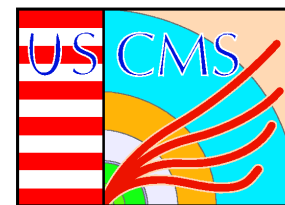




US - LHC



University Programs

Wesley Smith

University of Wisconsin - Madison

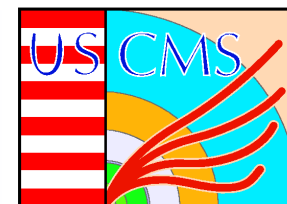
Presentation to HEPAP

July 13, 2001

http://www.hep.wisc.edu/wsmith/HEPAP_LHCuniv.pdf



U.S. Institutions in ATLAS



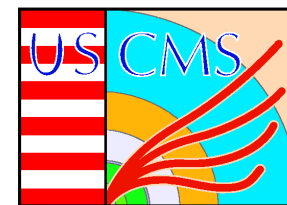
**182 physicists & 61 engineers
from 30 Universities & 3 Labs**

Subsystem	Institutions
Silicon	UC-Berkeley/LBNL, UC-Irvine, UC-Santa Cruz*, Iowa State, New Mexico, Ohio State, Oklahoma, SUNY-Albany, Wisconsin
TRT	Duke*, Hampton*, Indiana*, Pennsylvania
Liquid Argon Calorimeter	Arizona, BNL, Columbia, Pittsburgh, Rochester*, Southern Methodist U., SUNY-Stony Brook
Tile Calorimeter	ANL, Chicago*, Illinois-Champaign/Urbana*, Michigan State*, UT-Arlington*
Muon Spectrometer	Boston*, BNL, Brandeis*, Harvard*, MIT*, Michigan*, Northern Illinois, SUNY-Stony Brook, Tufts*, UC-Irvine, Washington*
Trigger and DAQ	ANL, UC-Irvine, Michigan State, Wisconsin

*** Work shown on next 5 slides**



University work on ATLAS



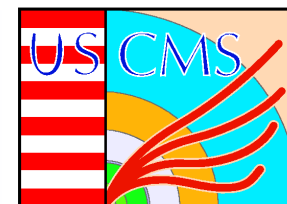
Example: U. Rochester: Barrel Cryostat

- Major milestone
- just met



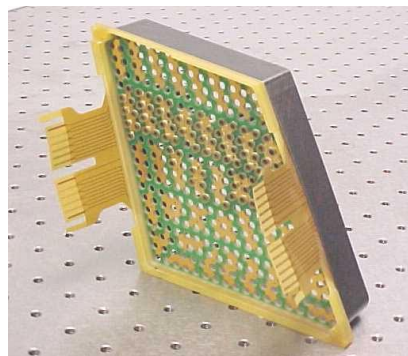


U.S. ATLAS TRT Production Sites



Duke University

- Wire Joint stations
- High Voltage plate
- Module 2, 3



Hampton University

- Component prep
- Straw subassembly



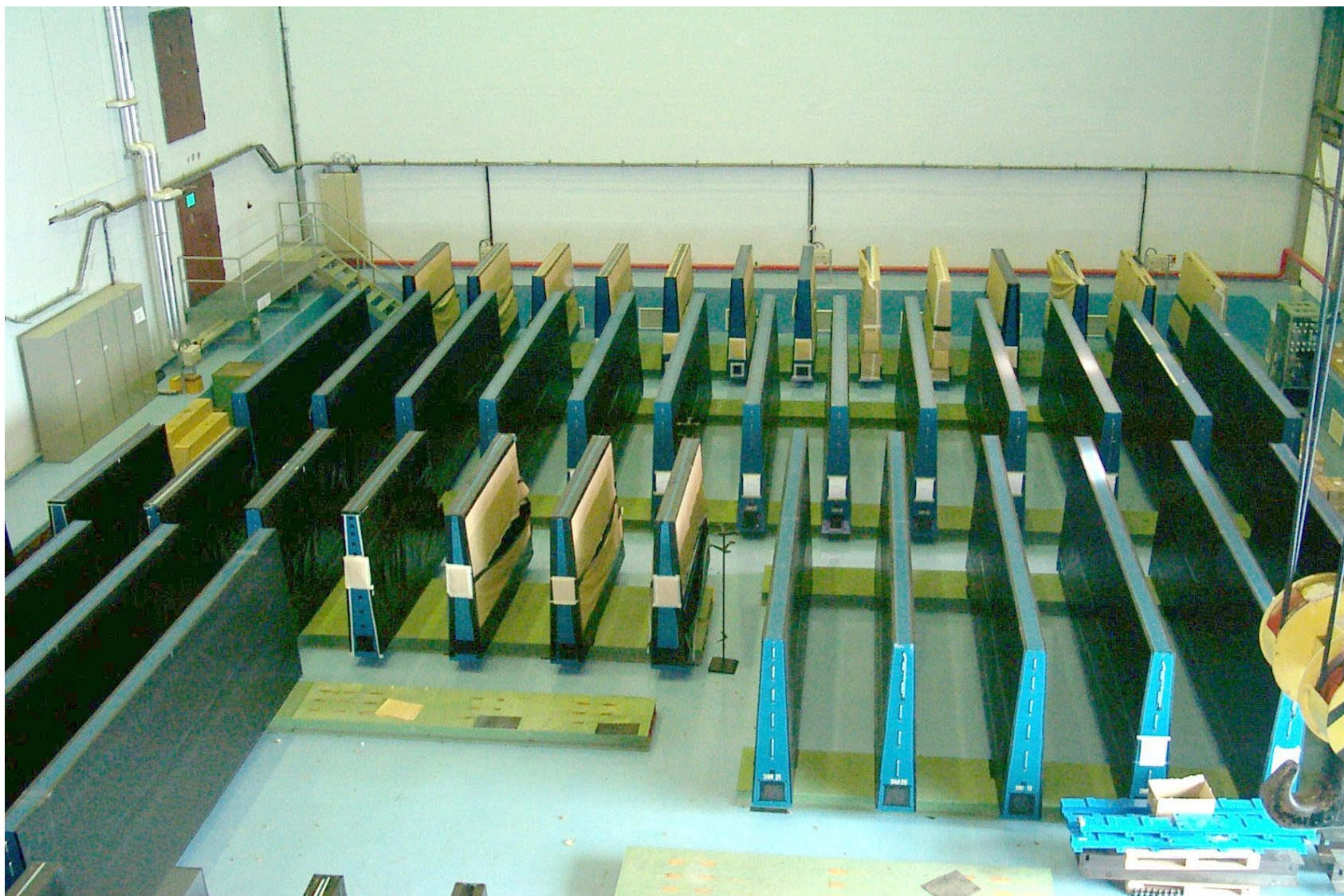
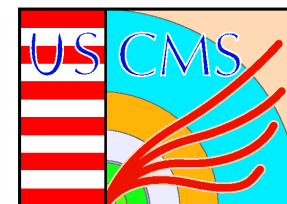
Indiana University

- Shell production
- Radiator punching
- Module 1, 3



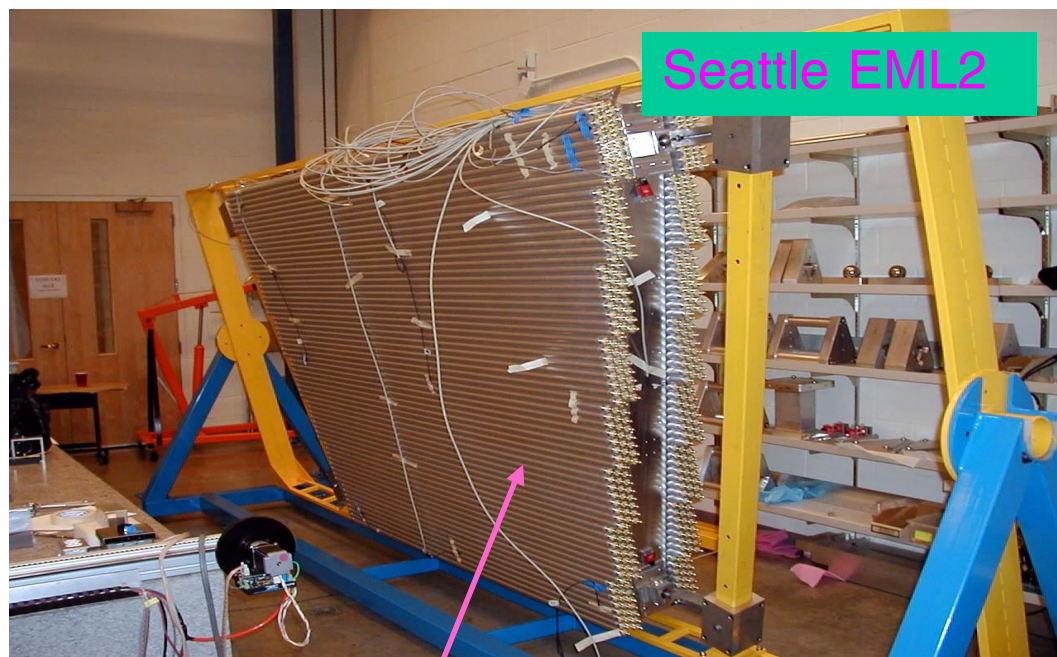
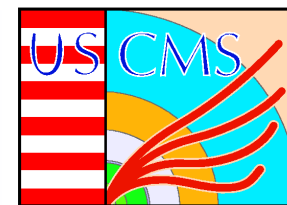


Lots of U.S. ATLAS Tilecal Modules at CERN





U.S. ATLAS MDT Base-Chamber Production



Seattle EML2

EML2: 3-Layer Chamber
Tube length: 2 to 2.9 m
No. Tubes: 384
No. Endplugs: 768

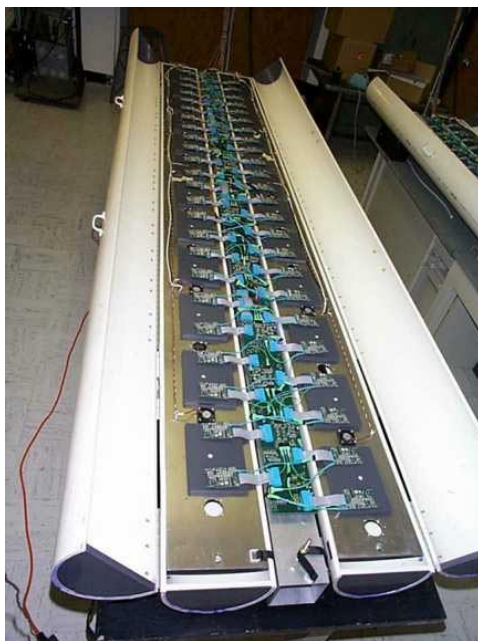
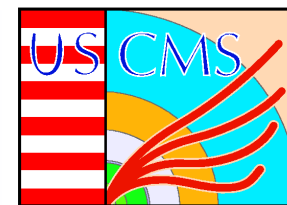


Michigan EMS5

EMS5: 3-Layer Chamber
Tube length: 3.2 to 3.6 m
No. Tubes: 384
No. Endplugs: 768

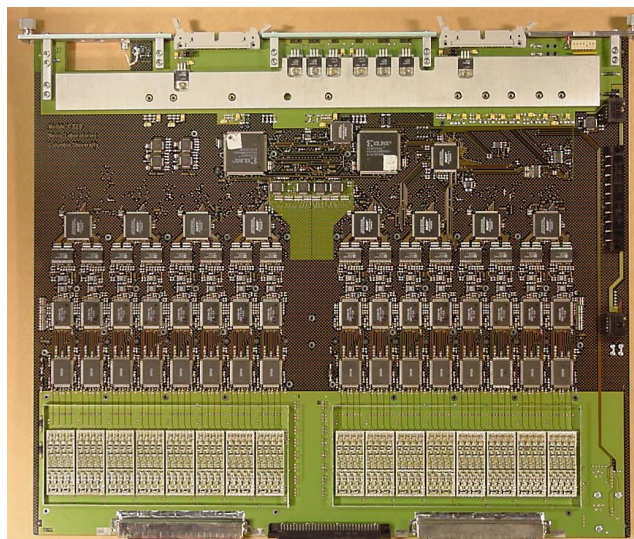


U.S. ATLAS University Electronics Work

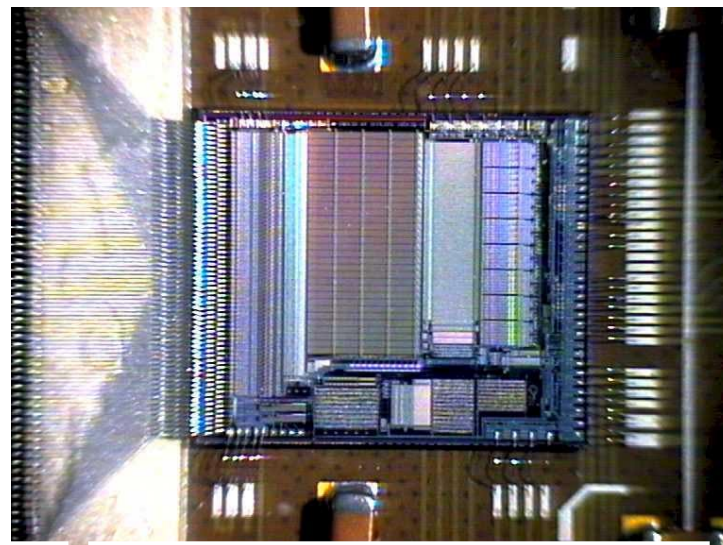


Tile Cal 3-in-1 card
burn-in station
(U.Chicago).

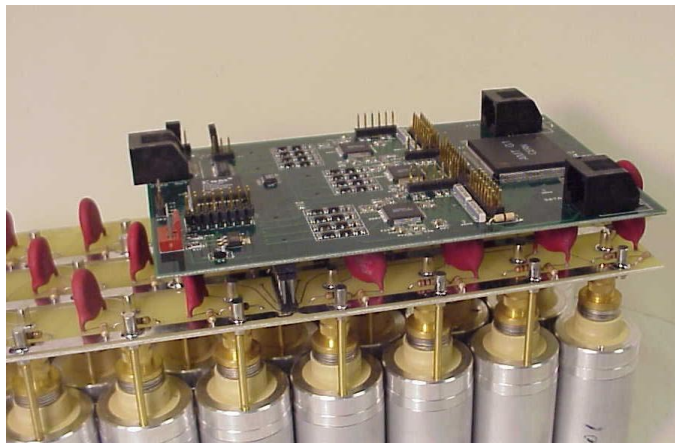
A sampling...



Liquid Argon Front End
board (Columbia U.)



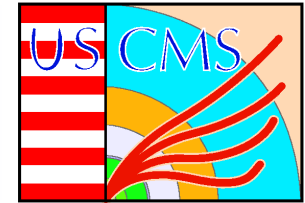
Silicon Strip Readout
Chip (UC Santa Cruz).



Prototype MDT
electronics
(Harvard).



Issue for U.S. Universities working in ATLAS



(Also issue for CMS)

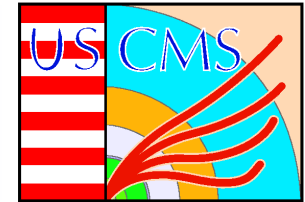
Over the years – Project and special infrastructure funds have had to be added beyond the original plan for engineering. Some of the infrastructure funding has been incorporated into the base – but even today - more engineering is still needed.

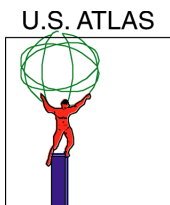
- With the pressure on maximizing deliverables, there is not always sufficient Project funds for all requests.
- With the pressure on the operating budget, particularly in FY02, there is a lack of flexibility
- At end of Project funding, need to keep some of engineering at universities to retain the institutional memory & move onto other projects.
- Should keep the engineers for M&O phase as part of the **research program**



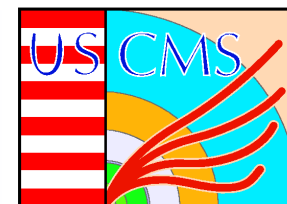
US CMS - at Present

387 Members from 38 Institutions





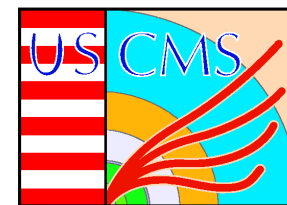
U.S. Institutions in CMS



Subsystem	Institutions
Endcap Muon	UC-Davis, UC-Los Angeles, UC-Riverside, Carnegie Mellon, FNAL, Florida, Northeastern, Ohio State, Purdue, Rice, Wisconsin
Hadron Calorimeter	Boston, Fairfield, FNAL, Florida State, Illinois-Chicago, Iowa, Iowa State, Maryland, Minnesota, Mississippi, Nebraska, Northeastern, Notre Dame, Purdue, Rochester
Trigger	UC-Los Angeles, Florida, Rice, Wisconsin
Data Acquisition	UC-San Diego, FNAL, MIT
EM Calorimeter	Caltech, Minnesota, Northeastern, Princeton
Forward Pixels	UC-Davis, FNAL, Johns Hopkins, Mississippi, Northwestern, Purdue, Rutgers
Silicon Tracker	UC-Santa Barbara, FNAL, Kansas, Kansas State, Northwestern, Rochester, Illinois-Chicago

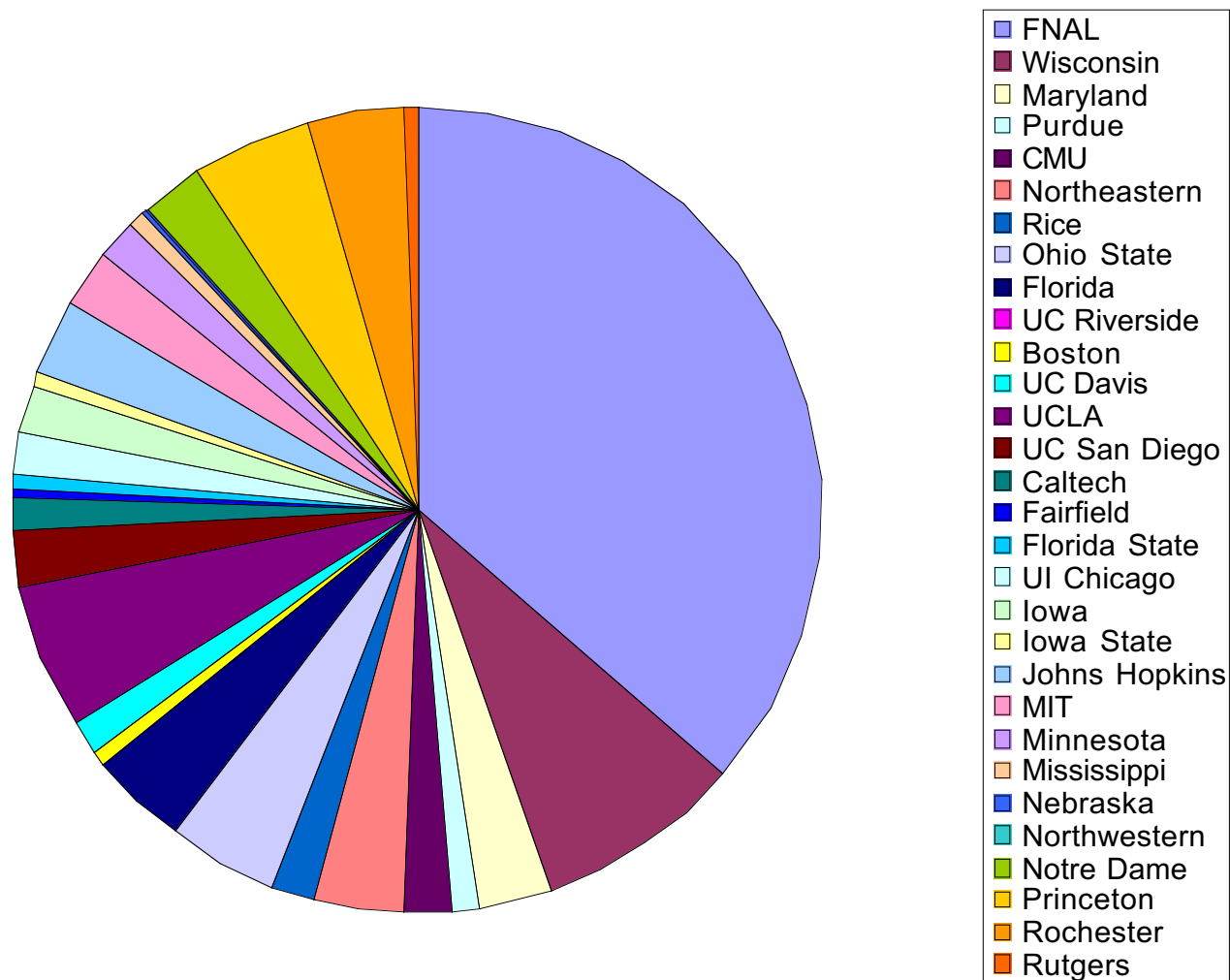


US CMS MOU - Baseline



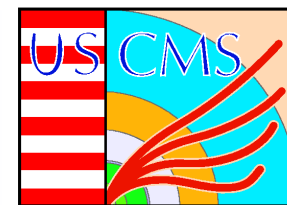
University groups take major responsibilities within US CMS.

US CMS MOU Drafts - no CP or PO



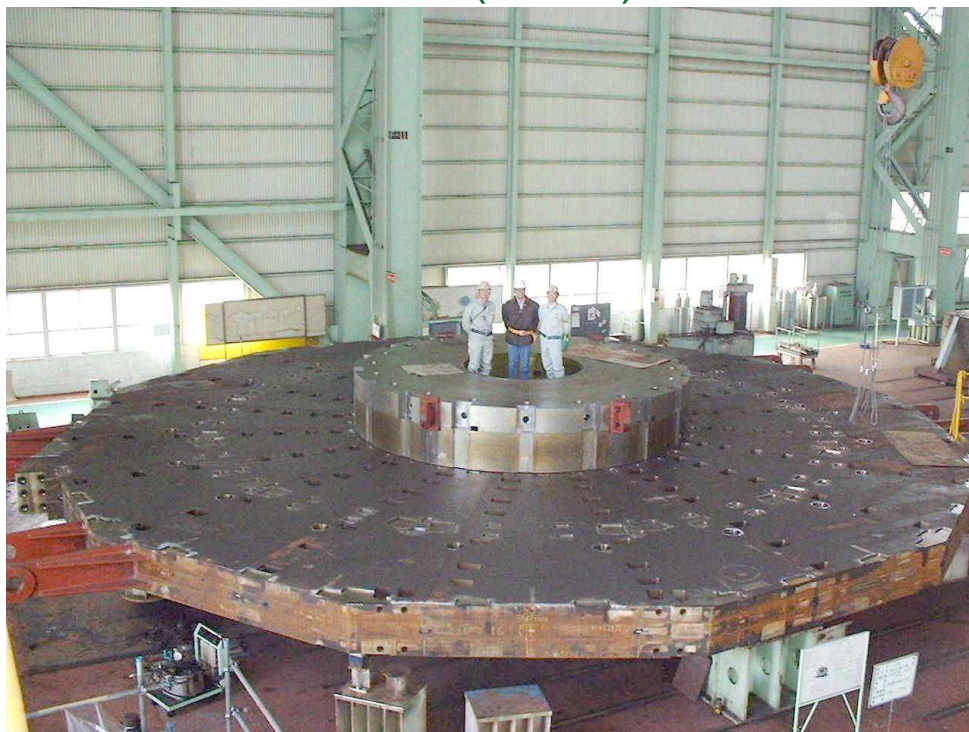


University work on CMS



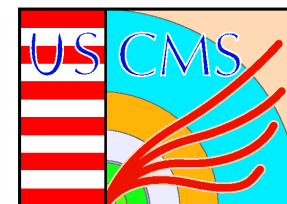
Example: U. Wisconsin: CMS Endcap Disks

- Under budget and on schedule
 - UW engineering & procurement
 - Disk assembly at CERN (6/01):
 - Disks manufactured at Kawasaki H. I. (11/00):



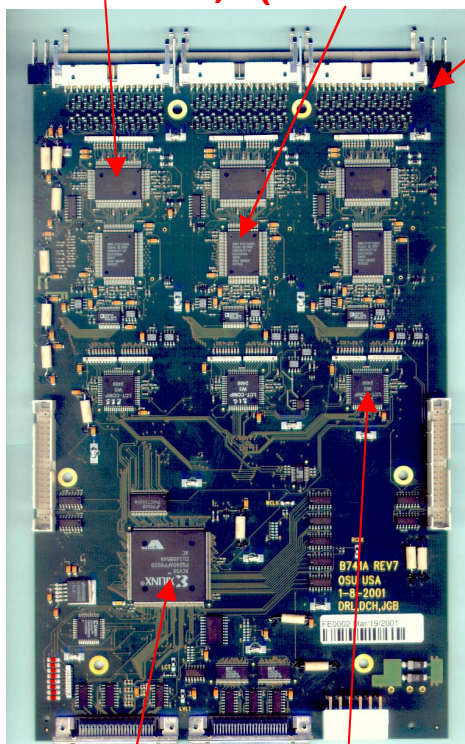


CMS Endcap Muon Front-End Electronics from Universities



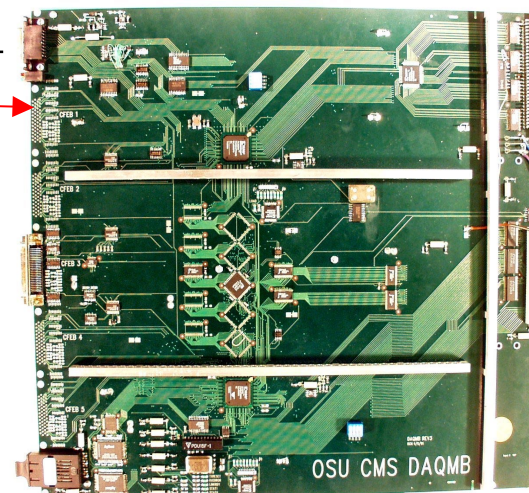
CSC Front-end Boards (Ohio State)

PA/SH ASIC (Ohio State) SCA (UC-Davis)

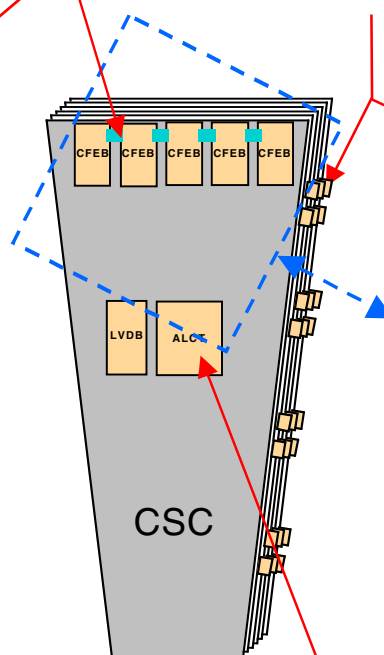
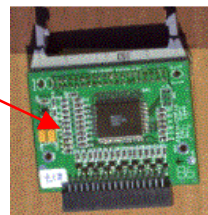


Control FPGA (Ohio State)
XILINX Virtex
Comp ASIC (UCLA)
Virtex (Trigger)

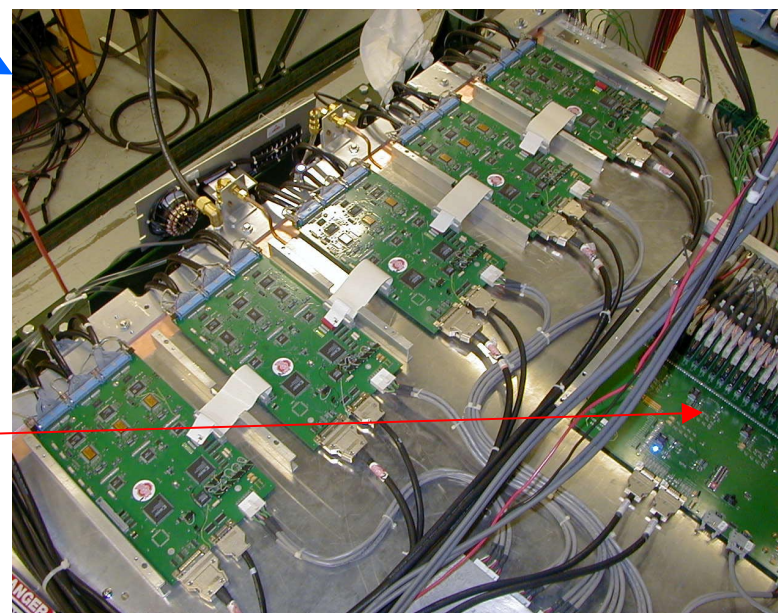
DAQ Motherboard (Ohio State)



Anode FE Boards (Carnegie Mellon)

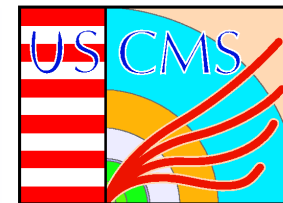


Anode LCT Board (UCLA)

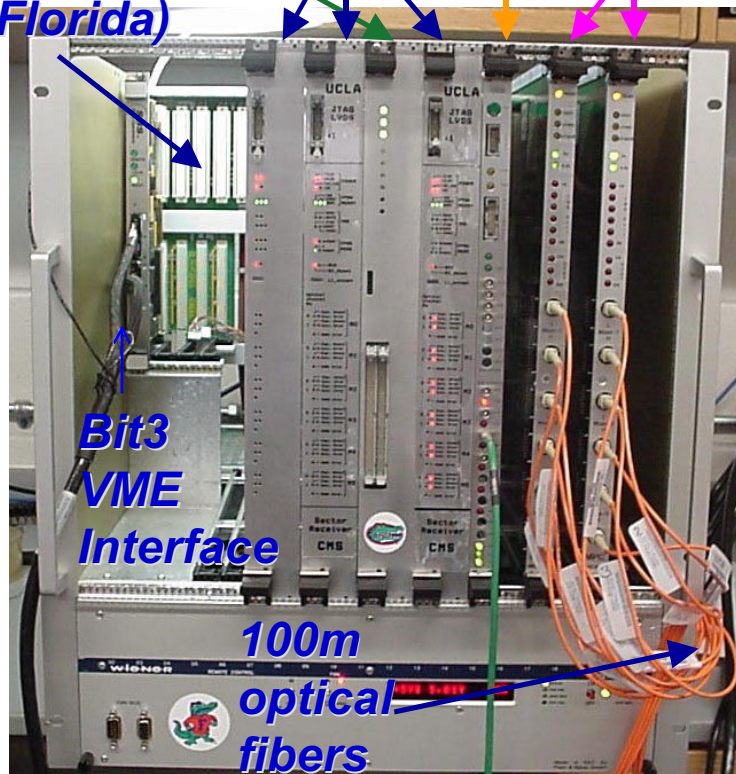




U.S. CMS University Work on Trigger Electronics



Sector Processor (U. Florida)
Custom backplane (U. Florida)
Muon Trigger Sector Receiver (UCLA)
Clock-Control (Rice)
Muon Port Card (Rice)

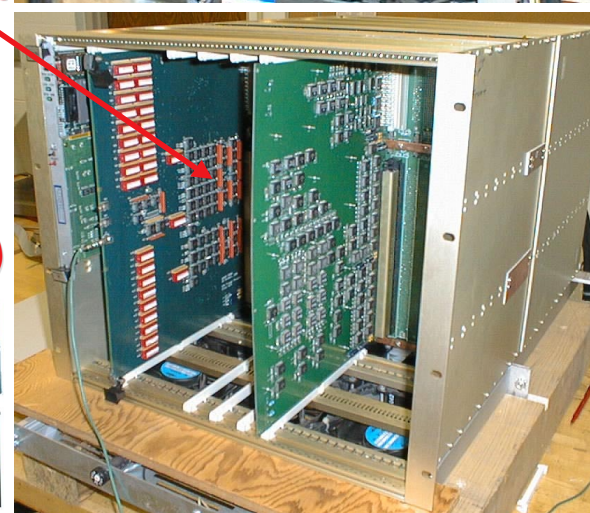
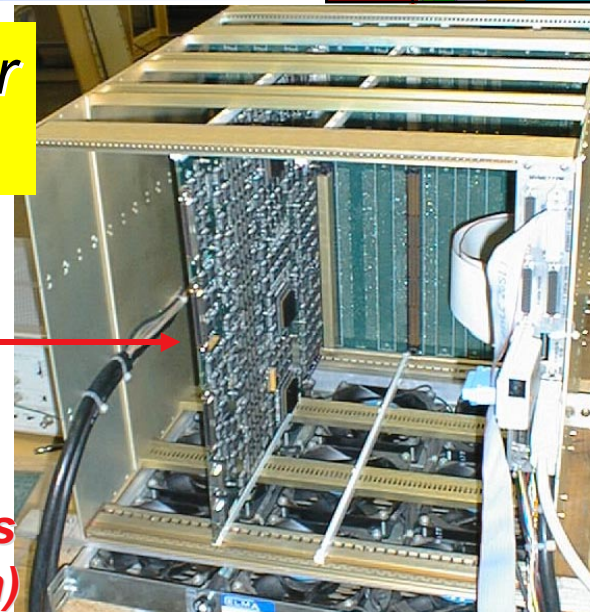
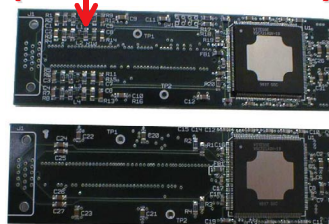


Bit3 VME Interface

100m optical fibers

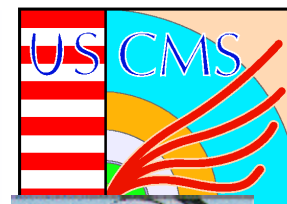
Calorimeter Trigger

160 MHz Backplane Receiver & Electron ID, Clock cards & GaAs ASICs (U. Wisconsin)
4.8 Gbaud 20 m Copper 4 channel link cards (U. Wisconsin)





U.S. CMS University Work on HCAL



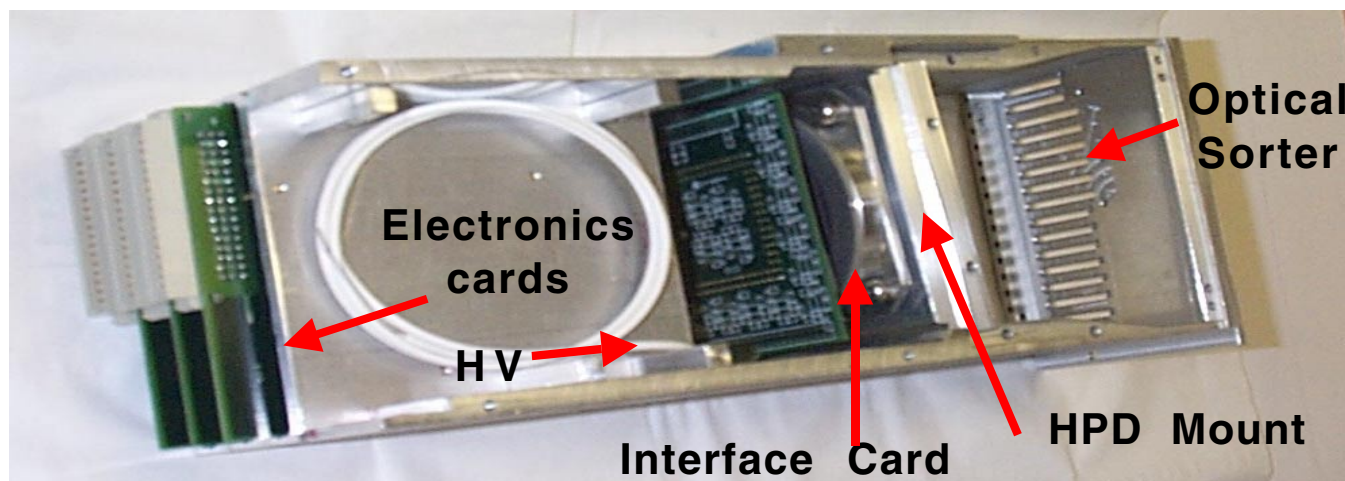
**U. Minnesota responsible for
Hybrid Photodiode Tubes**

**Vendor: Delft Electronic Products
(Netherlands)**

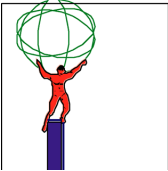
Subcontracts: Canberra
(Belgium) for diodes, Schott Glass (USA)
for fiber optic windows, Kyocera (Japan)
for vacuum feed-thru/ceramic carrier



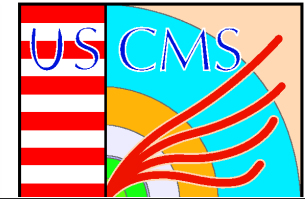
**Notre Dame responsible for boxes &
readout modules (RM) that integrate the HPD, front
end electronics, and digital optical drivers.**



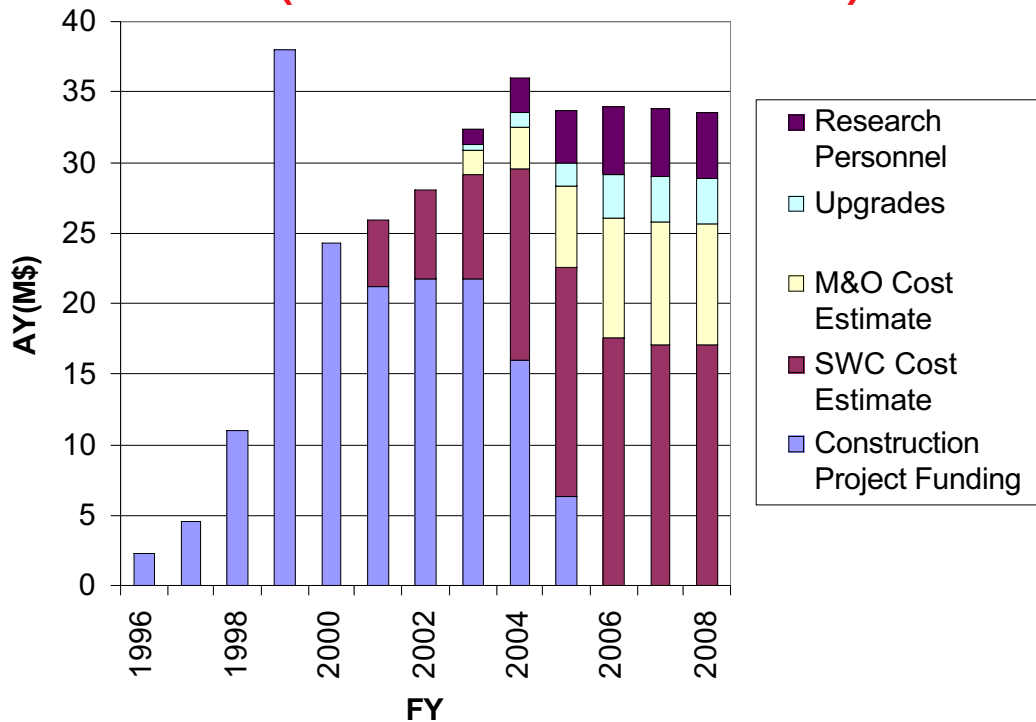
Factories at
Labs are often
'operated" by
University
postdocs - e.g.
U. Rochester
@ FNAL
for HCAL optics.



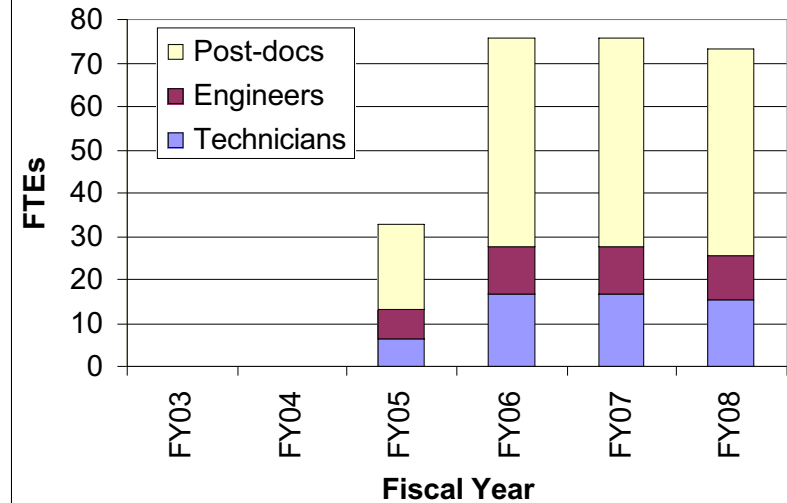
CMS University Issue: Maintenance & Operations - Cost and Manpower



**US CMS - Construction and Research
(Also issue for ATLAS)**



US CMS M&O Resource Usage

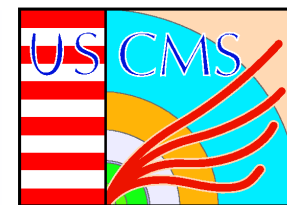


The components of the research program are SWC, M&O, upgrades and scaled estimates for the dislocation costs associated with postdocs and students - base program cost.

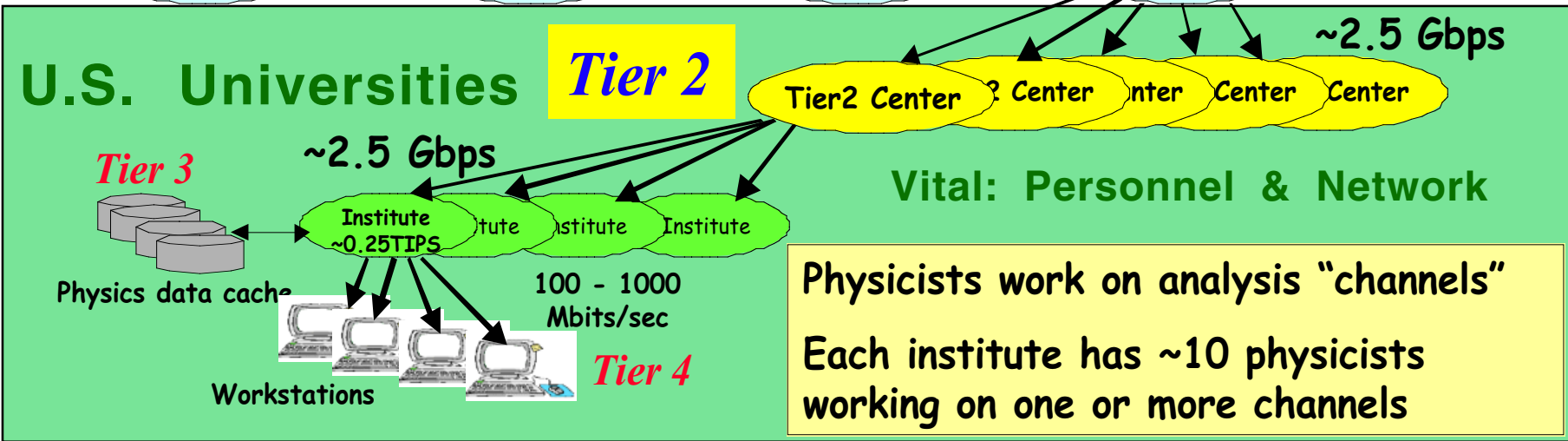
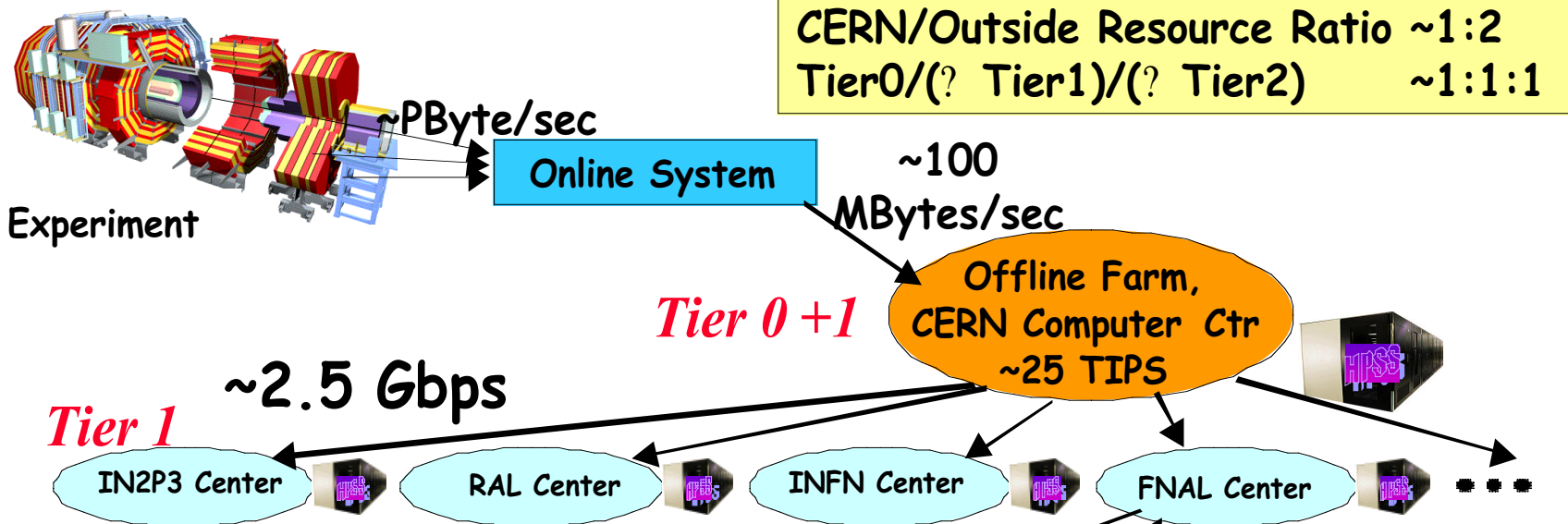
Cost estimates do not contain salaries of research personnel - postdocs & graduate students. ~48 "FTE" PD working on M&O. Base program salaries & increments needed for work at CERN are assumed to exist. Without them the effort fails.



U.S. Universities & LHC Physics Analysis

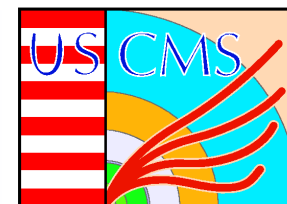


CERN/Outside Resource Ratio ~1:2
 Tier0/(? Tier1)/(? Tier2) ~1:1:1





U.S. ATLAS Computing



Regional Center – Tier 1 facility: BNL

- Operational, providing support for U.S. users
 - Releases, CPU cycles, data storage
- Core Computing & software: ANL, BNL, LBNL,
 - Responsibility for overall architecture, control/framework, data management (mainly lab responsibilities)

Tier 2 centers – 2 prototype sites active

Universities

- Boston U. and Indiana
- Testing grid computing, data intensive computing, networking

Reconstruction/simulation software leadership roles:

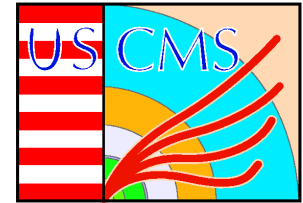
- Tracking (Indiana), EM Cal (Columbia), Tilecal (U.Chicago), Muons (Boston University, U. Michigan)

Background studies, Collaboratory tools

- U. Arizona & U. Michigan



US CMS Universities in Physics, Software, Computing, Networking



Initiating the CMS and US CMS Software Projects

- Caltech, Northeastern; UC Davis & Florida w/ Fermilab, 1996-2000

Building the Computing Model for CMS LHC:

- Caltech, Florida, UCSD, Wisconsin
- GIOD Distributed Data Project at Caltech 1996-1999
- MONARC Project: 1998 - (Originated the Grid Hierarchy Concept)
- GRID PIs: GriPhyN: P. Avery (Florida), PPDG: H. Newman (Caltech)

Prototype Tier2 Centers: Caltech/UCSD, Florida

Leading CMS SW: Core Software

- Princeton (D. Stickland): ORCA; Int'l Deputy S&C PM
- Northeastern (L. Taylor): IGUANA; Int'l S&C Tech Coordinator
- UCSD (J. Branson): Architecture Task Force; US Phys. Coord.

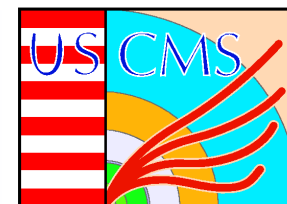
Transatlantic Networking for LHC and HEP: Caltech

Leading Physics Analysis

- MIT (Sphicas): CMS Physics Reconstruction & Software Leader
- US CMS Leaders: Muons: Florida (D. Acosta), Jets: Maryland (S. Eno)



U. Wisconsin Condor Computing System



Developed by UW Computer Science Department

- Software for job queuing on farms w/many advanced features
 - In use at Wisc., Bologna, etc.
 - Being adopted by grid projects



• UW Condor pool

<http://www.cs.wisc.edu/condor>

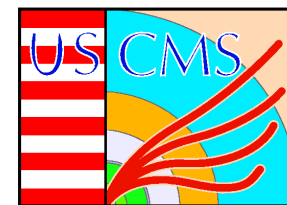
- 1000 CPUs, dedicated & after hours unused lab machines
- Used by Caltech & Wisc.-HEP to produce CMS simulations
 - About a million GEANT simulated events
- Used for CMS reconstruction w/ Wisc.-HEP & FNAL data storage
 - Now an integral part of world-wide CMS simulation production

Inter-disciplinary collaboration

- Wisc-Comp. Sci. ↔ Wisc.-HEP ↔ Caltech ↔ FNAL ↔ CERN
- Miron Livny's CS group part of PPDG & GriPhyN grid projects
- They provide expert advice on LHC computing strategies
- As members of major HEP computing grid projects they will provide distributed software components (i.e. toolkits)



US LHC University Program - The Challenge



Major responsibilities & shrinking funding

- Looking at a possible reductions
 - Inflation & Merit raises not counted
 - Translates into loss of ~ 1 physicist per group (quantization)
- Gilman panel recommended 10% increase
 - Never completed

Work is increasing

- People & groups are badly stretched

Students

- Supported by University funding
- Premature for LHC Ph.D. theses
- Can work on LHC projects if thesis on ongoing projects
 - But these may be cut!
- How can we recruit and train the next generation of HEP?



US LHC University Program - The Risk



Completion of the US ATLAS & CMS Projects requires increased University funding.

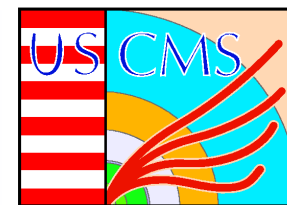
- Support for the US LHC project must include strong support for participating Universities.

Successful US operation of detectors & extraction of physics from LHC depends on strong University groups.

- Team that built the detectors is needed to operate them (institutional memory) and to extract the physics (calibration, alignment, diagnostics, performance).
- Key to maintaining leadership in LHC physics.
- Key to preserving & realizing the potential of the US investment.



US LHC University Program - The Message



US University program is a vital part of the LHC program with leadership at all levels: construction, commissioning, operation, data analysis, etc.

There is substantial leverage & assumed resources from the University program in the US LHC project.

- The US LHC program is short dozens of FTEs, many supposedly to come from Universities.
- Planning for transition from Construction Project to M&O assumes many university postdocs available to the project.
- Flagged by CMS Lehman Review as a problem

US University program is already badly stretched

US LHC University program is at hazard if funding levels are reduced.

We will not be able to realize our LHC investment.