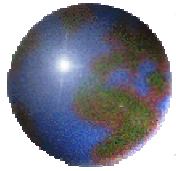
Dan Green

Fermilab



Outline

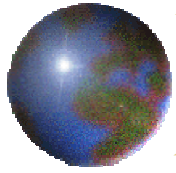
- ➊ **Introduction and History**
- ➋ **The Problem**
- ➌ **The Realities**
- ➍ **The Evolution to Worldwide Physics Analysis**



Scientists and Physics



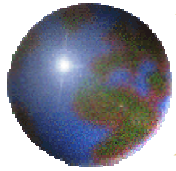
Faraday could work at home in his laboratory. The Curies could too but they processed tons of pitchblende.



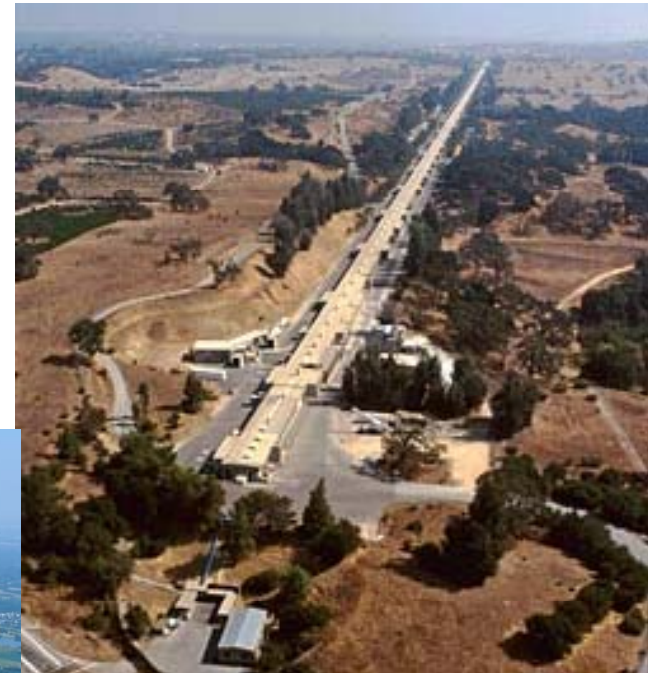
Accelerator Based Research



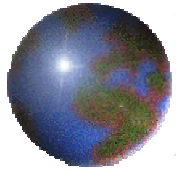
Then the tools became larger. Still, they could be operated on a university campus.



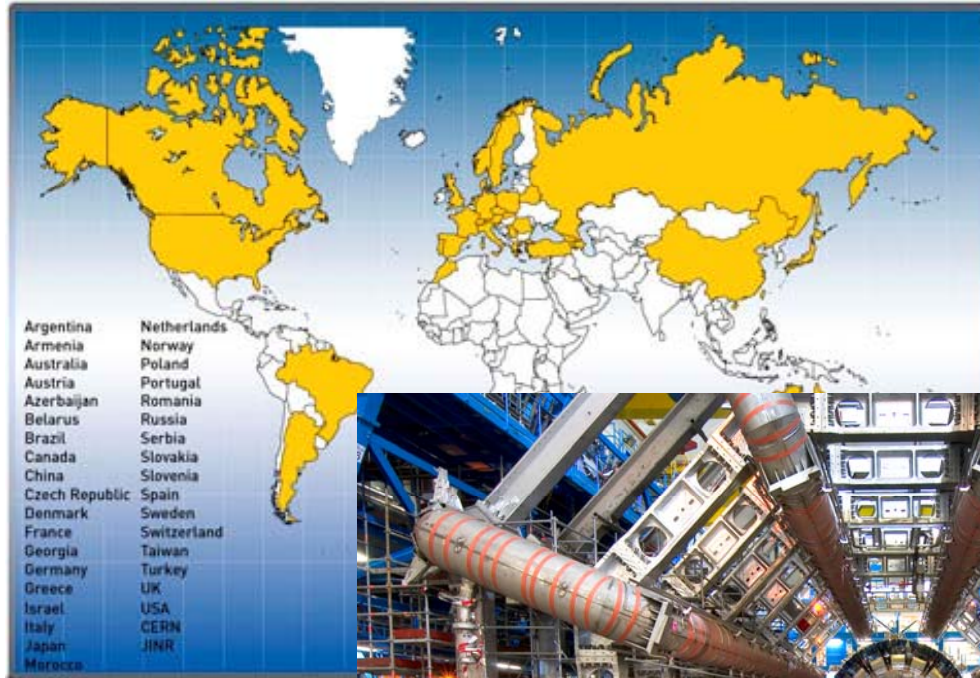
National Laboratories



**Post WW II
laboratories became
national facilities.
Physicists learned to
“commute”**

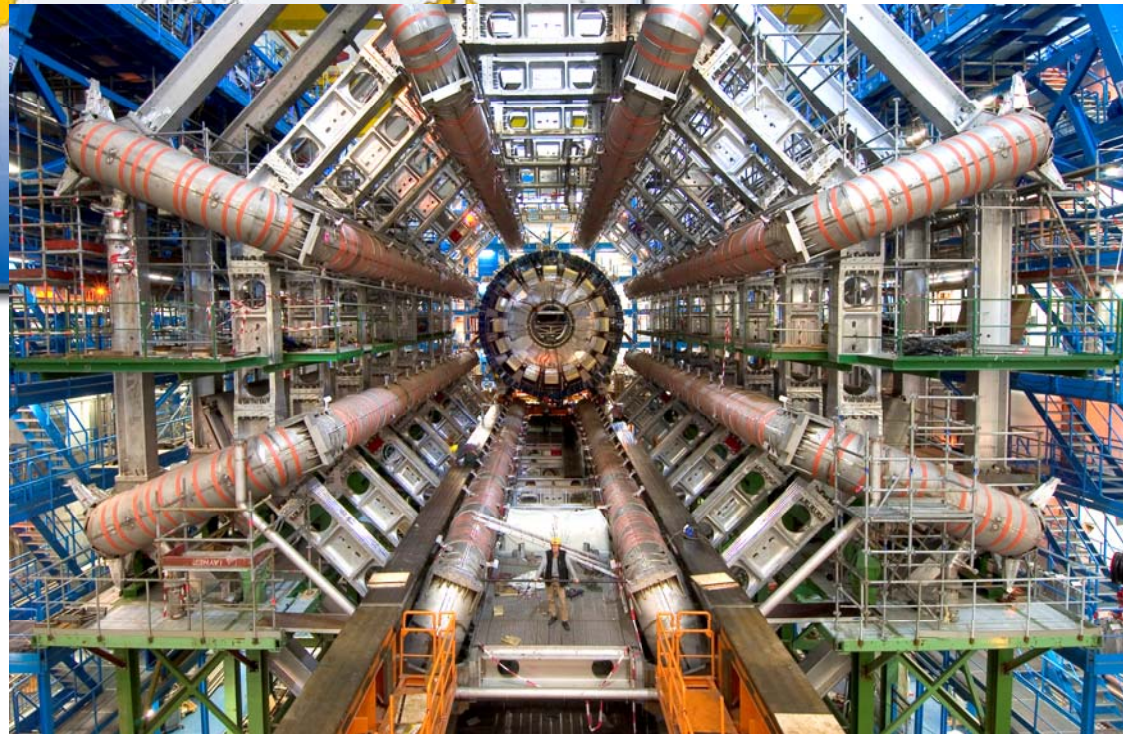


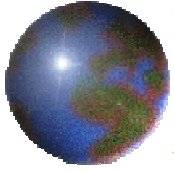
The Large Hadron Collider



The LHC collaborations are truly world wide and enormous by all measures

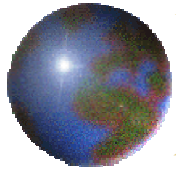
ATLAS





The Problem

- ❖ **The detectors have 100 million channels**
- ❖ **They need to be aligned , calibrated and monitored. There are large data bases which must be accessed.**
- ❖ **The data volume, even after zero suppression, is enormous; 1 MB/event, 100 Hz of events or 10^9 MB/yr (1 million CDs/yr)**
- ❖ **The US groups are only 1/3 of the LHC collaborations and they live an ocean away. In addition only about 1/3 of US physicists can be at CERN long term at any given time.**



Science Magazine

PHENOMENON OF THE YEAR: EUROPEAN BIG SCIENCE

IN SEPTEMBER, WHEN THE FIRST BEAMS circulated through the Large Hadron Collider (LHC), Europe's giant particle accelerator near Geneva, Switzerland, media outlets were quick to name a winner. "Europe leaps ahead on physics frontier" ran a story on MSNBC.com, and a blog trumpeted "LHC a sure sign that Europe is the center of physics." The electrical fault that put the LHC out of action just days after its inauguration didn't change the overall picture.

That success was bittersweet for U.S. particle physicists, whose own machine, the Superconducting Super Collider, was canceled in 1993. By most objective measures, U.S. research still leads the world, but in their ability to pool resources in the pursuit of "big science," European nations are showing increasing ambition and success.

CERN is the model of a pan-European laboratory. Formed in 1953 to help rebuild postwar European science and encourage international cooperation, the facility became a guiding light for European particle physics and spurred other fields to follow suit. The next few decades saw the creation

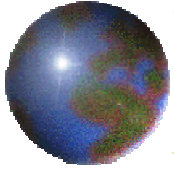
however. First off, the European Union (E.U.) decided that it wanted to host ITER, the worldwide reactor project that aims to prove nuclear fusion as a viable power source. During much of 2004 and 2005, the E.U. was locked in a staring match with Japan over whose site should take the honor. Determined shuttle diplomacy and a face-saving formula put together by E.U. officials finally paid off, and ITER is now under construction at Cadarache in southern France. Such is Europe's confidence in the project that when Congress zeroed out the U.S. contribution to ITER from its 2008 budget, managers in Cadarache barely broke step.

The E.U. didn't stop there. In 2002, it created the European Strategy Forum on Research Infrastructures (ESFRI), which set about drawing up a list of projects worthy of E.U. support. The ESFRI Roadmap, published in October 2006, lists 35 projects, which include a database on population aging and a neutrino observatory on the Mediterranean seabed. The E.U. didn't have



The ESFRI Roadmap and E.U. infrastructure funding have given a number of projects a major push toward becoming reality. This year, the European XFEL, an x-ray light source, and the Facility for Antiproton and Ion Research, both in Germany, have enlisted international partners for construction, and both expect to sign conventions by early next year. The European Spallation Source, proposed in the early 1990s, now has three sites vying to host it, and a decision—in part brokered by ESFRI—is expected this month. A final design for the *Aurora Borealis*, a groundbreaking polar research ship, was also released this month. And this autumn, groups of European astronomers and astroparticle physicists have published their own road maps, listing potentially world-leading instruments such as the European Extremely Large Telescope and

www.sciencemag.org on April 27, 2009



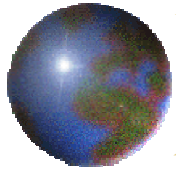
The Realities



LHC experiments need to engage the entire collaboration in order to simultaneously operate, analyze and upgrade these complex devices.

The necessities of the LHC experiments mean that US groups will be fully engaged and enabled – e.g. Remote Operations Center

APS Meeting, May 2-5, 2009



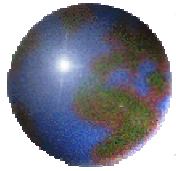
Remote Operations



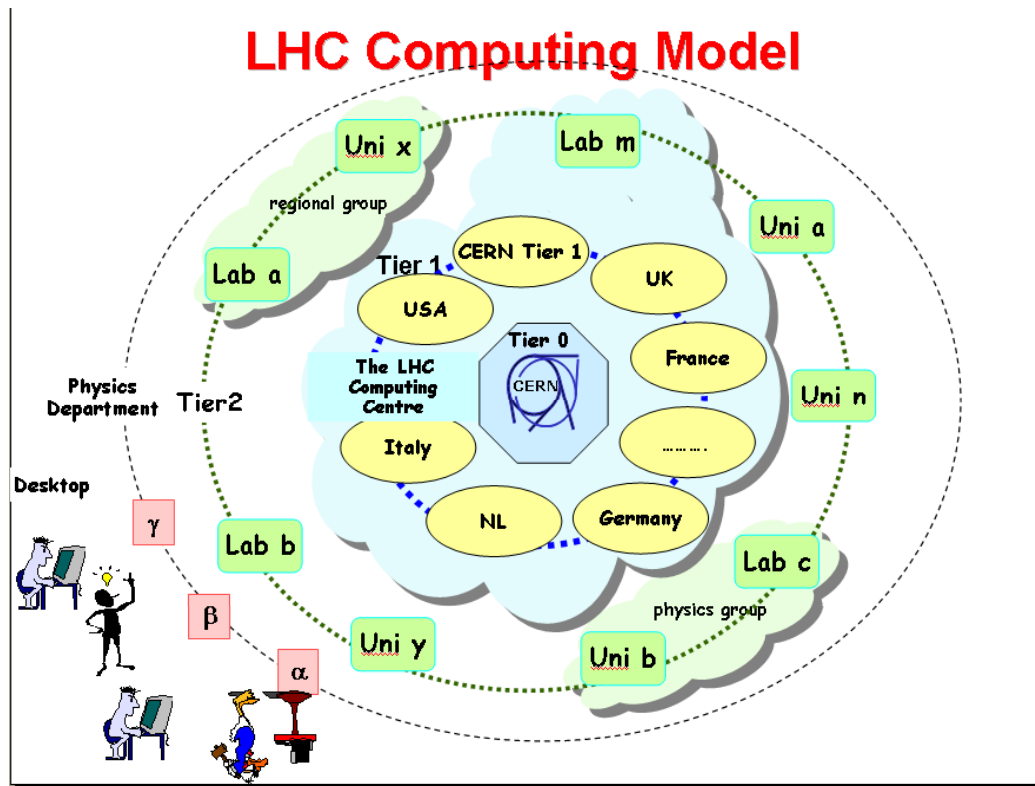
The LHC@FNAL Remote Operations Center (ROC) at Fermilab is located on the first floor of Wilson Hall. From the ROC, shifters perform real-time monitoring of the data recorded by the CMS Experiment.

ROC	WBM / WBM Twiki	FNAL ELog	Mailing List	Agendas / ROC / AEM	Presentations & Notes
	cmsroctor / nippon	Runs	CVS	SiTracker / MTCC	
	Screen Snapshot Service	FAQ	Accounts & Nodes	New User Instructions	Web Cams
	CMS Workbook	Directories / Glossaries	Photos	EVO	Google / Wikipedia
LHC@FNAL	Computing	Console Map	Documents	Mailing List	One East Mtg Schedule
	rocshare	Telephones	To Do List	Video Conferencing	
CMS Shifter	CSC	DAQ	DataOps	DQM / FNAL ROC	ECAL
	Event Display	HCAL	Pixel	Trigger	

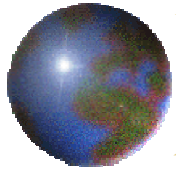
Exploit the fact that the collaborative tools are falling into place – for example Web Based Monitoring, ELog, webcams, teleconferencing. The US is about 7 hours out of phase with CERN. Therefore, stand remote “evening” shifts. With China and India on board full 24/7 coverage is easily possible.



Tiered Computing



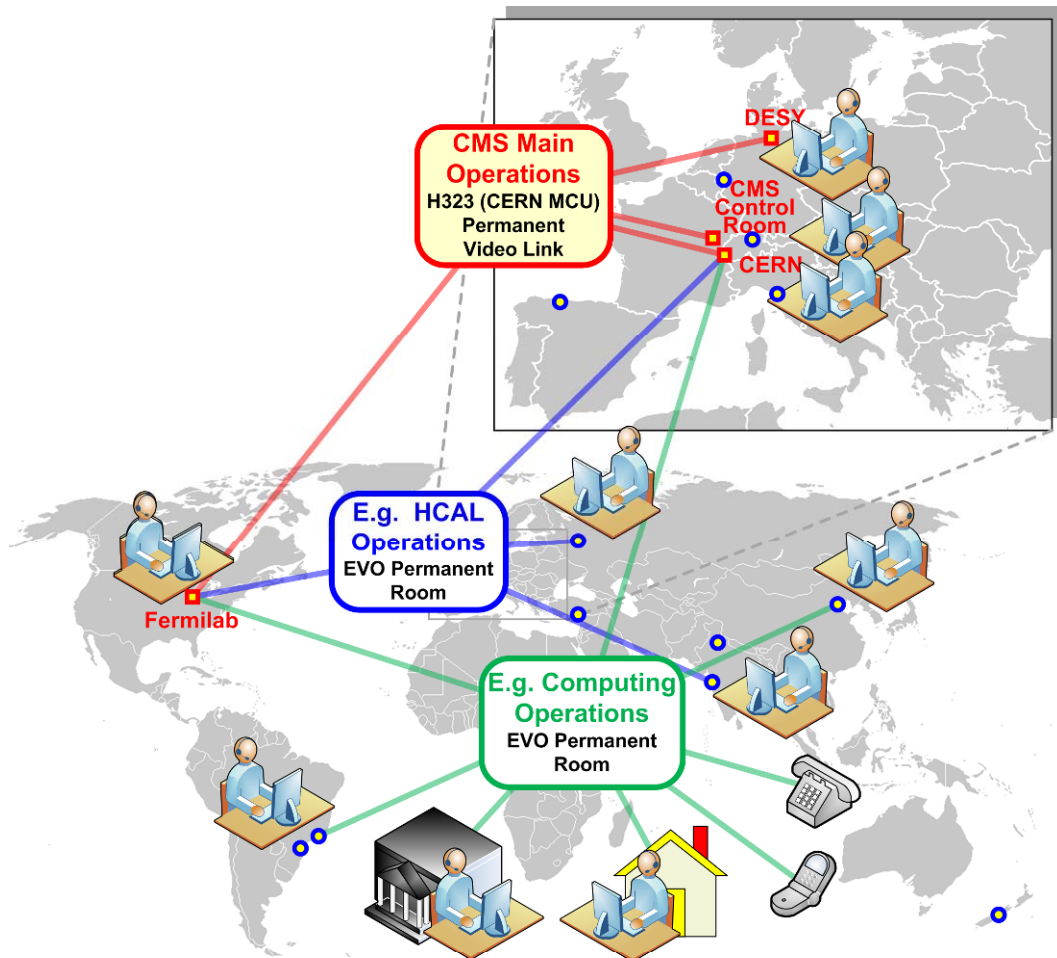
LHC data analysis required worldwide, grid, computing. First pass is done at CERN and then the data is sent to “T1” centers. BNL and FNAL are national computing centers for US ATLAS and US CMS. “T2” are centers located at specific universities. Finally, “T3” are located at all collaborating institutions.

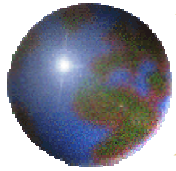


Data Operations

The enormous data sets require world wide computing. CERN sends data to several national “T1” Centers for analysis.

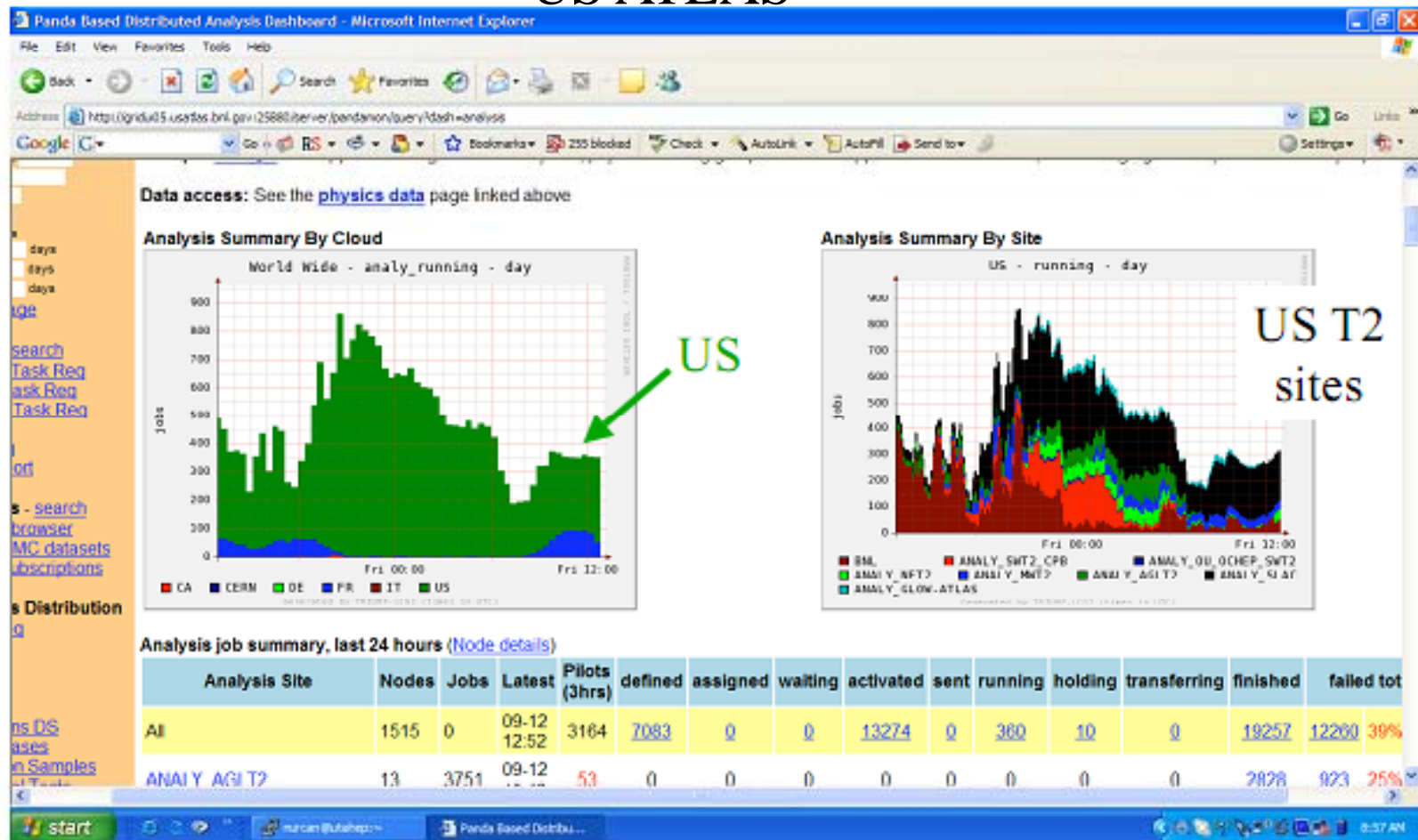
Data flow and monitoring of computing must be 24/7. There is a permanent video link between CERN-DESY-and FNAL for US CMS

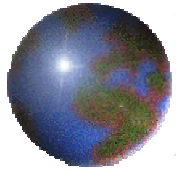




University Groups are “T2” or “T3”

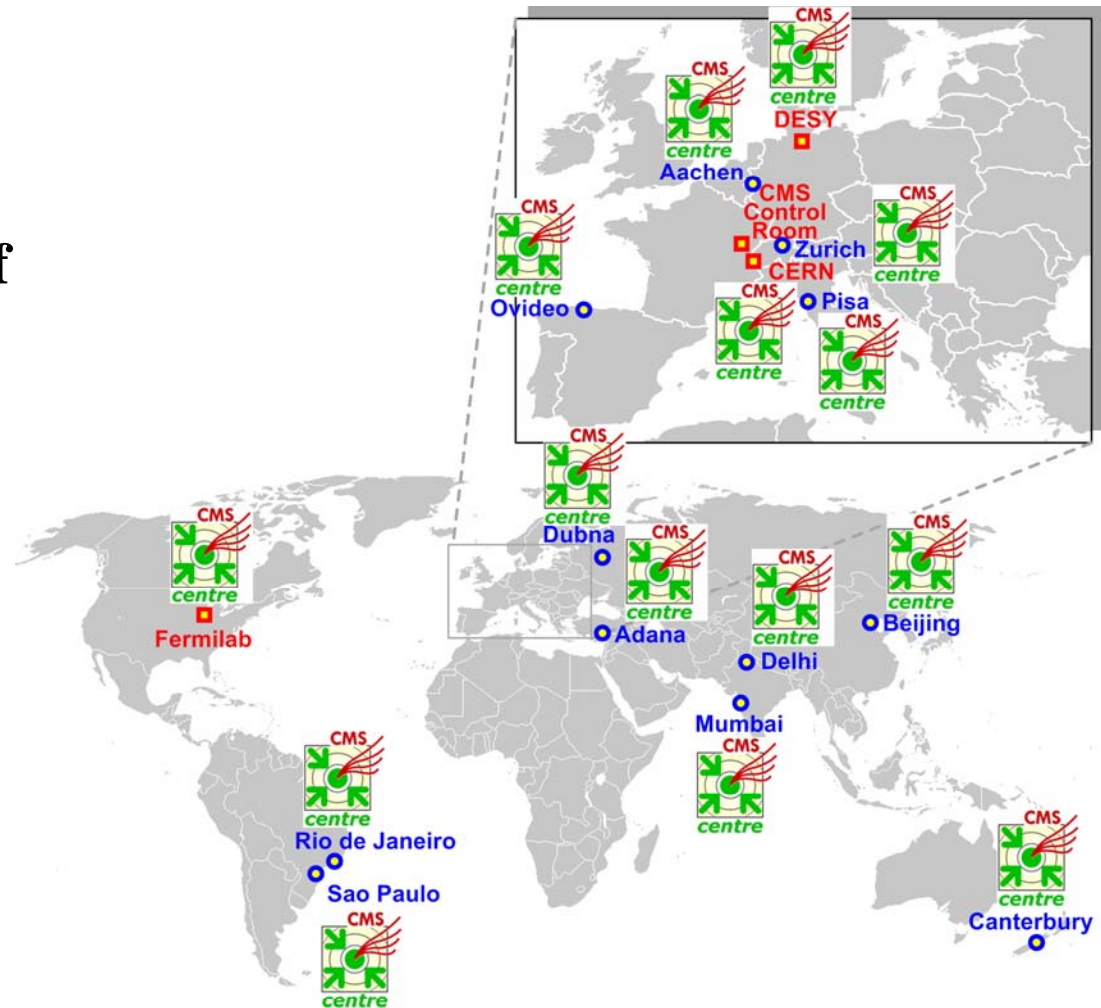
Snapshot of Analysis jobs during readiness test US ATLAS

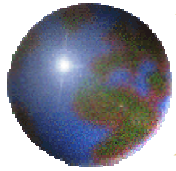




The Evolution of Work

The reality of the LHC experiments is that all physicists cannot live at CERN while the work of all physicists is needed as the number of jobs soon will increase dramatically (operations, analysis and upgrade). The T1 and T2 centers are becoming nucleation points for ‘local’ work.





Collaborative Tools



login

[Home](#) > [Experiments](#) > [ATLAS Meetings](#)

ATLAS Meetings (Managers: Desnyder-Ivesdal, M.; Potter, C.; Demirdjian, C.; Massip, C.; Wintersgill, K.; Info-Protection, A.)

This category contains the agendas, minutes and transparencies of ATLAS meetings.

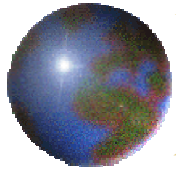
Categories:

- [ATLAS Collaboration Weeks](#) (36) (protected)
- [ATLAS Trigger & Physics Weeks](#) (8)
- [CB Chair Advisory Group](#) (11)
- [Collaboration Board](#) (22)
- [Commissioning](#) (104)
- [Computing](#) (3447)
- [Cooling](#) (3)
- [Data Preparation](#) (161)
- [Electronics](#) (96)
- [Executive Board](#) (73) (protected)
- [Experimental Zone and Infrastructure](#) (21)
- [Inner Detector](#) (1979)
- [LHCC interactions](#) (65)
- [Liquid Argon Calorimeter](#) (2100)

Tools

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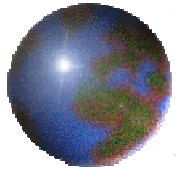
INDICO is a tool for agenda creation. It also serves as a “memory” since all the posted talks are persistent.



Collaborative Tools - II



The LHC experiments use a teleconferencing tool called EVO. This allows all LHC collaborators with web access to participate remotely in meetings. ILC uses WEBEX



Collaborative Tools - III

iSGTW INTERNATIONAL SCIENCE GRID
THIS WEEK

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[Home](#) > [iSGTW - 25 March 2009](#) > iSGTW Feature - Role of e-Infrastructure in creation of global VOs

Feature - Global virtual communities: opportunities versus barriers

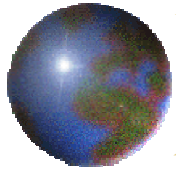
With over a decade of development, the vision of a global research community connected through a distributed computing infrastructure is increasingly becoming reality. But what makes this research environment, called e-Infrastructure, and these communities, called Virtual Organizations, successful? And to what extent do scientists from diverse communities experience this transition and contribute to it?

Addressing this question is the goal of [eResearch2020](#), a newly launched collaboration between the [University of Chicago/National Opinion Research Center](#), the [Oxford Internet Institute](#), the [University of Applied Sciences Northwestern Switzerland](#) and [empirica Communication and Technology Research](#) (Germany). Tasked by the European Commission, [Directorate General Information Society and Media](#) to complete its assessment by the end of the year, the study will propose strategies to enhance e-Infrastructure uptake and use in different fields of science.



Image courtesy of cybersociology.com

This research modality is not limited to particle physics.

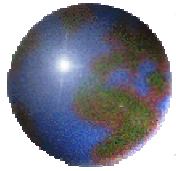


US Groups in LHC

US ATLAS Institutions

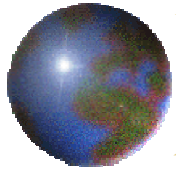
- 43 US institutes (from 21 states)
 - Albany, ANL, Arizona, UT Arlington, Berkeley LBL and UC, Boston, Brandeis, BNL, Chicago, Columbia, UT Dallas, Duke, Fresno State[#], Hampton, Harvard, Indiana, U Iowa[#], Iowa State, UC Irvine, Louisiana Tech^{*}, Massachusetts, MIT, Michigan, MSU, New Mexico, NIU[^], NYU, Ohio State, Oklahoma, Oklahoma State, Oregon, Pennsylvania, Pittsburgh, UC Santa Cruz, SLAC, SMU, South Carolina^{*}, SUNY Stony Brook, Tufts, Illinois Urbana, Washington, Wisconsin, Yale
 - Corresponding to 38 voting institutions
 - * = affiliated with BNL; # = affiliated with SLAC; ^= affiliated with ANL
- Others ...
 - No US discussions, but continuing to establish closer ties with South Africa (also fostering closer relations with South America)
- As of Sept 30, 2008
 - 38/169 voting institutions (22%)
 - 395/1817 “current M&O authors” = ~PhDs (22%)

US CMS is similar. Fraction is slightly larger ~ 1/3



Nucleation at Laboratories

- ❖ **US ATLAS has Argonne, Brookhaven Lawrence Berkeley and SLAC as collaborating laboratories. A dispersed support model is favored.**
- ❖ **US CMS has Fermilab as the major laboratory (LLNL is a small effort). Naturally, with a different sociology, they favor a central nucleation. Thus in US CMS there is a single large ROC and LPC. These were part of the US CMS baseline plan ab initio.**



US ATLAS Analysis Support Efforts

US ATLAS Analysis Support

Initial Organization, purpose (& acronyms)

SLAC is a T2

Currently 3 components

Analysis Support Centers
(ASCs)

ANL, BNL, LBNL

Loci of support activity:

Home to many ASG experts
Site of tutorials/jamborees

Regional gathering locations

Analysis Support Group
(ASGs)

Software & performance
experts based in US timezone

Most support provided by
hypernews (little use of phone)

Many experts available during
Jamborees & tutorials

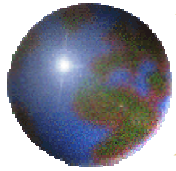
Analysis Forums
(AFs)

Informal venue for
physics/performance
discussions

Regular meetings

focus on nuts & bolts
(often not possible in CERN-
based meetings)

Complimentary
(not parallel)
to CERN meetings



Analysis Support

USATLAS Analysis Support Personnel

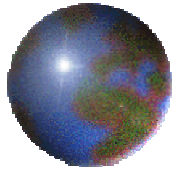
The FY08 analysis support effort from OP funds included:

- 0.5 FTE effort at BNL
- 0.5 FTE effort in documentation effort.
- Request for additional analysis support effort : (Support at ASCs & CERN) remained unfunded
 - Voluntary effort by several physicists has been filling this gap
- Approved hire in support of ROOT and related analysis tools development remained unfilled

For FY09, these two fronts have been merged:

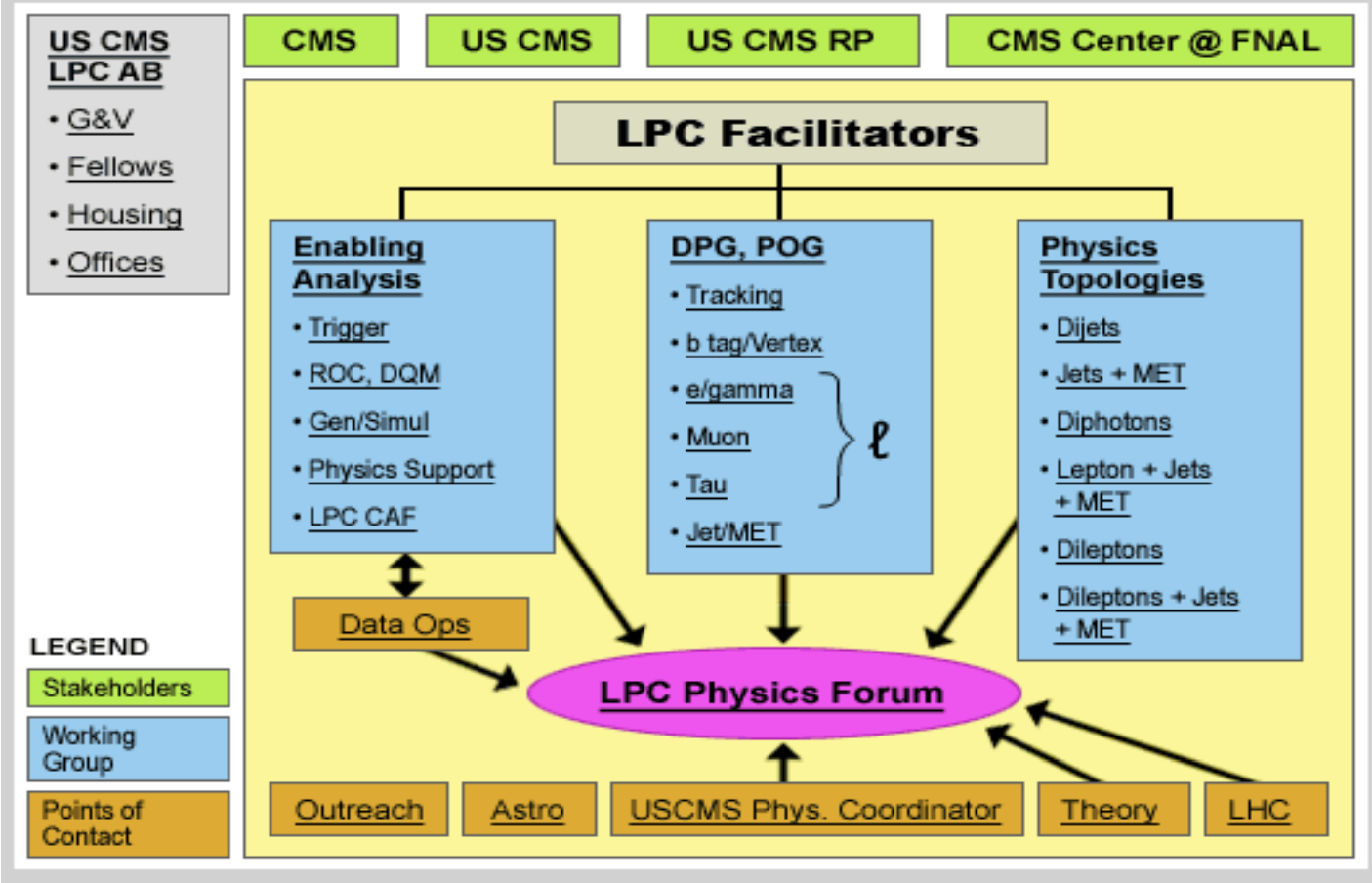
- New hired personnel expected to be engaged in development of analysis tools and support of U.S. physicists in their use
 - Examples:
 - Generic software tools common across analysis
 - Creation of DPD: thinning, slimming and skimming data sets
 - Retrieval and analysis of datasets based on physics selection
 - Use of PROOF and other ROOT based tools
 - Adapting software to work in Athena and ROOT environment

“Local” US ATLAS analysis support. Favor hires at Universities which split the costs. FY09 at Duke, Iowa State and NYU. Try to ramp up support at the 3 ASC and at CERN (US physicists resident)

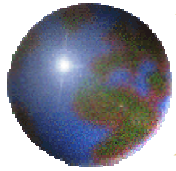


The LHC Physics Center

LPC Organization Chart:



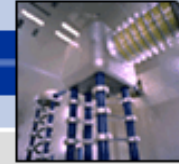
The LPC has been part of the US CMS baseline plan from the beginning. Note the Physics Support Group – ramp up



Guest and Visitor Programs



for physicists



home	about Fermilab	contacting Fermilab	inquiring minds	visiting Fermilab	education	search	
for physicists	Fermilab now	events	publications	Fermilab at work	jobs	press room	help



FELLOWSHIP PROGRAM

URA-FNAL
Visiting Scholars Program

There are several G&V programs to support US CMS visitors to the LPC

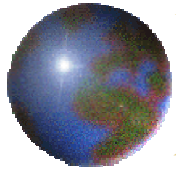
Related Links

- [Overview](#)
- [Application Procedure](#)
- [Award Administration and Fermilab Visitor Information](#)
- [Guidelines for Applications](#)

Overview

UNIVERSITIES RESEARCH ASSOCIATION VISITING SCHOLARS PROGRAM

Under the FRA/DOE contract for the operation of Fermilab, each of the 87 member institutions of [Universities Research Association, Inc.](#) (URA) has agreed to contribute \$5000/year for five years in support of joint Fermilab-URA research initiatives. These funds are being used to support visits by researchers from URA institutions to work at Fermilab for periods of up to one year.

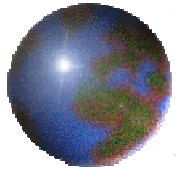


Experts on Call



Role	Task	Who
Responsible teacher	guarantees the pedagogical contents and coherence of the material	Frédéric Bonga
Content providers	provide material for different learning modules	FR, KLP, Benedikt Hegner, Steven Lowette, Roger Wolf, Volker Adler, Sal Rappoccio, Detar Maksimovic, Thomas Kress, CRAB team
Tutors	guide the participants in their exercises and in their project	Sal R, Roger W, Sudhir Malik, Benedikt Mura, Charles Blager
Support for tutors	help tutors when needed	Benedikt H, Frédéric R
Project management	plan and manage the project	KLP
Local organization & technical support	practical arrangements and technical support	KLP (CERN) Sudhir Malik (FNAL)

It is important to have experts available for help in real time. In addition, the experts should be in your time zone. As of now, CMS has 2 teams – one in CERN and one in FNAL (4 US CMS – LPC Physics Support Team).



Web Based Mentoring

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In order to be up to date, the LPC has started a “US CMS Mentors Program” which takes Facebook as a model. In this way senior US CMS physicists can help mentor graduate students and postdocs remotely.

Your groups



[US CMS Communication](#)



[New Physics](#)

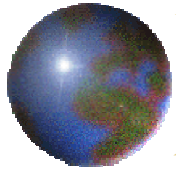


[Mentors](#)

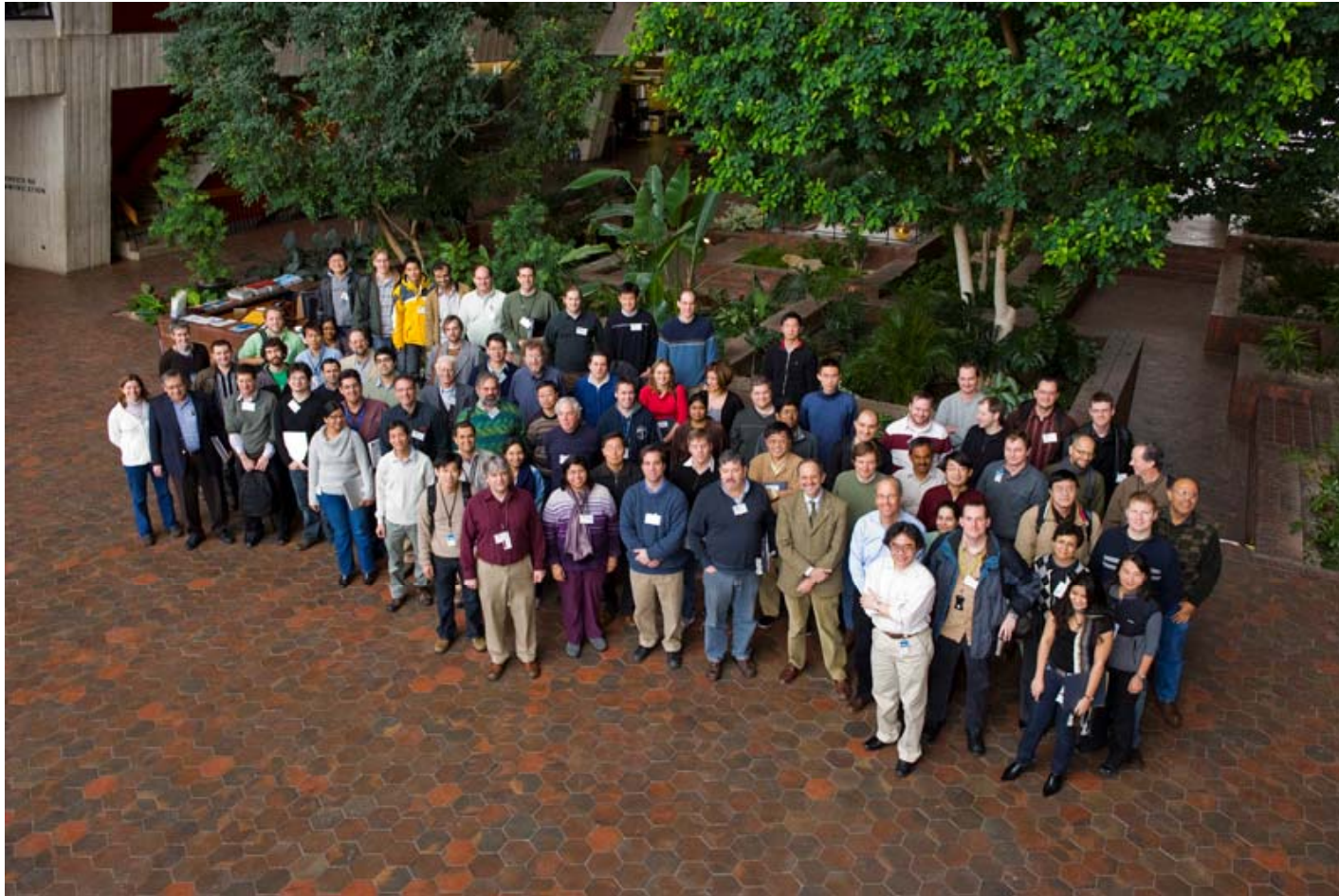
US CMS Mentors



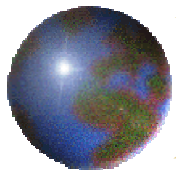
[EW Physics](#)



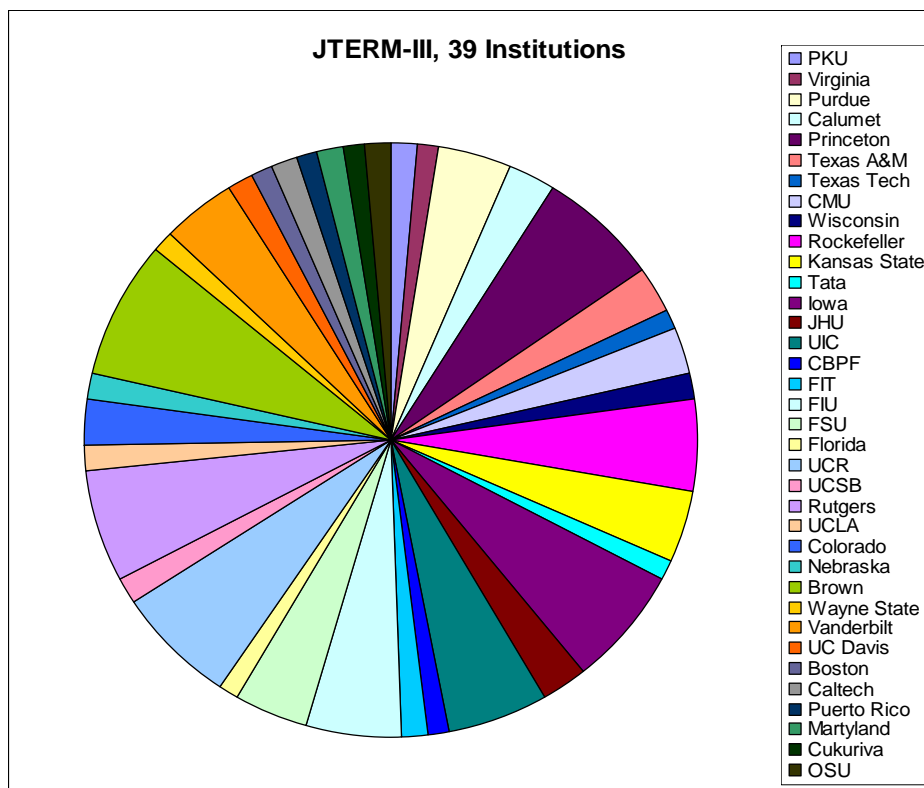
LPC Hosts US CMS Workshops



“Local” Workshops in the US are well attended.

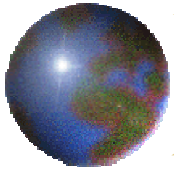


Metrics - I

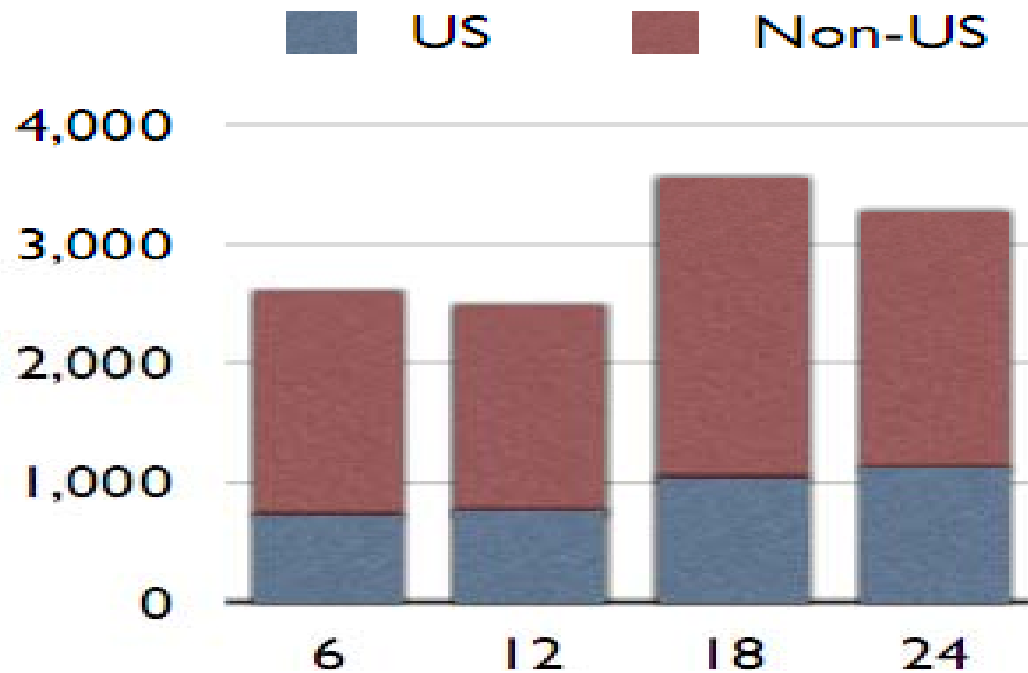


How well is US CMS engaged in physics analysis? Metrics hard to specify. Well attended

Workshops/Tutorials with a good sampling of US CMS groups. The LPC is reaching the US CMS community of 46 university groups, quite widely it seems.

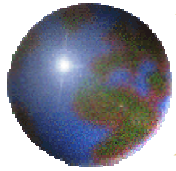


Metrics - II



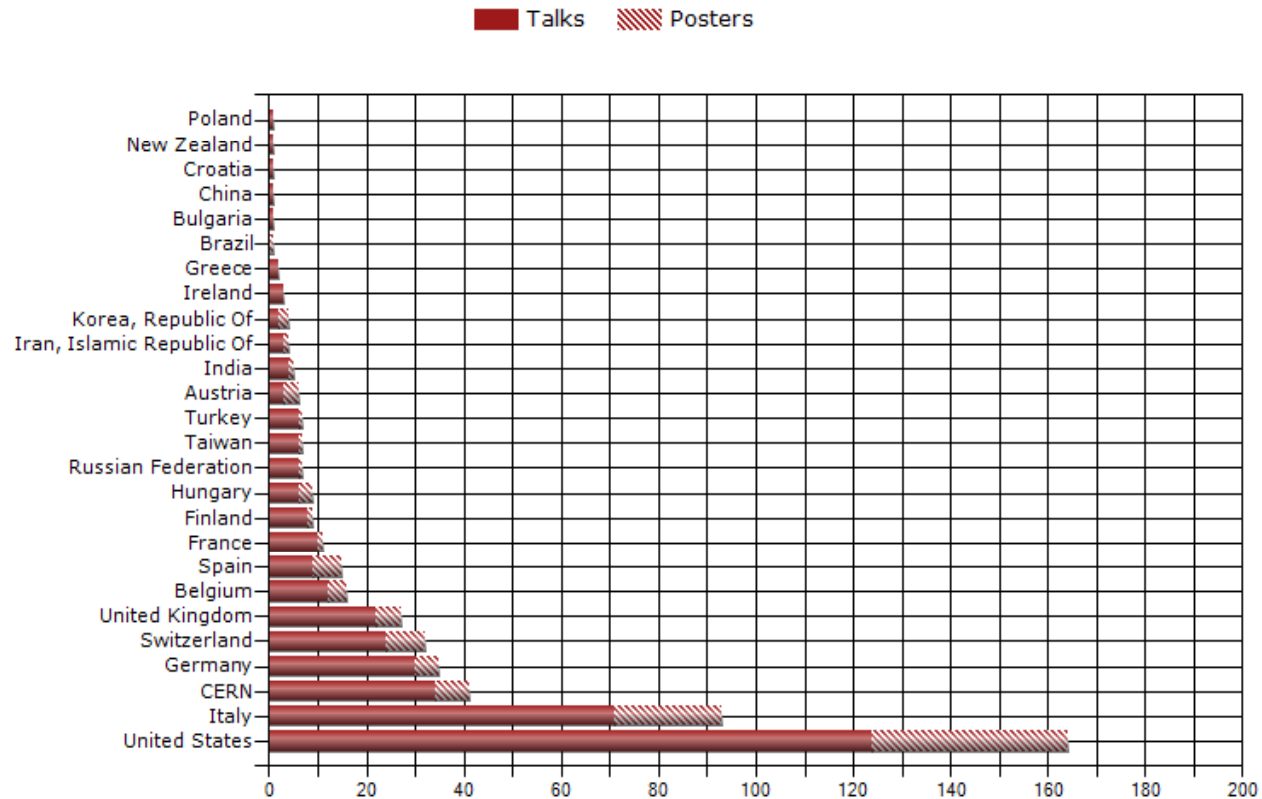
Last 2 years – 6 month bins

Mine data in INDICO to see what fraction of CMS talks at CMS meetings are given by US physicists. The fraction is roughly pro rata, or 1/3.

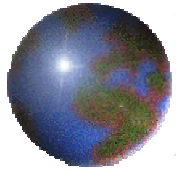


Metrics - III

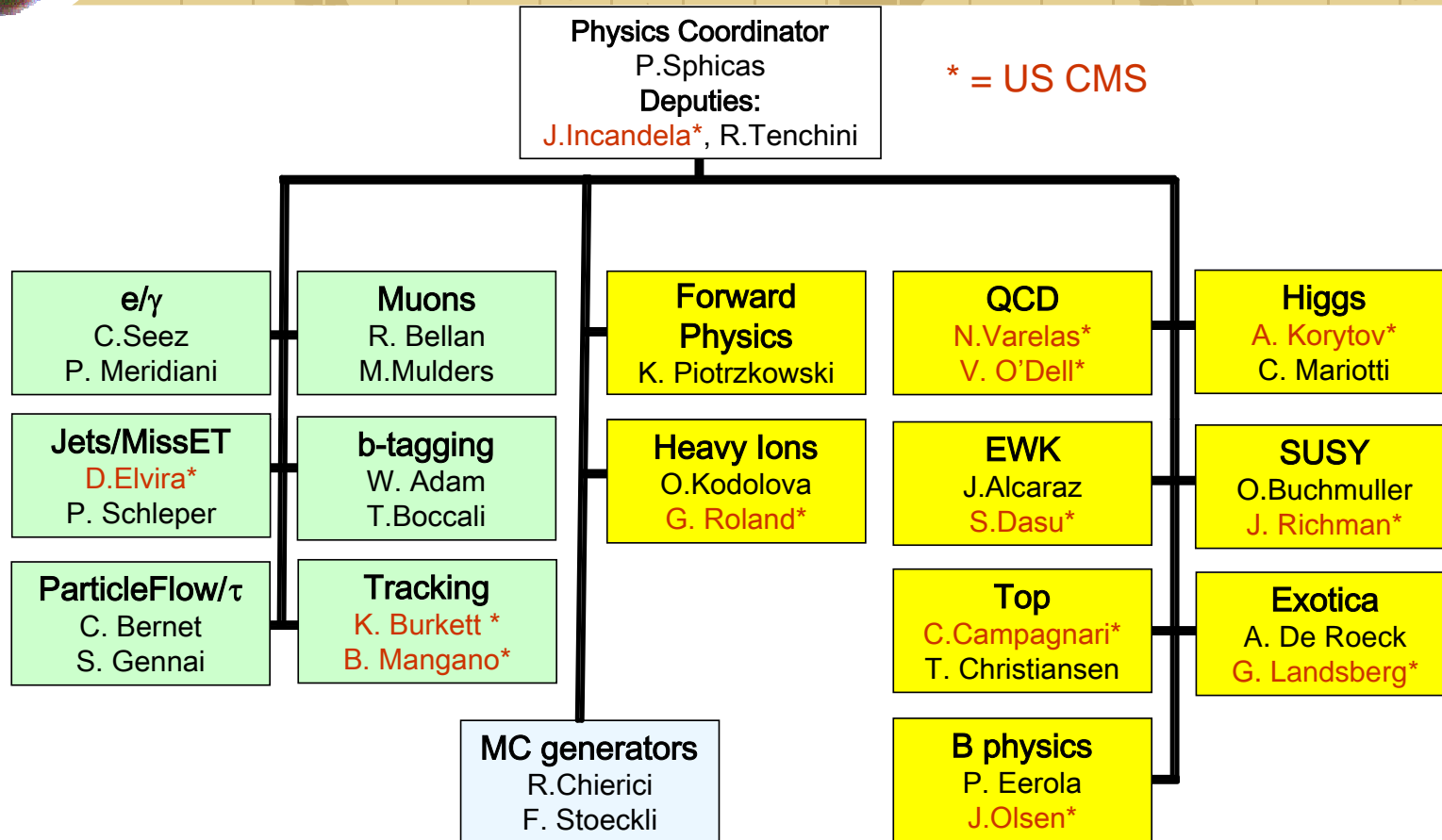
CMS talks and posters in the last 12 months



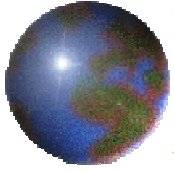
Mine CMS Conference Committee data to look at conference talks sorted by nationality. The US is roughly pro rata and gave the most talks of any national group.



Metrics - IV

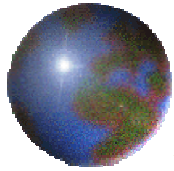


Due to the Tevatron experience of US physicists the representation of US physicists in CMS physics groups is more than pro rata In the core analyses (yellow) US physicists comprise more than half the conveners



Summary

- **The LHC experiments are of unprecedented size and complexity, as are the collaborations**
- **In order to operate, analyze and upgrade the experiments , all of the collaborators must be both engaged and enabled.**
- **To enable fully - tiered computing, grid tools, remote operations centers, distributed data operations and collaborative tools must be fully deployed.**
- **US groups are fully active in the LHC experiments and participate proportionally.**
- **Metrics for US participation indicate that US ATLAS and US CMS strategies to engage fully have, to date, been successful. However, we have yet to take first data.**



ATLAS Physics & Performance Groups

Physics coordinators

Dave Charlton
Tom LeCompte

Physics Groups

e/Physics WG	S. Hassani, C. Petridou
Top WG	M. Bosman, R. Hawkings
Standard Model WG	L. di Ciaccio, S. Tapprogge
Higgs WG	A. Nisati, K. Assamagan
SUSY WG	G. Polesello, P. de Jong
Exotics WG	E. Ros, P. Savard
Heavy Ions WG	B. Wosiek, P. Steinberg
Monte Carlo WG	O. Jinnouchi, J. Katzy

Combined Performance Groups

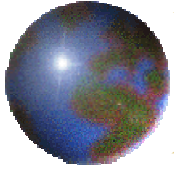
e/gamma WG	D. Froidevaux, L. Serin
Flavour Tagging WG	L. Vacavant, G. Watts
Jet/EtMiss WG	J. Proudfoot, T. Carli
Tau WG	W. Mader, Y. Coadou
Muon WG	C. Schiavi, D. Crestano

Other

Trigger	N. Ellis
Tracking Performance	S. Haywood, A. Wildauer
Production Team	B. Kersevan

Conveners serve
staggered
2 year terms

Nominated by
collaboration
board, appointment
decided by physics
coordinators



ATLAS-wide (Distributed) Analysis Support Personnel

Effective Sep 29, 2008, PanDA/Ganga support is provided by the AtlasDAST (Atlas Distributed Analysis Shift Team)

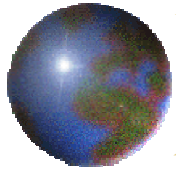
AtlasDAST currently 8 members:

4 in the US time zone & 4 in the EU time zone

One member from each zone is on shift for 7 hrs/day (9am-11pm CERN time) 5 days/week

Nurcan Ozturk (UTA) & Daniel van der Ster (CERN) were appointed to coordinate this effort

This shift work counts toward Operations Task credit



USATLAS Analysis Support Personnel

- As recommended, new hires to be located at Universities splitting costs:
 - Allows them to work part time on physics making jobs more attractive
 - OP funds allows for stable and committed support
 - Overhead and other saving from University environment
- FY09 budgeted hires:
 - 0.5 FTE at Duke (support for PROOF and Root based tools)
 - 0.5 FTE at NYU (Support for Athena based analysis tools)
 - 1 FTE at Iowa State (Support for analysis tools and data selection)
 - Together with already existing 1 FTE support, this brings the total to 3 FTE in FY09

Expect support needs to increase in FY10 as large scale data analysis commences:

- Support at the three analysis support centers
- Support for U.S. physicists based at CERN
- It takes extensive effort and experience to provide technical analysis help to physicists.
We need to make sure we have this in place before data taking starts
- Additional 2 FTE anticipated & requested (under RBT) for FY10.
 - FY09 experience will help us understand better the size & scope of the needed support