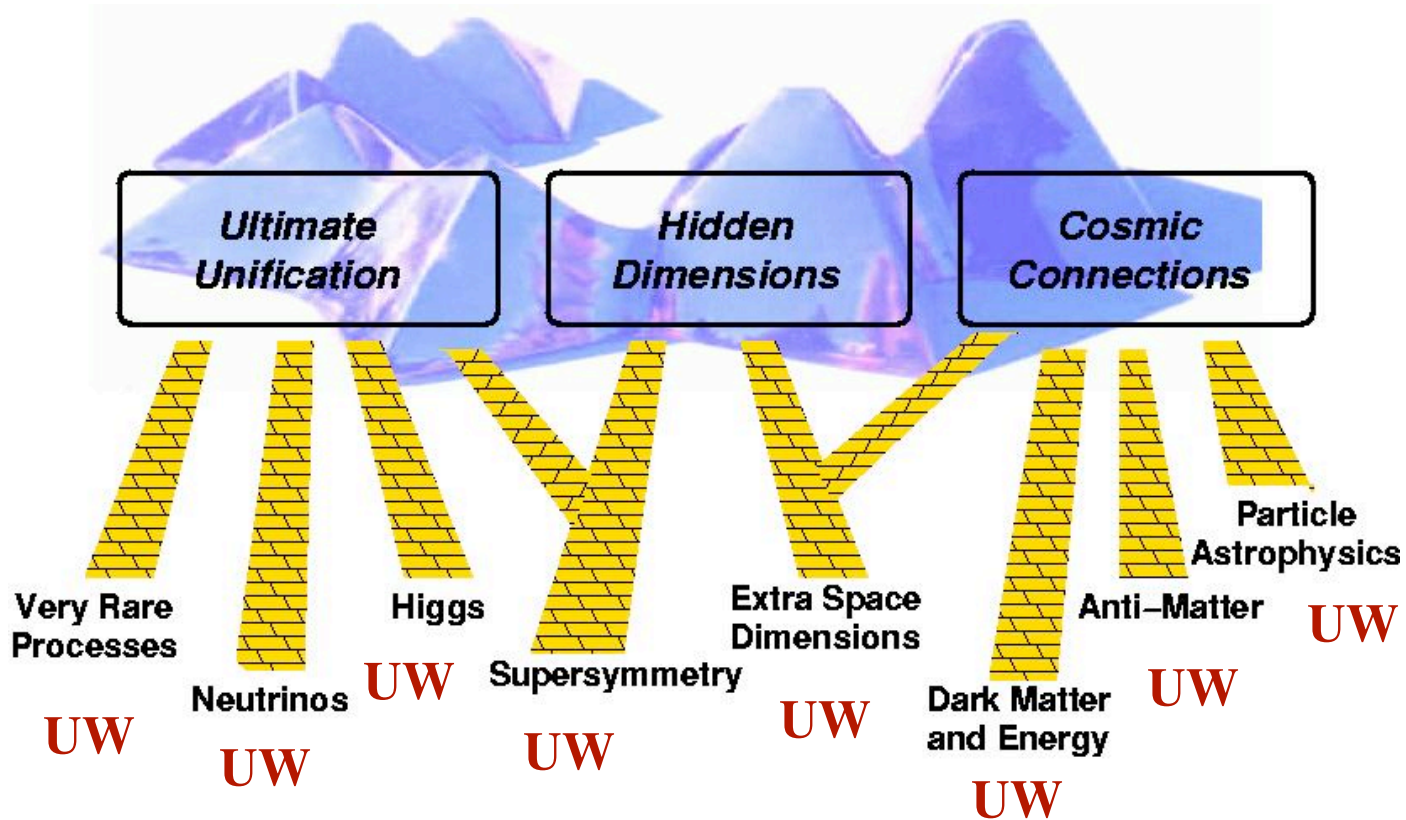




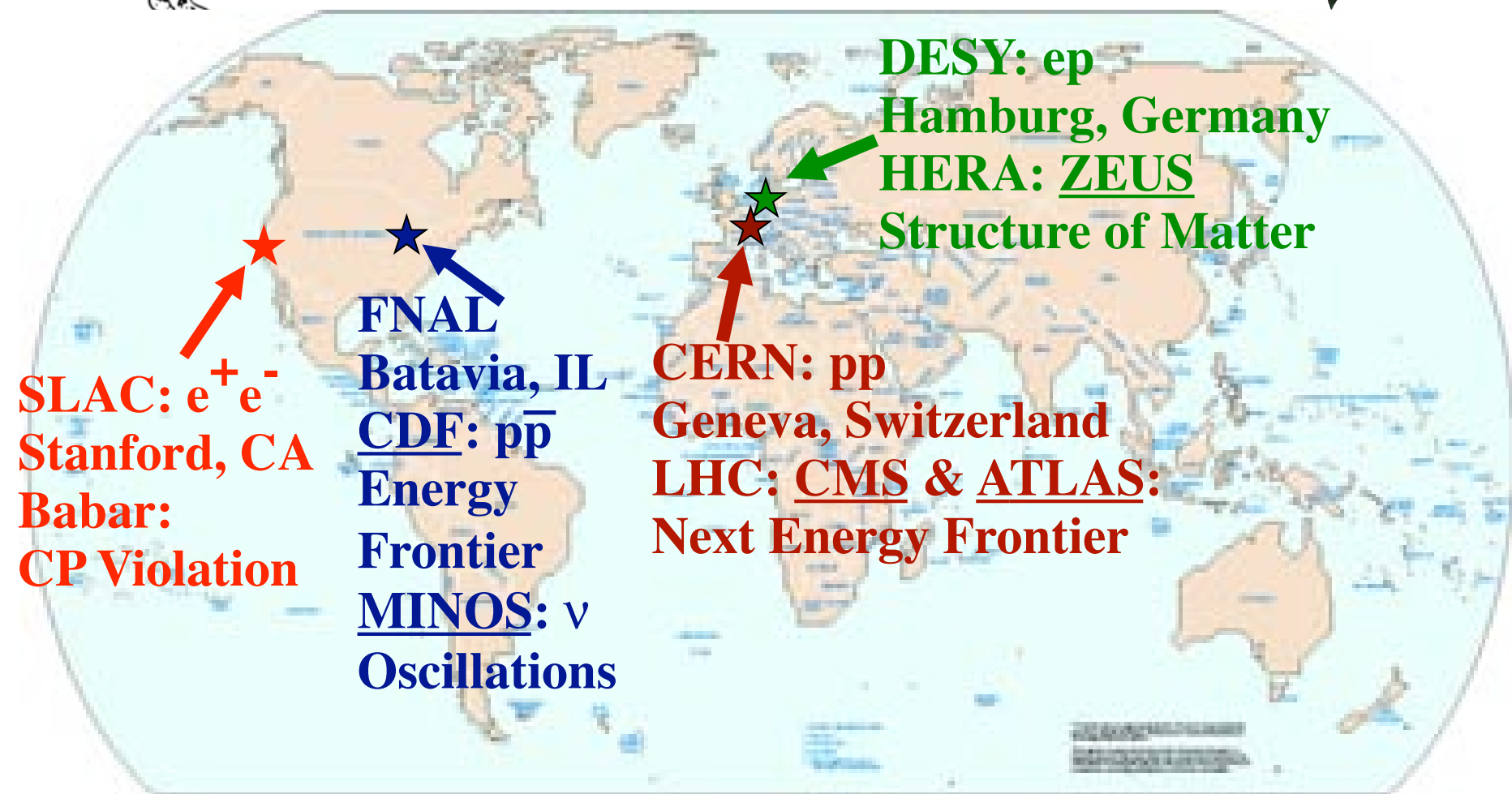
# Matter, Energy, Space, Time



## *Trails in Particle Physics*



# Wisconsin program



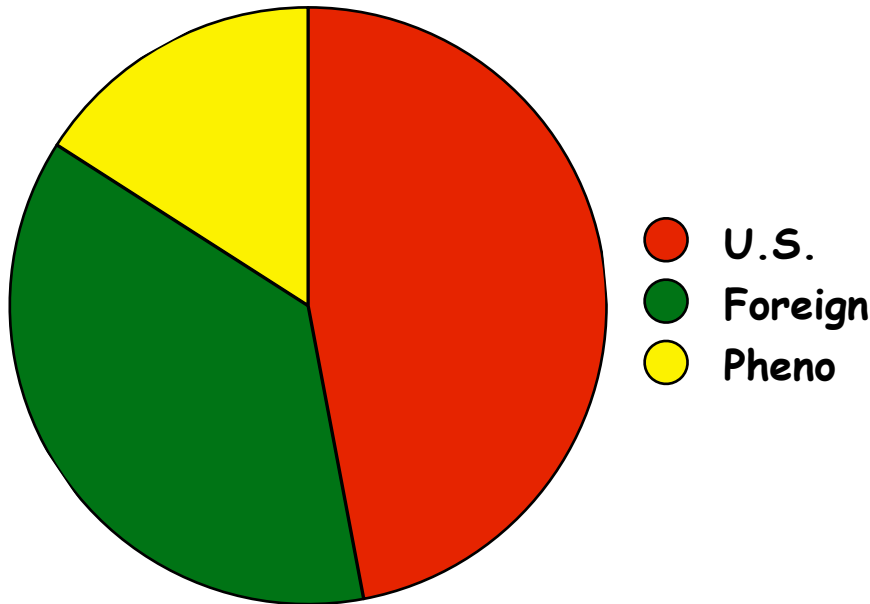


# Experimental HEP



## Broad and diverse program

**Funding:** 45+ year history, 2nd largest US university grant



### Personae Dramatis

faculty	9
scientists	10
engineers	3
post-docs	5
administrators	2
technicians	2
grad students	38

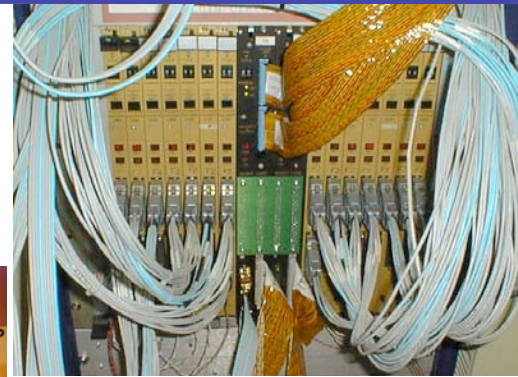
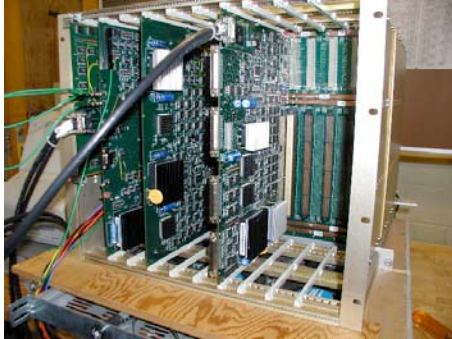


# Infrastructure



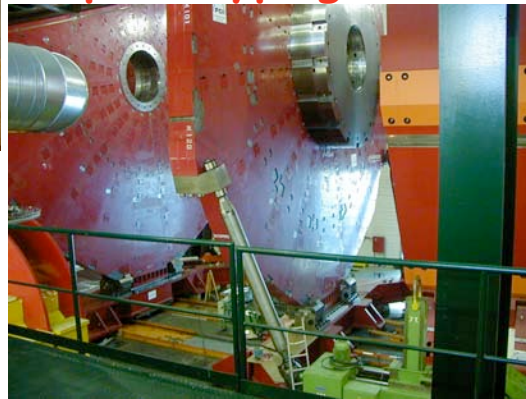
## Electronics:

design  
engineering  
prototyping



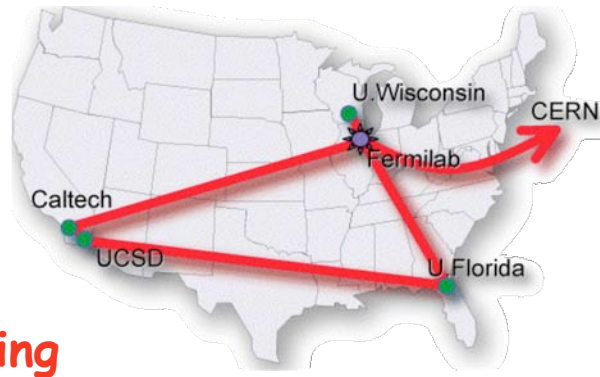
## Computing & Networking:

graphics  
analysis  
display  
CAD  
DAQ  
Condor



## Mechanical:

design  
precision alignment  
production



## GRID Computing



# Wisconsin Leadership



- CDF: Forward muon detector, muon drift tube upgrade
- Babar: Data Acquisition, forward muon system
- Zeus: W. Smith is trigger co-convenor, chair of US Zeus Institutes. UW group operates calorimeter trigger
- ATLAS: 2nd level trigger, silicon vertex electronics
- CMS: W. Smith is Trigger Project Manager, D. Loveless is US Endcap Muon System Project Manager and responsible for Endcap Steel. D. Reeder is Muon Institution Board Chair.



# Current Activities



CDF	$p \bar{p}$	D. Carlsmith, M. Herndon L.G. Pondrom	FNAL
ZEUS	$e^{\pm} p$	W. H. Smith D.D. Reeder	DESY
BaBar	$e^+ e^-$	R. Prepost, S. Dasu Y. Pan, S.L. Wu	SLAC
Minos	$\nu$	A. Erwin	FNAL
CMS (2007)	$p p$	W.H. Smith, D.D. Reeder D. Carlsmith, S. Dasu	CERN
Atlas (2007)	$p p$	Y. Pan S.L. Wu	CERN



# CP Violation @ Babar

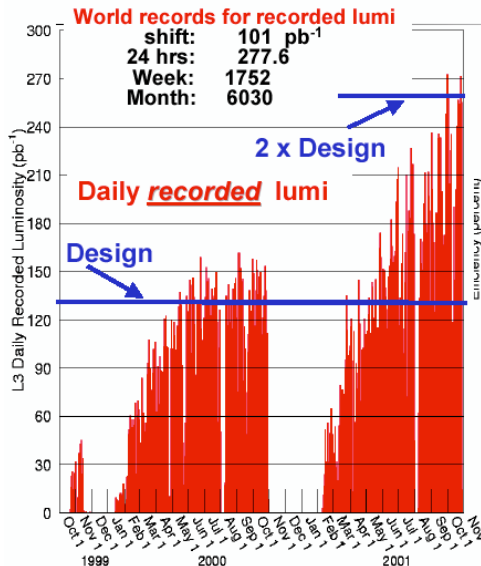


Professor R. Prepost  
 Professor S. Dasu  
 Professor Y. Pan  
 Professor S. L. Wu

$$e^+ e^- \Rightarrow b \bar{b}$$

SLAC: PEP-II  
 Stanford, CA

Now taking data at record luminosity  
 and publishing b-physics results





# CP Violation



- P parity -- inversion of right and left
- T time reversal -- invariance under  $t \rightarrow -t$
- C charge conjugation -- particle  $\rightarrow$  antiparticle

CP violation was first observed in strange quark weak interaction. It is now seen in bottom quark weak interactions and, in the standard model, is connected to mass generation via the Higgs mechanism. Precise measurements of CP violation parameters are being made by the Babar experiment.





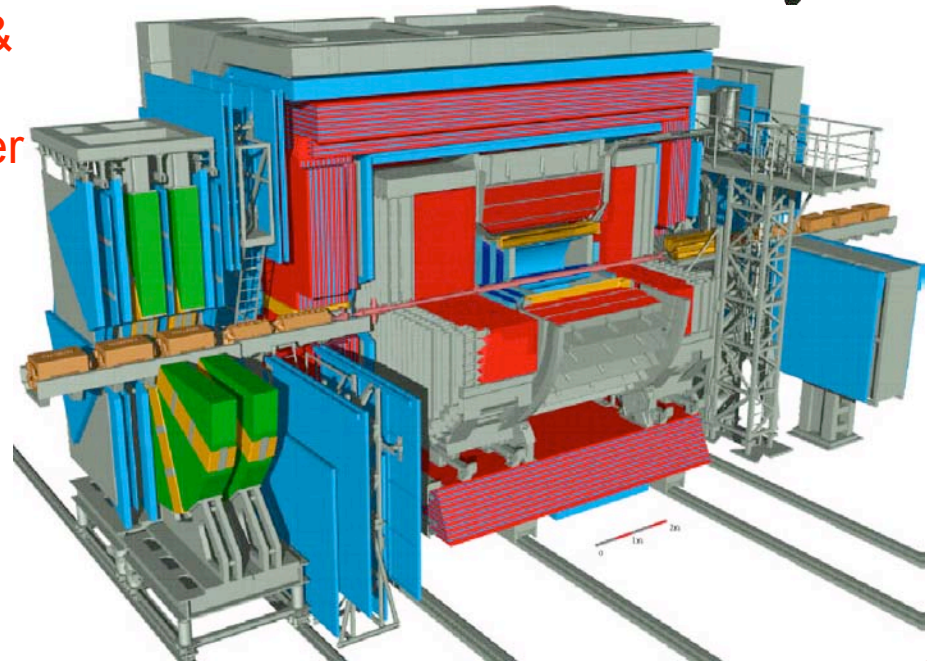
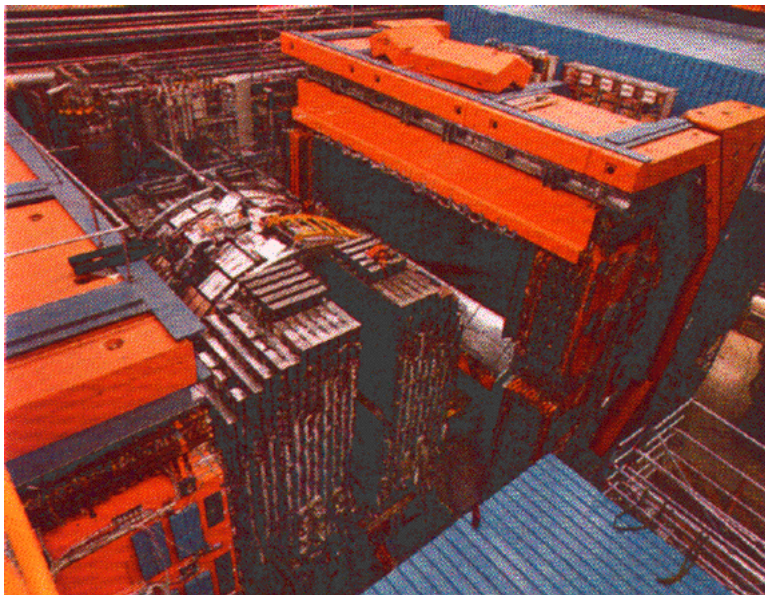
# QCD@ZEUS



Prof. W. Smith  
Prof. D. Reeder

UW built &  
operates  
calorimeter  
trigger

DESY: HERA  
Hamburg, Germany



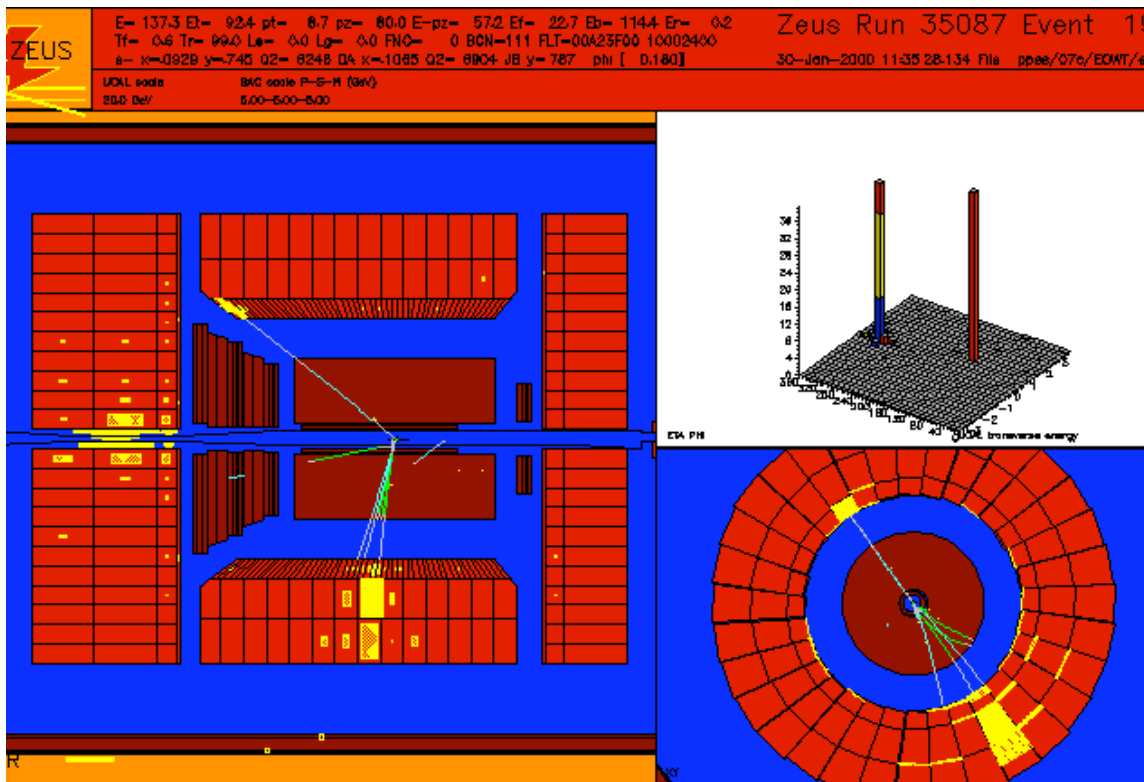
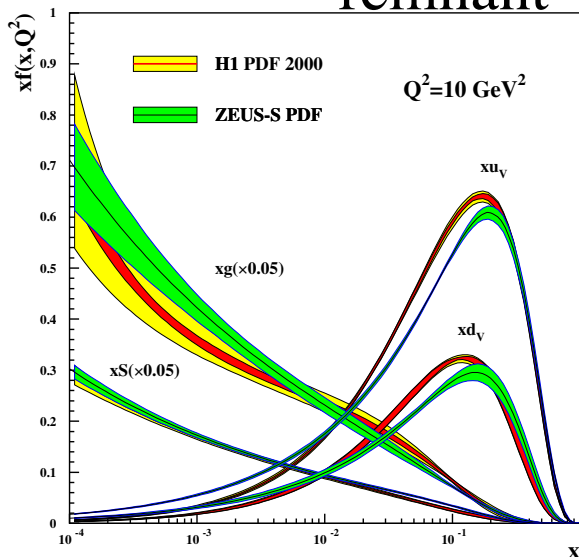
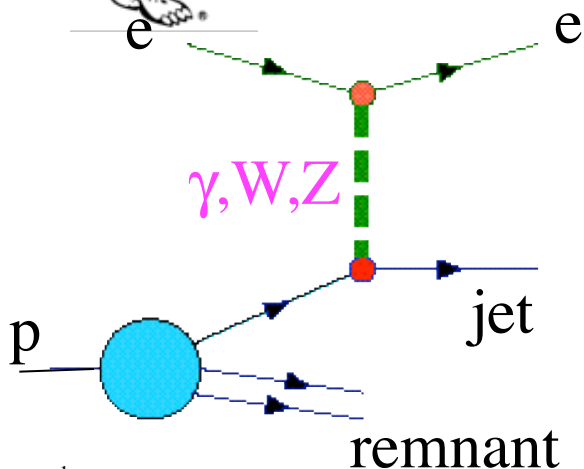
*Only lepton-hadron collider ever!*  
*Use ep collisions to study quarks  
and gluons in the proton*  
*New: x5 Luminosity upgrade &  
polarization now running*



# Structure of Matter



*Scattering of electrons from constituent quarks provides an increasingly detailed view of the QCD dynamics inside a proton.*





# Energy Frontier @CDF **W**



*Prof. L. Pondrom*

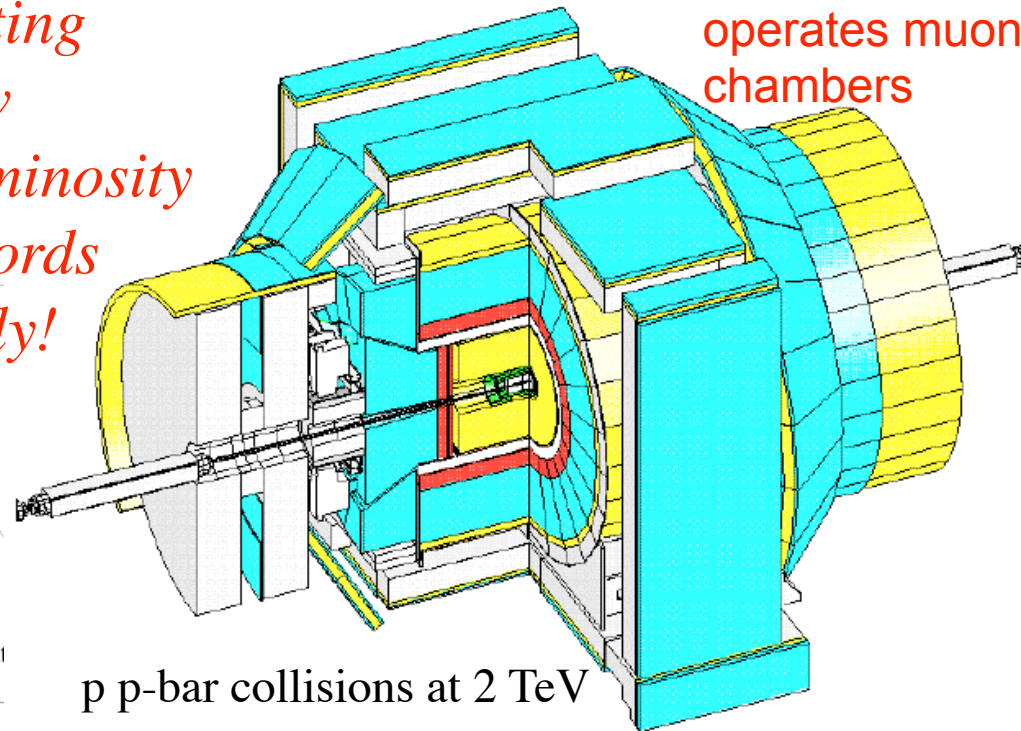
Fermilab: Tevatron

*Prof. D. Carlsmith*

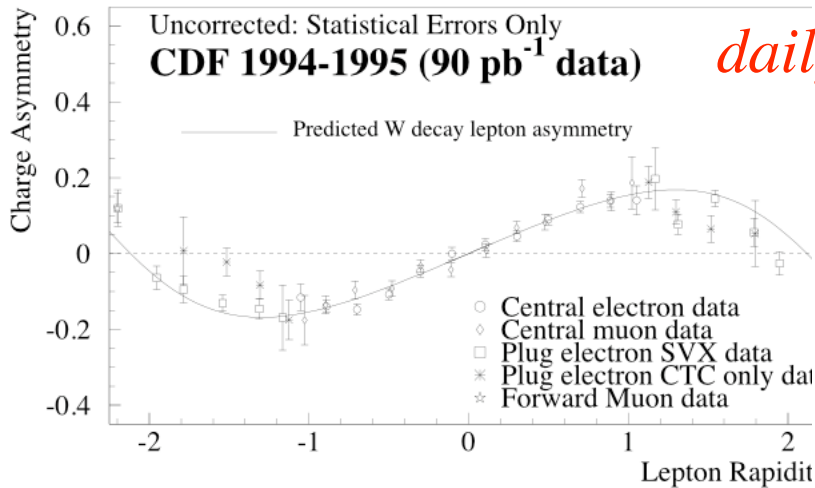
Batavia, IL

*Setting  
new  
Luminosity  
records  
daily!*

UW built & operates muon chambers



p p-bar collisions at 2 TeV

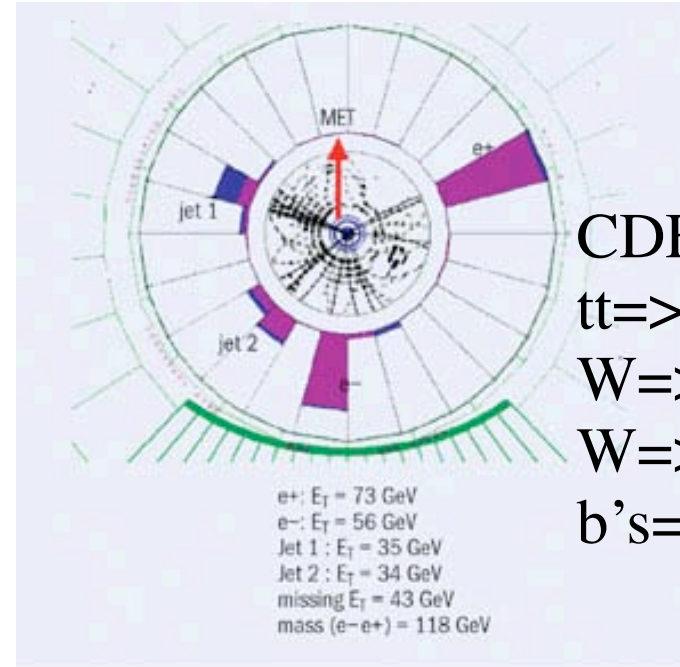




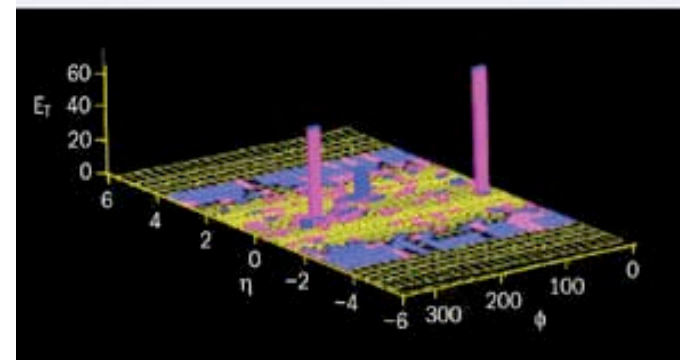
# Energy frontier



Today, the highest masses are available in p-pbar collisions at Fermilab. CDF studies W & Z bosons, b & t quarks. Searches continue for new heavy particles, e.g. those req'd by supersymmetric theories.



CDF:  
 $tt \Rightarrow WbWb$   
 $W \Rightarrow e \nu$   
 $W \Rightarrow e \nu$   
 $b's \Rightarrow \text{hadrons}$

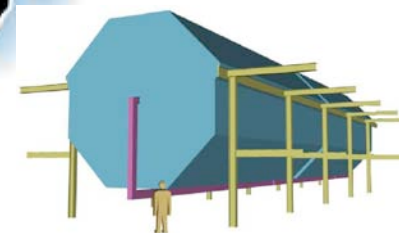
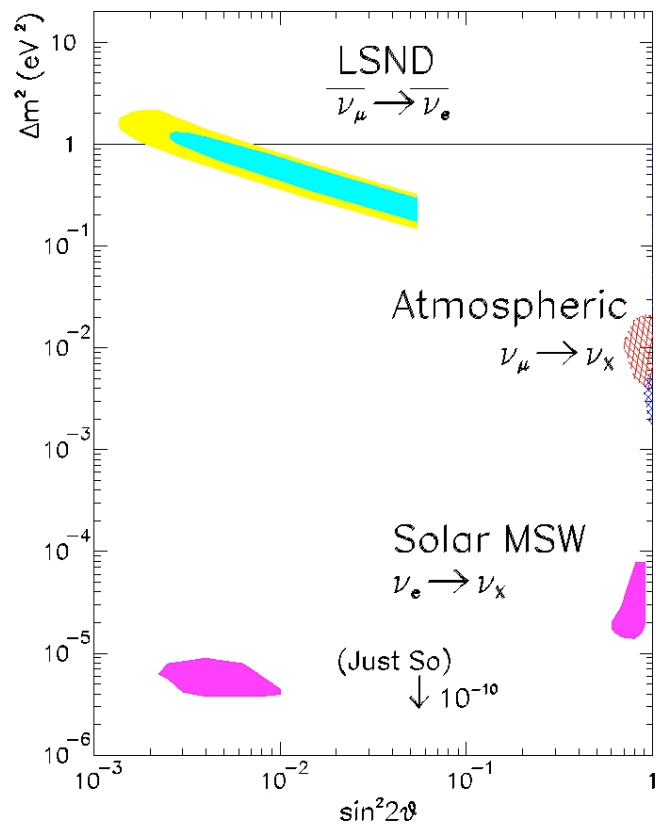




# Neutrino Mixing @ Minos **W**

Prof. A. Erwin

## Neutrino Oscillation Limits





# New life in neutrinos



Neutrinos are light compared to electrons but perhaps not massless. Recent observations suggest neutrinos have mass and neutrino flavors are mixed rather like quark flavors.

Consequently, one flavor may oscillate into another flavor while traveling near light speed over distances measured in hundreds of km.

MINOS just started data-taking for studying the oscillation.

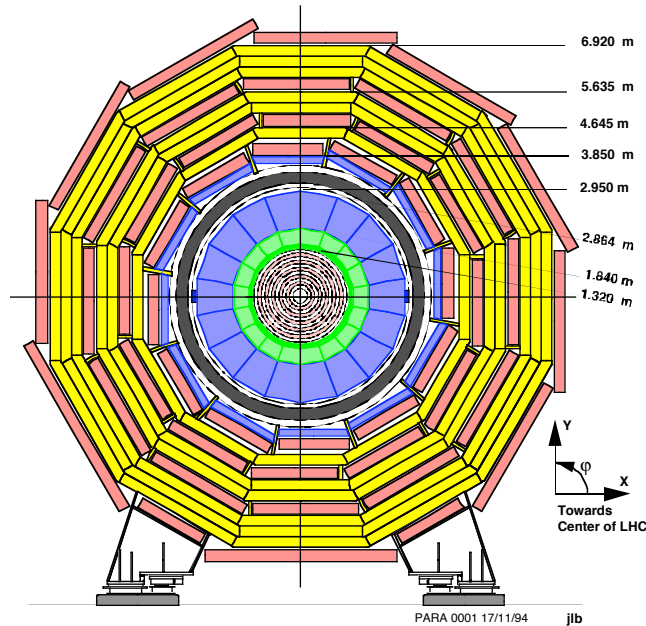


# New Frontier @ CMS



*Prof. S. Dasu*  
*Prof. D. Carlsmith*  
*Prof. W. Smith*  
*Prof. D. Reeder*

CERN: LHC  
 Geneva,  
 Switzerland:  
 pp at 14 TeV



Transverse View





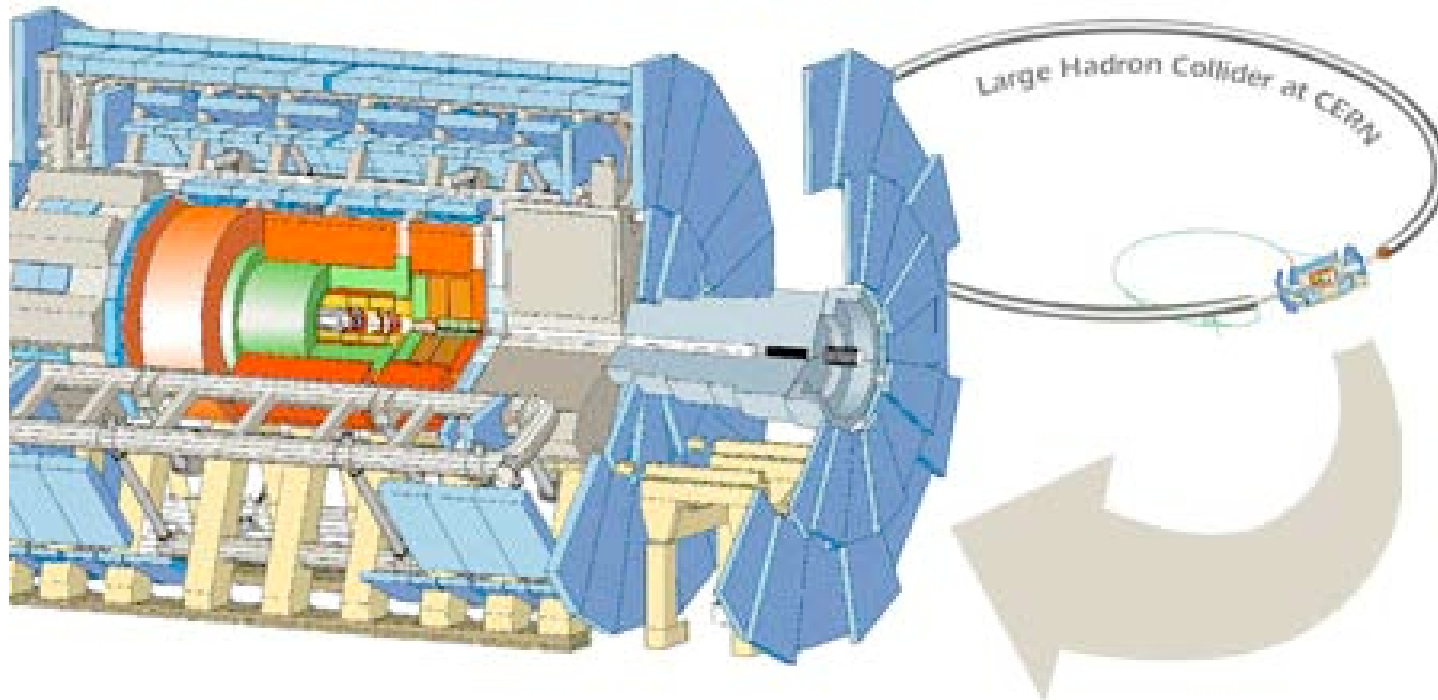
# New Frontier @ Atlas



*Prof. Y Pan*  
*Prof. S.L. Wu*

CERN: LHC  
Geneva,  
Switzerland  
pp at 14 TeV

## The ATLAS Detector







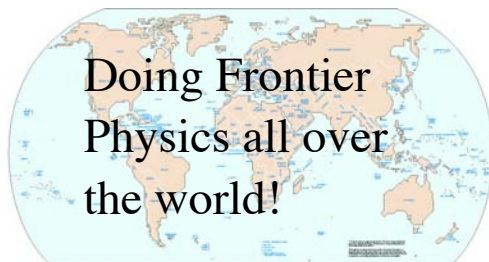
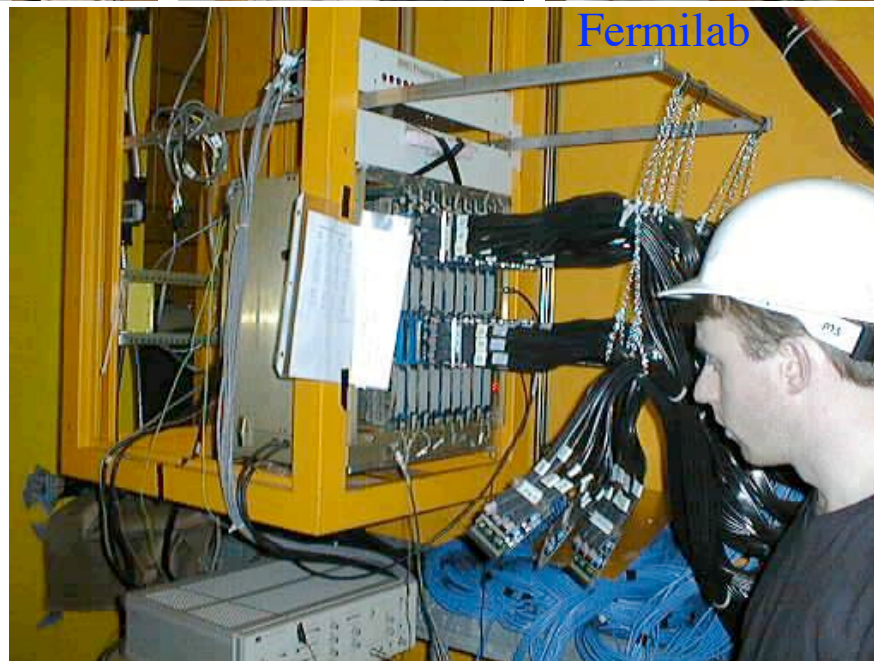
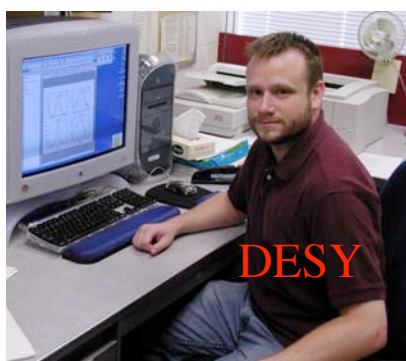
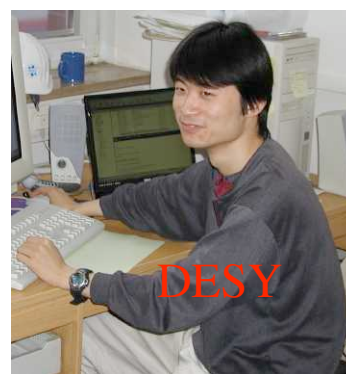
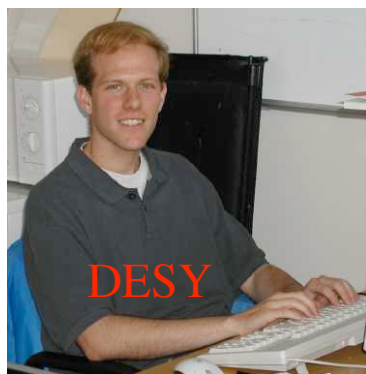
# Physics at LHC



- Search for Standard Model Higgs
  - $120 < m_H < 1000 \text{ GeV}$
- Search for Supersymmetry and other physics beyond the Standard Model
  - quark/lepton compositeness
  - new  $W'/Z'$  bosons or heavy quarks, leptons
  - extra Dimensions
  - ?



# HEP Students at work





# Summary

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Lots of opportunity

Good Physics &

Good Travel &

Communication skills &

Good friends &

Good jobs

...fun and a rewarding education

**Welcome to the adventure!**