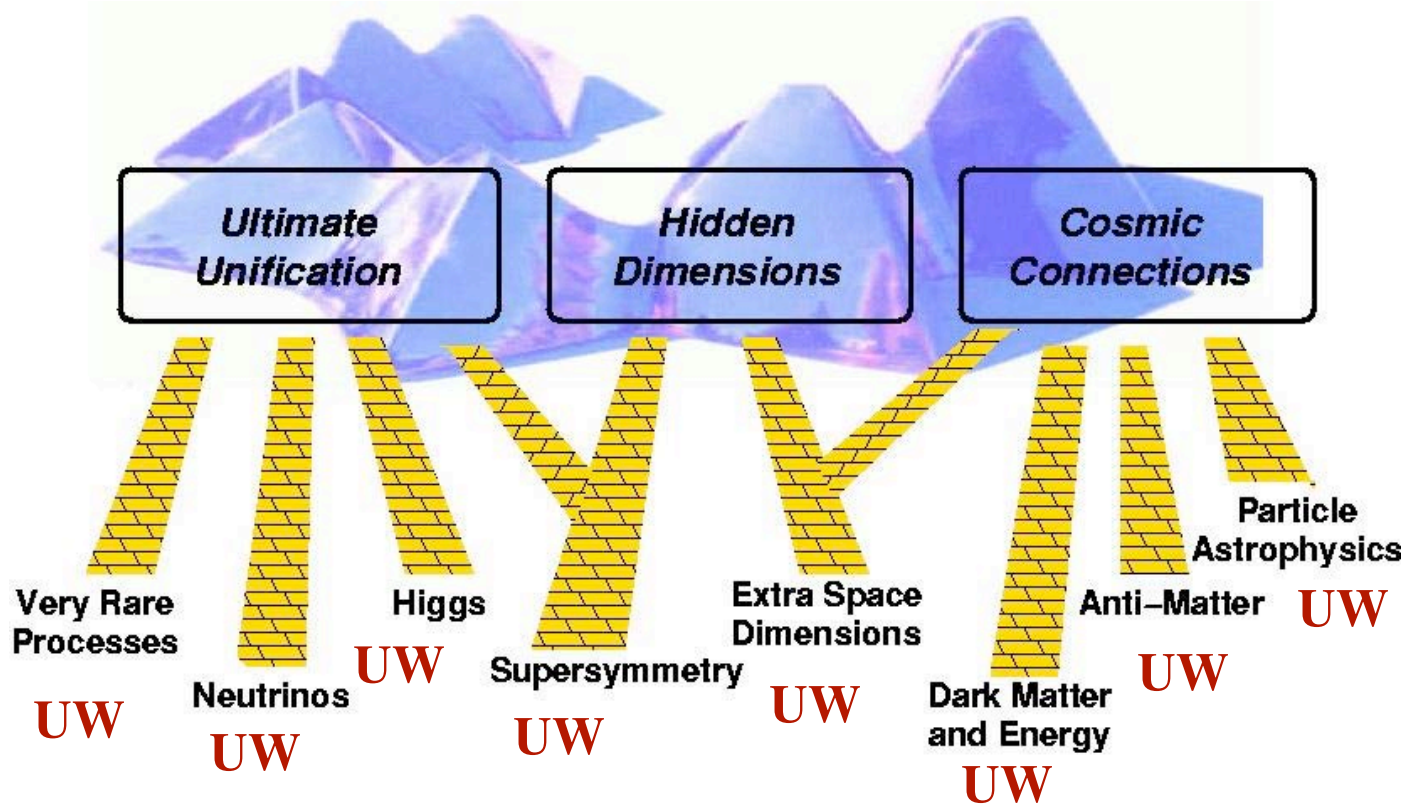
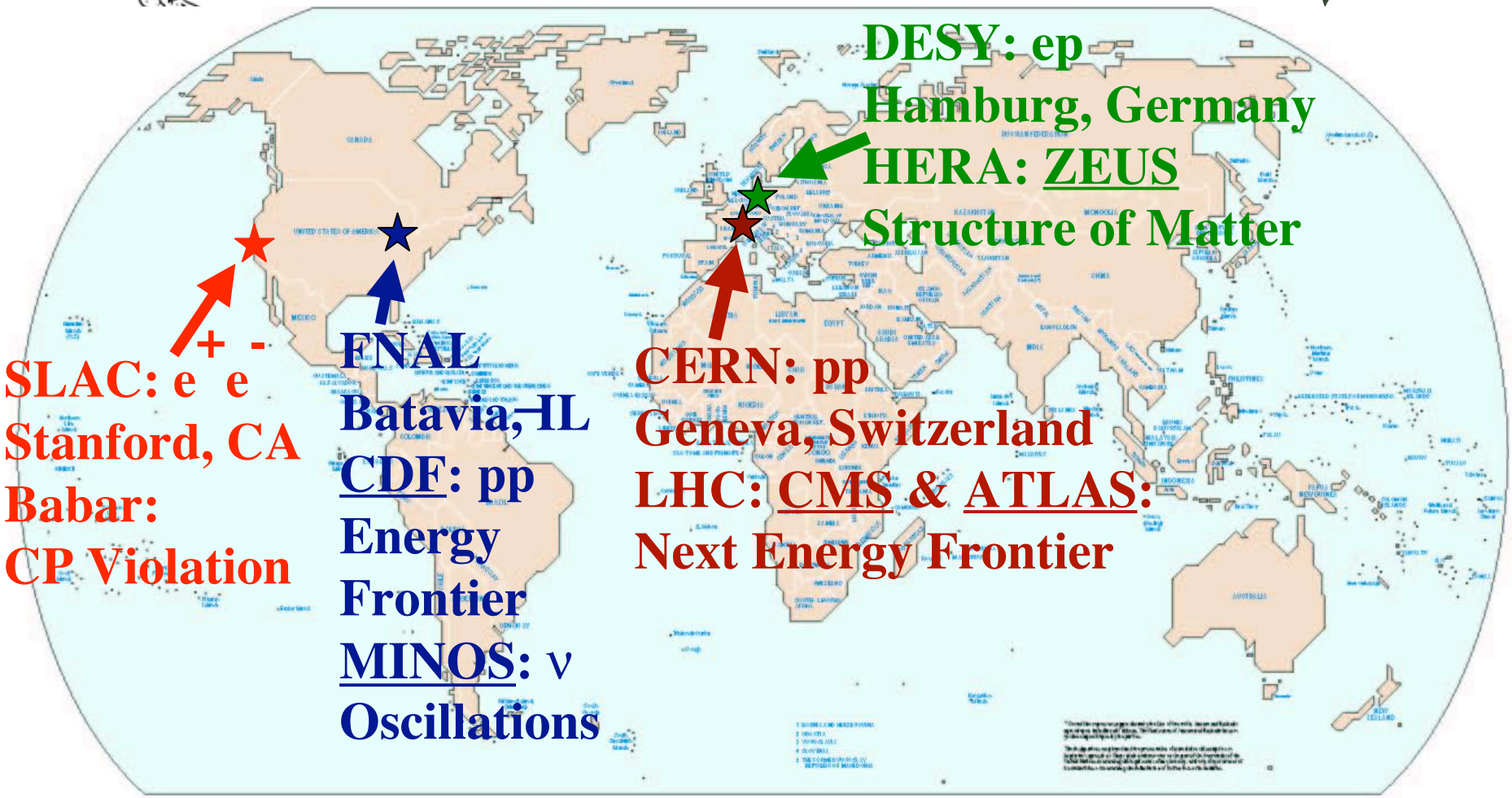
Matter, Energy, Space, Time



Trails in Particle Physics

Wisconsin program

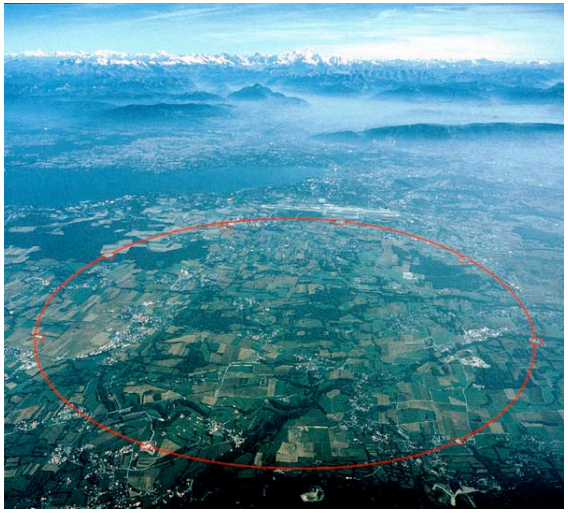


LABORATORIES

SLAC

DESY

FNAL

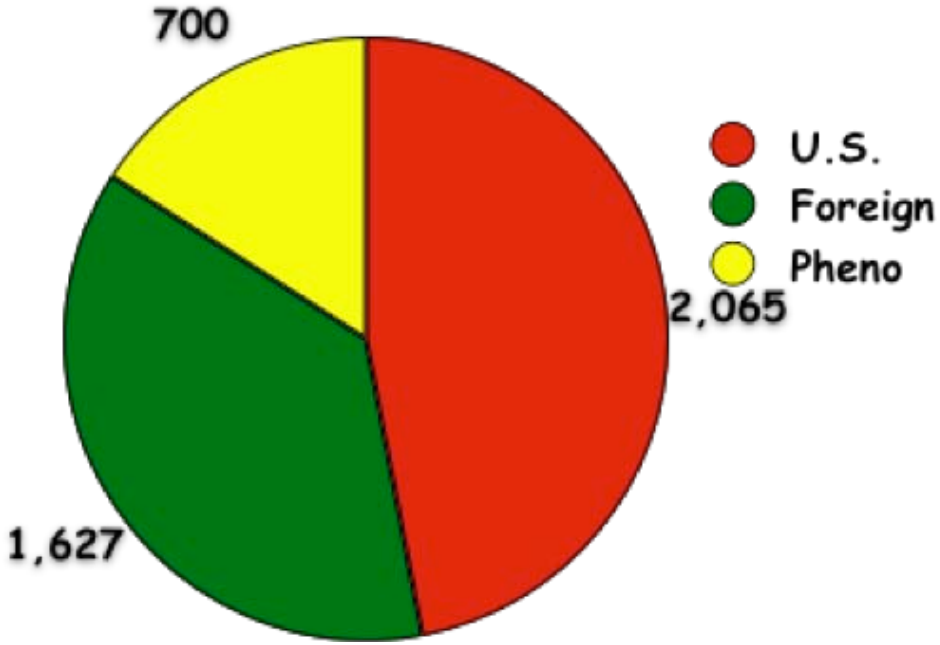


CERN

Experimental HEP

Broad and diverse program

Funding: 50 year history, 2nd largest US university grant

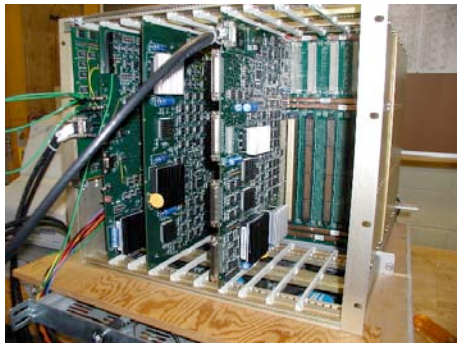


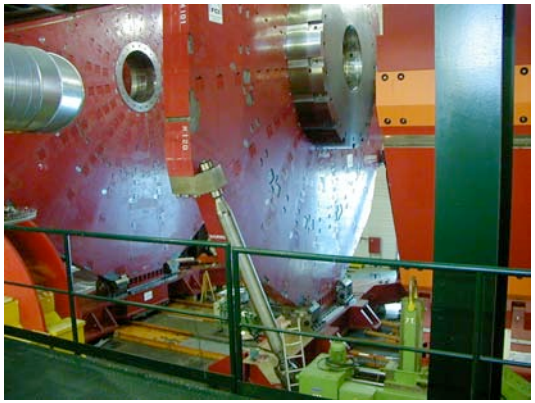
Personae Dramatis

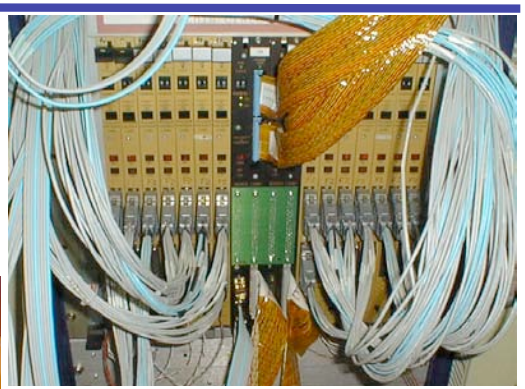
faculty	9
scientists	10
engineers	3
post-docs	5
administrators	2
technicians	2
grad students	38

Infrastructure

Electronics:
- design
- engineering
- prototyping

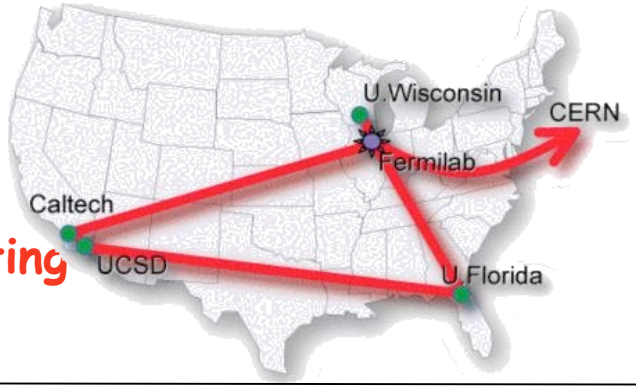






Mechanical:
- design
- precision alignment
- production

Computing & Networking:
- graphics
- analysis
- display
- CAD
- DAQ
- Condor
- GRID Computing



Wisconsin Leadership

- CDF: Forward muon detector, muon drift tube upgrade
- Babar: Data Acquisition, forward muon system
- Zeus: Trigger and calorimeter
- ATLAS: 2nd level trigger, silicon vertex electronics
- CMS: Trigger and Muon Endcap

Current/Future Activities

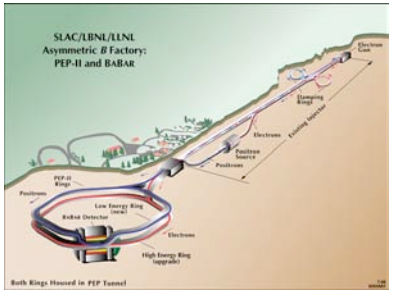
CDF	$p\ \bar{p}$	D. Carlsmith, M. Herndon L.G. Pondrom	FNAL
ZEUS	$e^{\pm}\ p$	W. H. Smith D.D. Reeder	DESY
BaBar	$e^{+}\ e^{-}$	R. Prepost, S. Dasu Y. Pan, S.L. Wu	SLAC
Minos	ν	A. Erwin	FNAL
CMS (2007)	p p	W.H. Smith, D.D. Reeder D. Carlsmith, S. Dasu	CERN
Atlas (2007)	p p	Y. Pan S.L. Wu	CERN

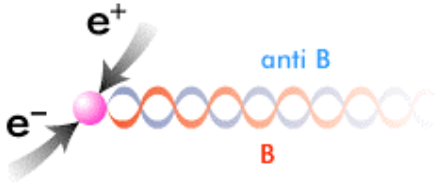
CP Violation @ Babar

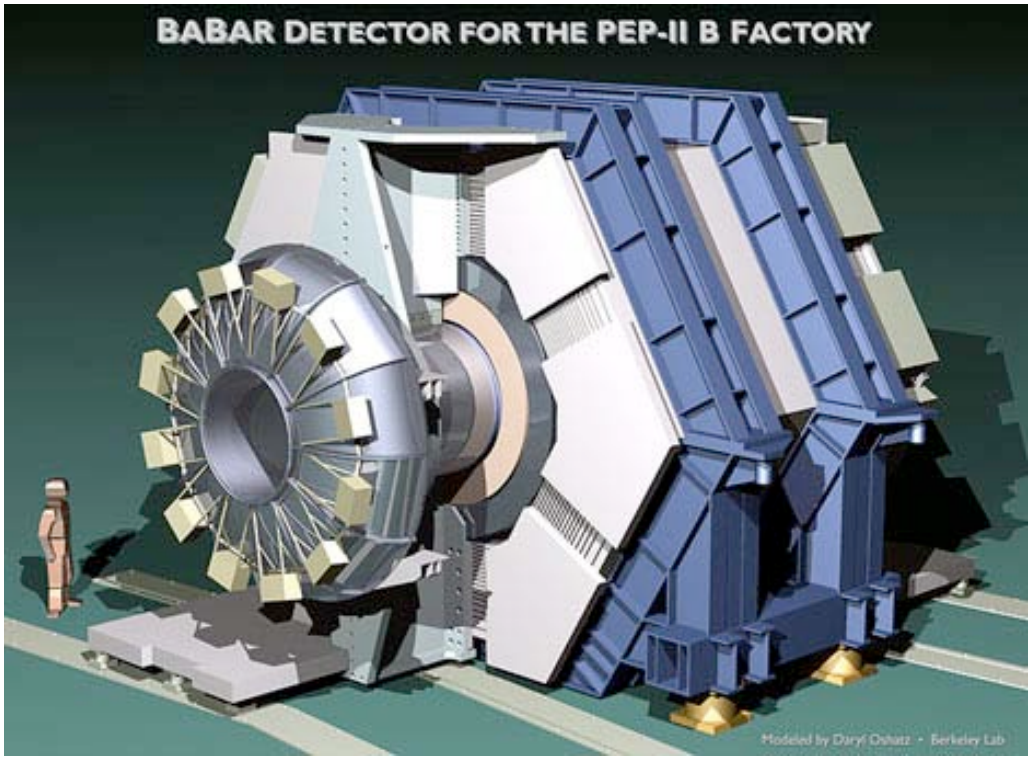
Professor R. Prepost
Professor S. Dasu
Professor Y. Pan
Professor S. L. Wu

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

SLAC: PEP-II
Stanford, CA



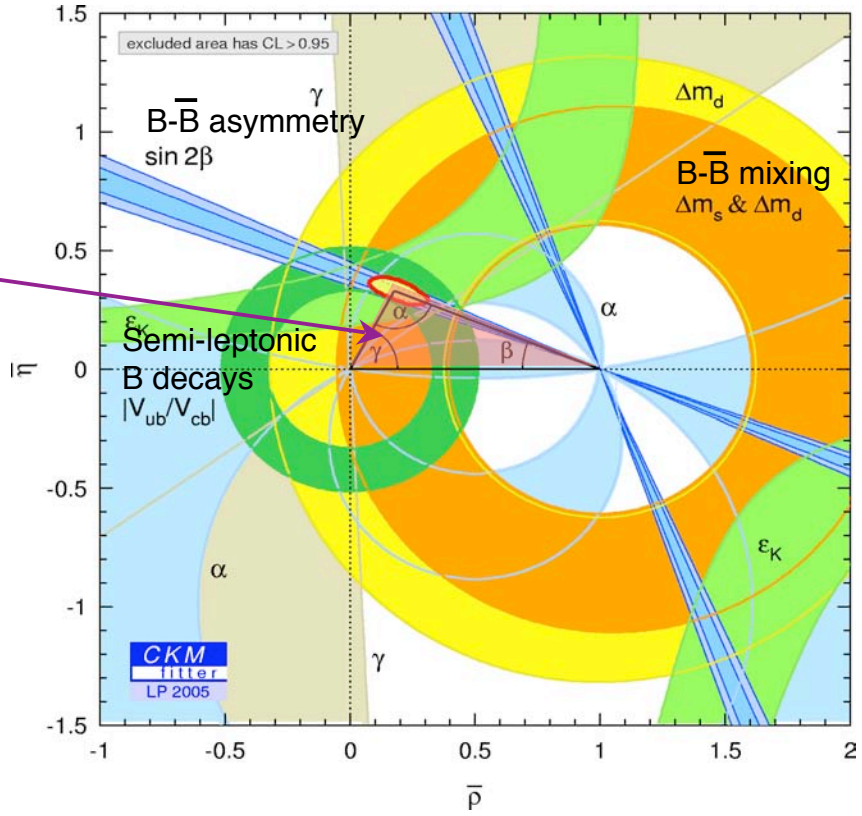


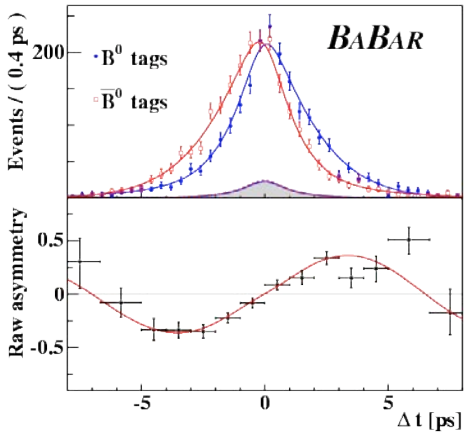


CP Violation @ Babar

Universe is matter dominated. Why?

- BaBar probes fundamental matter & anti-matter asymmetry (CP-violation) especially as revelaed in matter-antimatter oscillations
- The area of the Unitarity Triangle is a measure of the extent of CP-violation





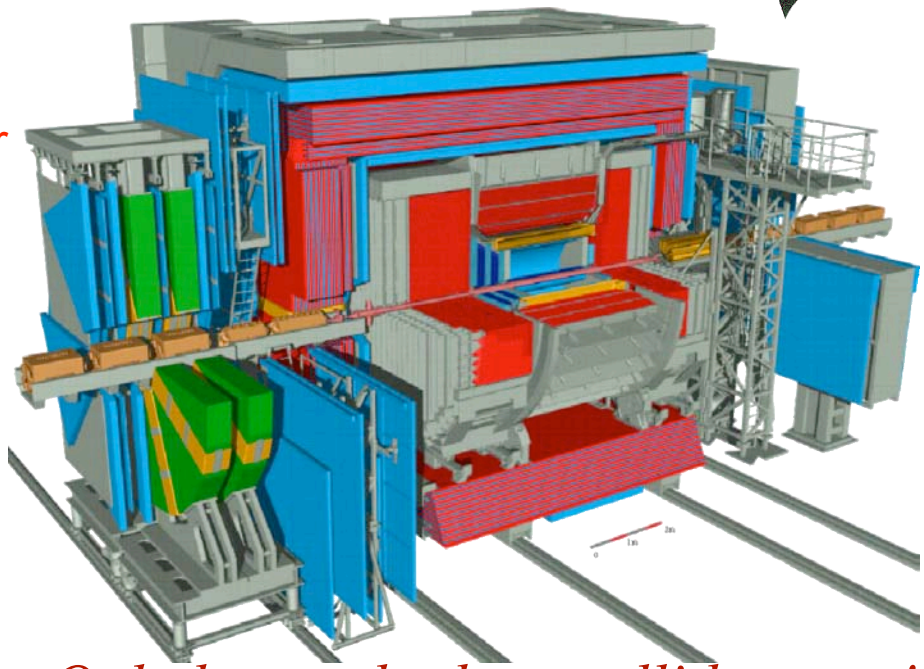
Measurements of UT angles & sides for consistency check
Any deviations ⇒ New physics

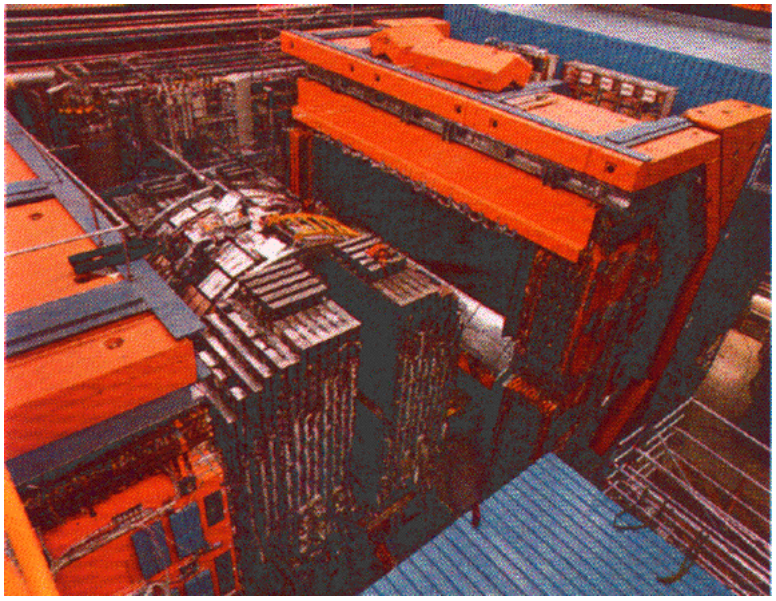
QCD@ZEUS

Prof. W. Smith
Prof. D. Reeder

DESY: HERA
Hamburg, Germany

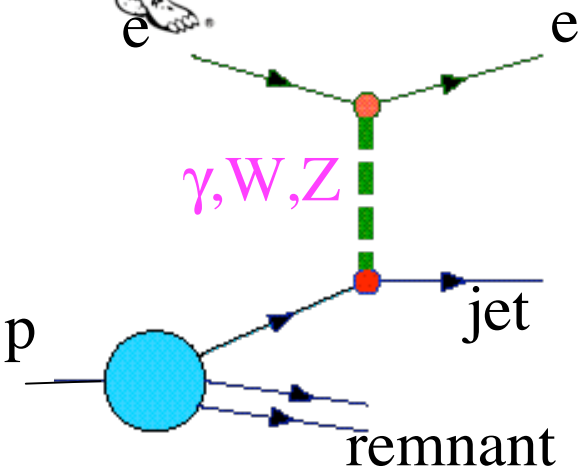
UW built & operates calorimeter trigger



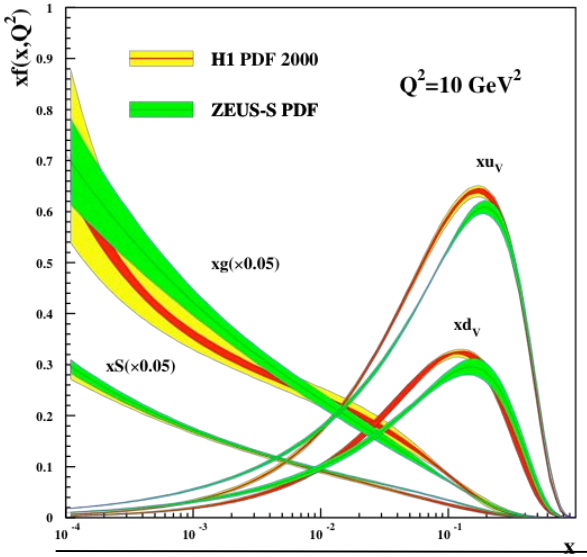


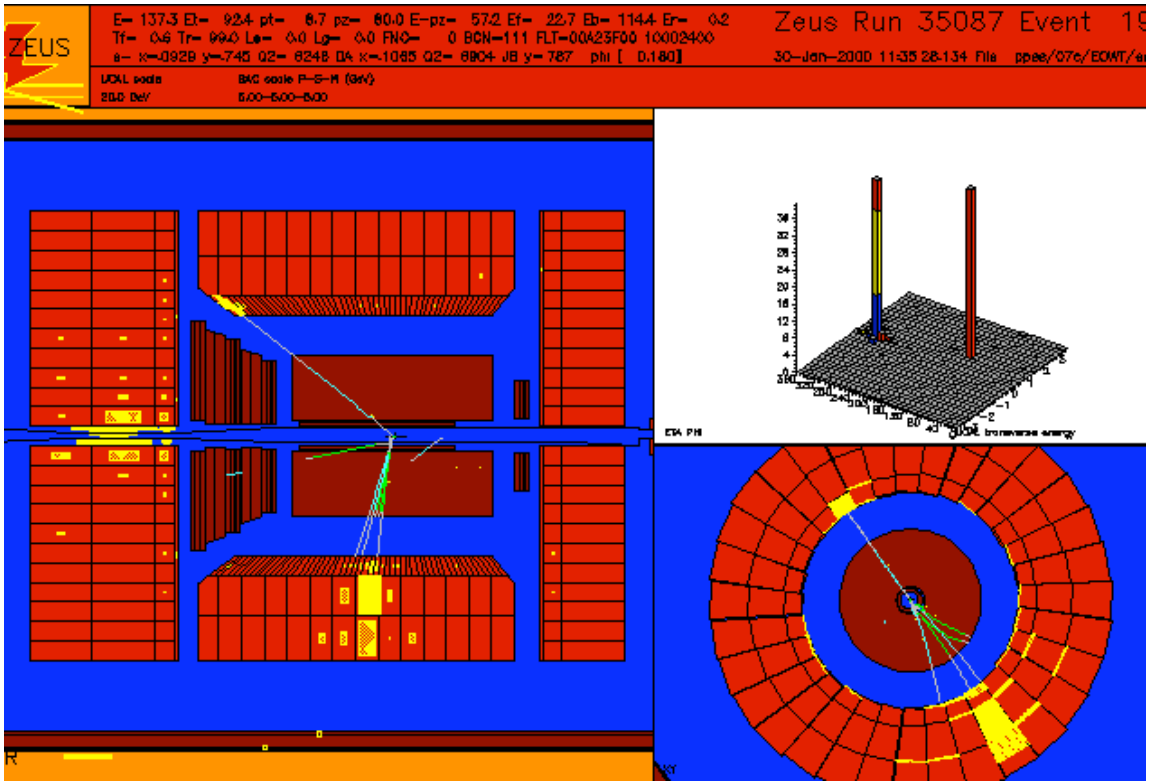
Only lepton-hadron collider ever!
Use ep collisions to study quarks and gluons in the proton
New: x5 Luminosity upgrade & polarization now running

Structure of Matter



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



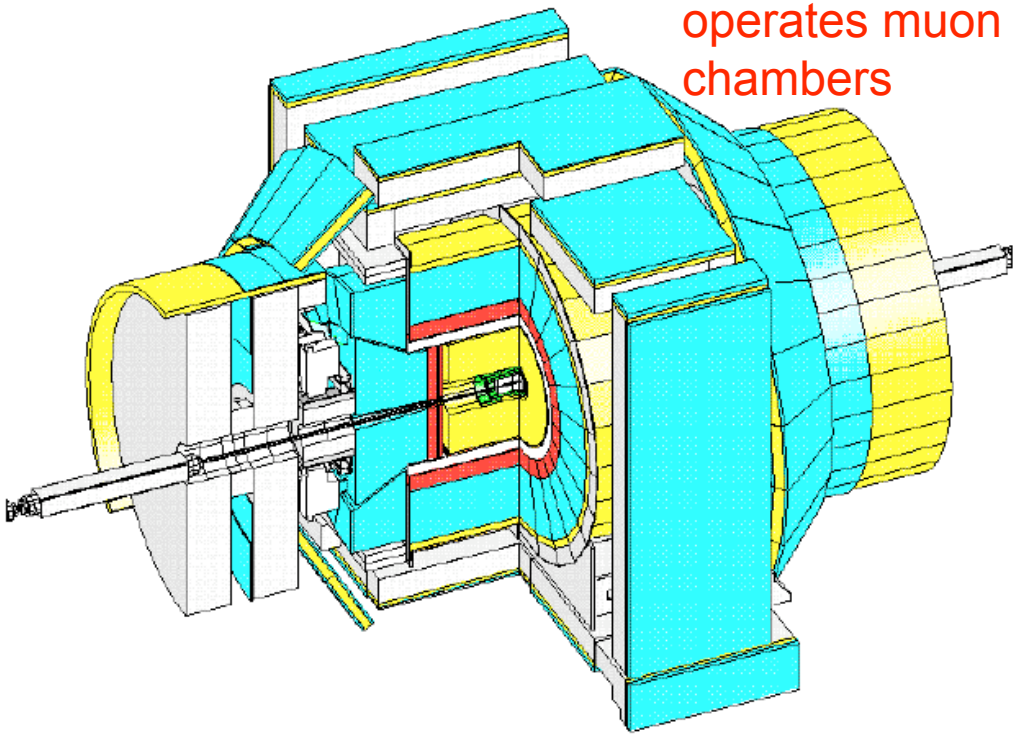


Energy Frontier @CDF

Prof. L. Pondrom
Prof. D. Carlsmith
Prof. M. Herndon

Fermilab: Tevatron
Batavia, IL

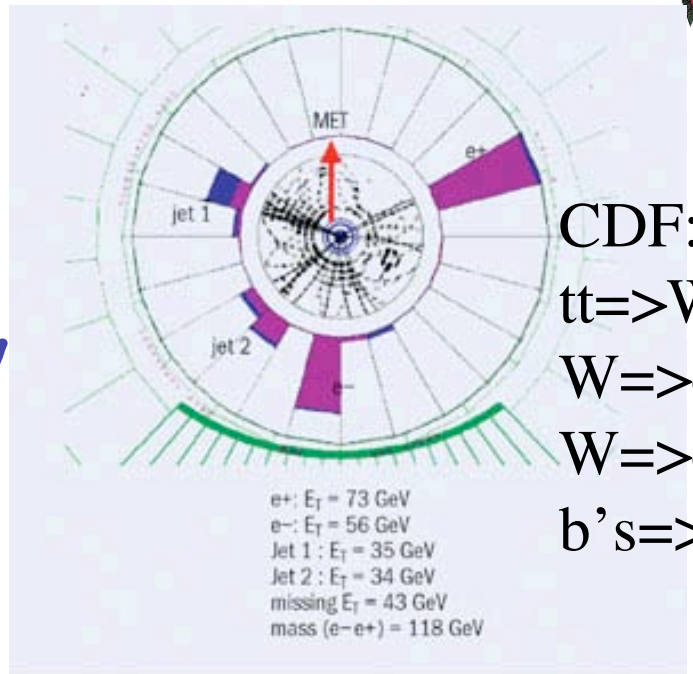
UW built & operates muon chambers



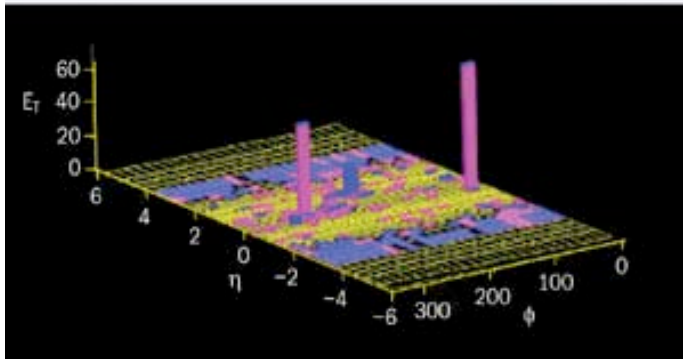
p p-bar collisions
at 2 TeV

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=>WbWb
W=>e nu
W=>e nu
b's=>hadrons



New Tevatron Results since Lepton-Photon 2005

Results blessed since Summer 2005 (Lepton Photon 2005) are highlighted in yellow!

Results to be blessed by Summer 2006 (ICHEP 2006) are in white.

Tevatron Combined Results

Measurement (webpage)	Result	Dataset	
B Physics (Entire Results)			
Limit on B_s Oscillations using Semileptonic B Decays	$\Delta m_s > 6.7\ ps^{-1}$ @95% CL (Sensitivity 10.4 ps^{-1})	CDF 355 pb^{-1}	2(
Limit on B_s Oscillations using Fully Reconstructed $B_s \to D_s 3\pi$	$\Delta m_s > 0.0\ ps^{-1}$ @95% CL (Sensitivity 9.8 ps^{-1})	CDF 355 pb^{-1}	2(
Combined Limit on B_s Oscillations	$\Delta m_s > 8.6\ ps^{-1}$ @95% CL (Sensitivity 13.0 ps^{-1})	CDF 355 pb^{-1}	2(
Measurement of B^0 Oscillations and Calibration of Flavor Tagging in Semileptonic Decays	$\Delta m_d = 0.511 \pm 0.020 \pm 0.014 ps^{-1}$ $\varepsilon D^2 = 1.55 \pm 0.08 \pm 0.03\%$	CDF 355 pb^{-1}	2(
Measurement of B^0 Oscillations and Calibration of Flavor Tagging in Fully Reconstructed Decays	$\Delta m_d = 0.536 \pm 0.028 \pm 0.006 ps^{-1}$ $\varepsilon D^2 = 1.553 \pm 0.163 \pm 0.050\%$	CDF 355 pb^{-1}	2(
$B_c \to J/\psi\ \pi$ Observation	$M(B_c) = 6275.2 \pm 4.3(stat) \pm 2.5(syst)$ MeV	CDF 800 pb^{-1}	2(
B_c meson lifetime	$\tau_{B_c} = 0.474\ ^{+0.073}_{-0.066} \pm 0.033$ ps	CDF 360 pb^{-1}	2(
Λ_b meson lifetime	$\tau_{\Lambda_b} = 1.45 \pm 0.13 \pm 0.02$ ps $\tau_{\Lambda_b}/\tau_{B^0} = 0.944 \pm 0.089$	CDF 370 pb^{-1}	2(
$D^0 \to K^\pm \pi^\mp$ Wrong Sign DCS Decays	$R(WS/RS) = 4.05 \pm 0.21\ (stat) \pm 0.12\ (sys) \times 10^{-3}$	CDF 350 pb^{-1}	2005-11-03
$BR(B_s \to D_s 3\pi) / BR(B^0 \to D^\pm 3\pi^\mp)$	$BR(B_s \to D_s 3\pi (\phi\pi)) / BR(B^0 \to D^+ 3\pi^-) = 1.15 \pm 0.12 \pm 0.09 \pm 0.29(BR) \pm$	CDF 355 pb^{-1}	2005-10-19

LEP Electroweak Working Group and Tevatron Electroweak Working Group and D0 Top Group and TeV4LHC workshop

CDF II Top Quark Group Physics Results

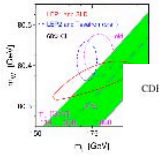
top quark mass, pair & single production, top quark properties

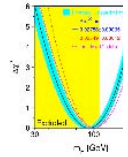
Colour Key
New results with 750pb-1
Other New results

Tevatron summer 2005 combination of CDF+D0 Run I+II results:
Top quark mass = 172.7 +- 2.9 GeV

Effect on global electroweak fit and Standard Model Higgs boson

Effect on MSSM





eps eps

- **Top Turns Ten!**
- Latest CDF results and Recent talks by CDF speakers
- Archive of conference notes and past results
- All CDF papers
  - CDF Run 2 Top papers - 02/02/2006 18 and counting...
  - CDF Run 1 Top papers
- Information about the CDF Vertex b-tag algorithm
  - Last updated February 18 2005 with 15% higher b-tag efficiency
- Information about the CDF jet energy scale.
  - Last updated February 22 2005 with about 50% reduction in total uncertainty from previous Run II estimate. This is the majority of the work needed for the world's best top quark mass measurement released by CDF on March 31 2005.
  - *Determination of the Jet Energy Scale at the Collider Detector at Fermilab* A. Bhatti *et al.* Submitted to Nucl. Instr. Meth. A October 18 2005. hep-ex/0510047.

All CDF measurements (last updated 02/23/06)

Top quark mass
Overview
More information on Tevatron combination
Future

CDF (last upd

CDF Electroweak Physics Public Results

CDF Run 2 Electroweak Public Results

For more information, contact the electroweak conveners, Chris Hays and Eric James

W Mass

Status and Plans	Results	Data Sets	Documentation
Uncertainties determined Update for winter, 2005	76 MeV combined e, mu uncertainty	200/pb	hep-ex/0505064, hep-ex/0506016

Diboson Production

Analysis	Results	Data Sets	Documentation
W(->e/mu nu), Z(->ee or mu mu) + gamma cross sections	σ(ppbar -> W + gamma) = 18.1 ± 3.1 pb σ(ppbar -> Z + gamma) = 4.6 ± 0.5 ± 0.2 pb	200/pb	PRL 94, 041803 (hep-ex/0410008)
WW(->ee/mu mu/e mu) cross section and WW(->e/mu + track) cross section	σ(ppbar -> WW) = 14.6 + 5.8 - 5.1 (stat) + 1.8 -3.0 (syst) ± 0.9 (lum) pb	200/pb	PRL 94, 211801 (hep-ex/0501050)
WW/WZ(->e/mu + 2 jets) cross section	σ(ppbar -> WW+WZ) < 40 pb $-0.52 < \Delta\kappa < 0.65$ $-0.37 < \lambda < 0.39$	200/pb	None
WZ/ZZ(->2l/3l/4l, l=e,mu) search	σ(ppbar -> WZ+ZZ) < 15.2 pb	200/pb	PRD 71, 091105 (hep-ex/0501021)

W/Z Cross Sections and Asymmetries

Analysis	Results	Data Sets	Documentation
W cross section with forward electrons	σ(ppbar -> W) = 2.815 ± 0.013 (stat) + 0.094 - 0.089 (syst) ± 0.169 (lum) nb	223/pb	Public note
Z(->mu mu) cross section	σ(ppbar->Z) = 261.2 ± 2.7 (stat) + 5.8 - 6.9 (sys) ± 15.1 (lum) pb	337/pb	None
Z(->tau_h tau_e) cross section	σ(ppbar->Z) = 265 ± 20 (stat) ± 21 (sys) ± 15 (lum)	349/pb	Nucl Phys Proc Suppl 144, 323-332 (2005)

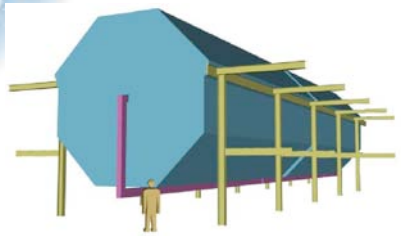
8 pages of results just in B physics

Top
Electroweak
Exotics
Higgs
QCD
…

Neutrino Mixing @Minos

Prof. A. Erwin

Neutrinos have mass and neutrino flavors are mixed rather like quark flavors.

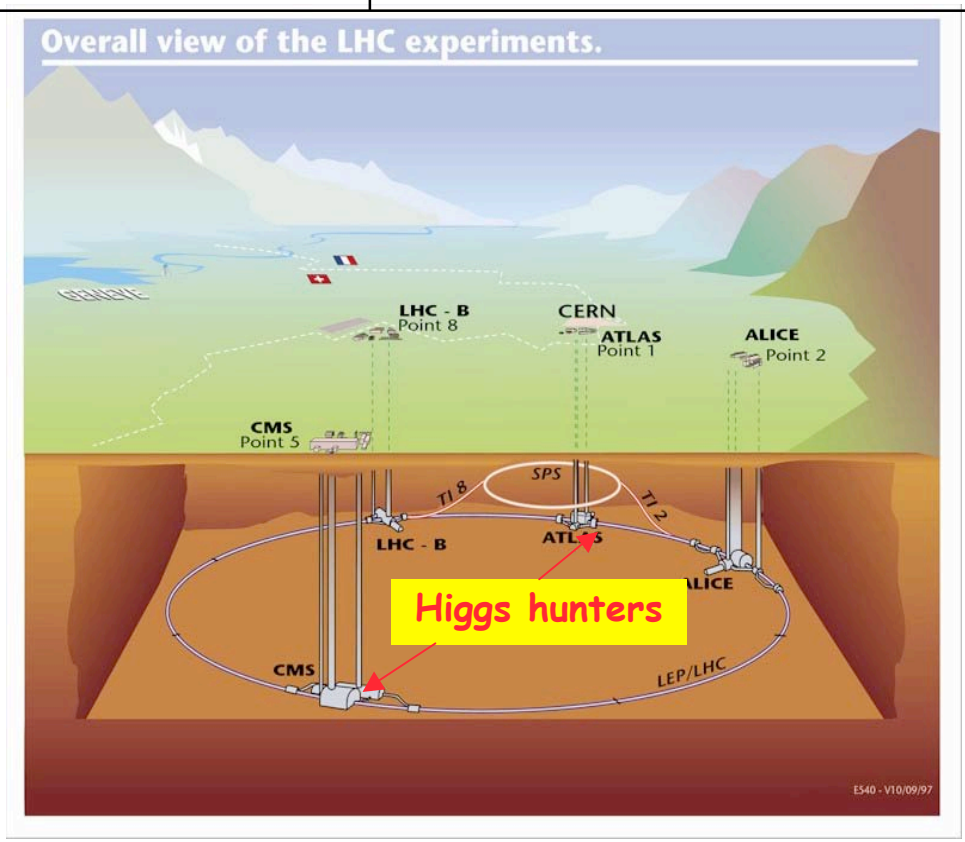


Large Hadron Collider

Center of mass Energy	14 TeV
Design Luminosity	10^{34} cm^{-2} s^{-1}
Crossing rate	25 ns (40 MHz)

Under construction

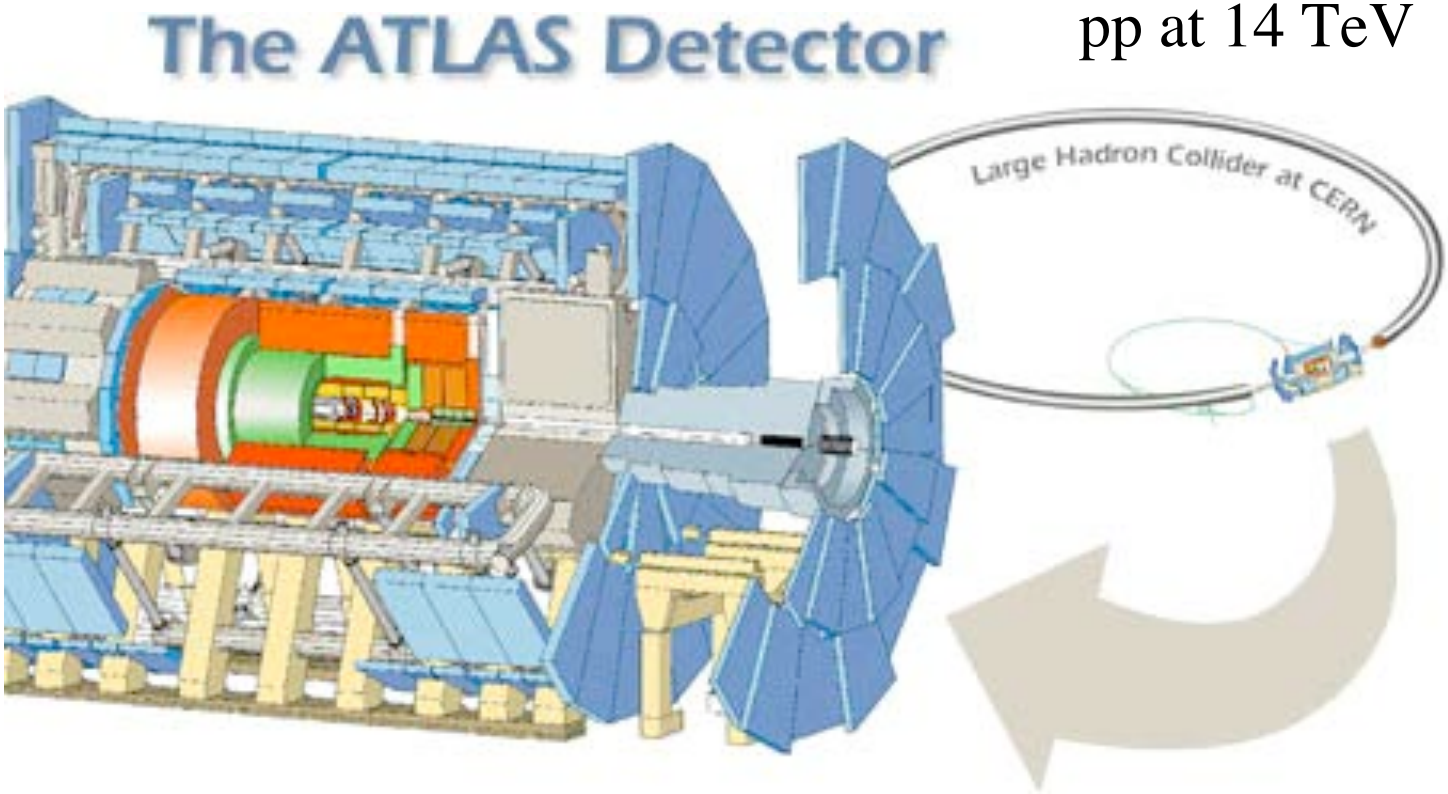
Turn on 2007



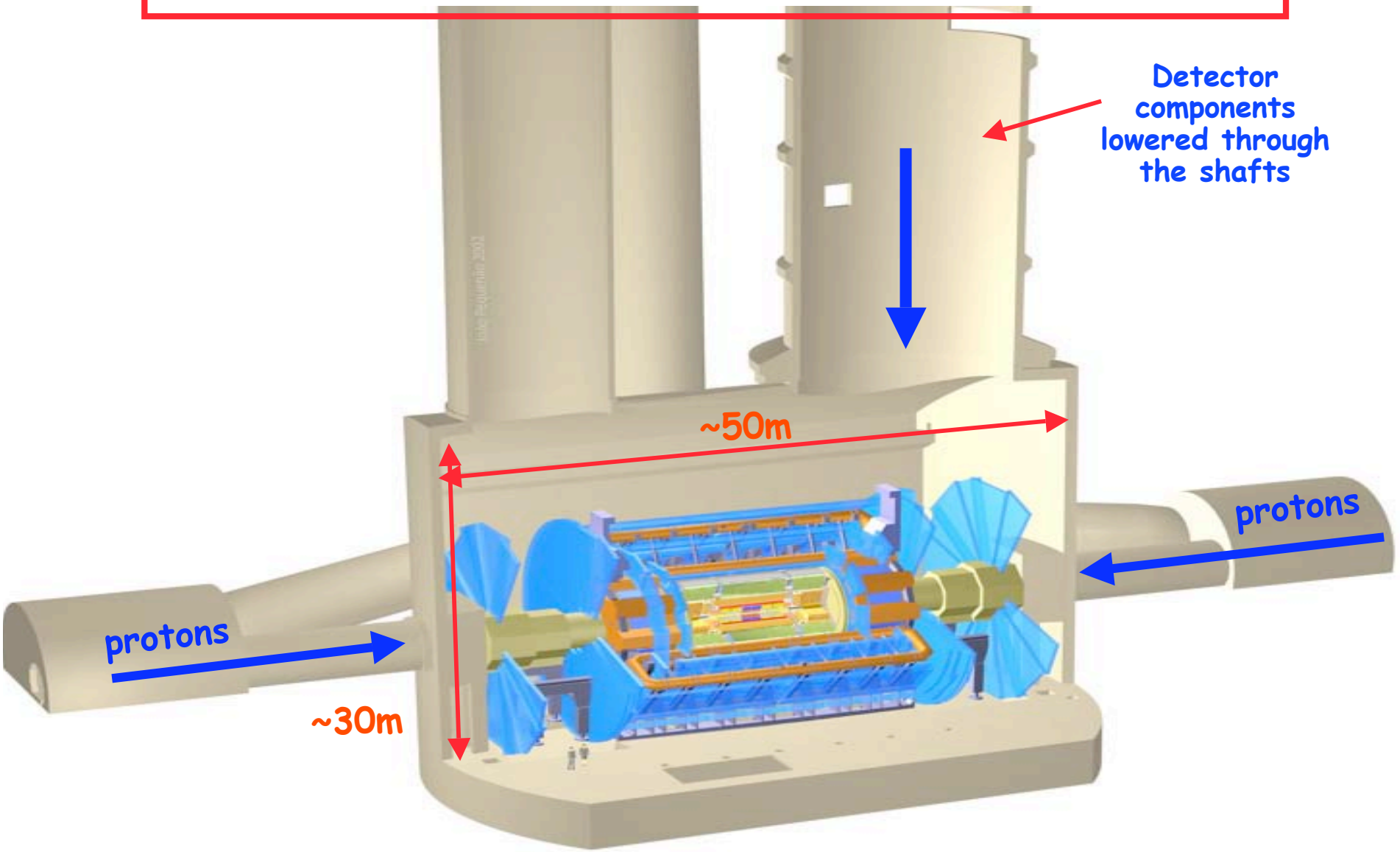
New Frontier @ Atlas

Prof. Y Pan
Prof. S.L. Wu

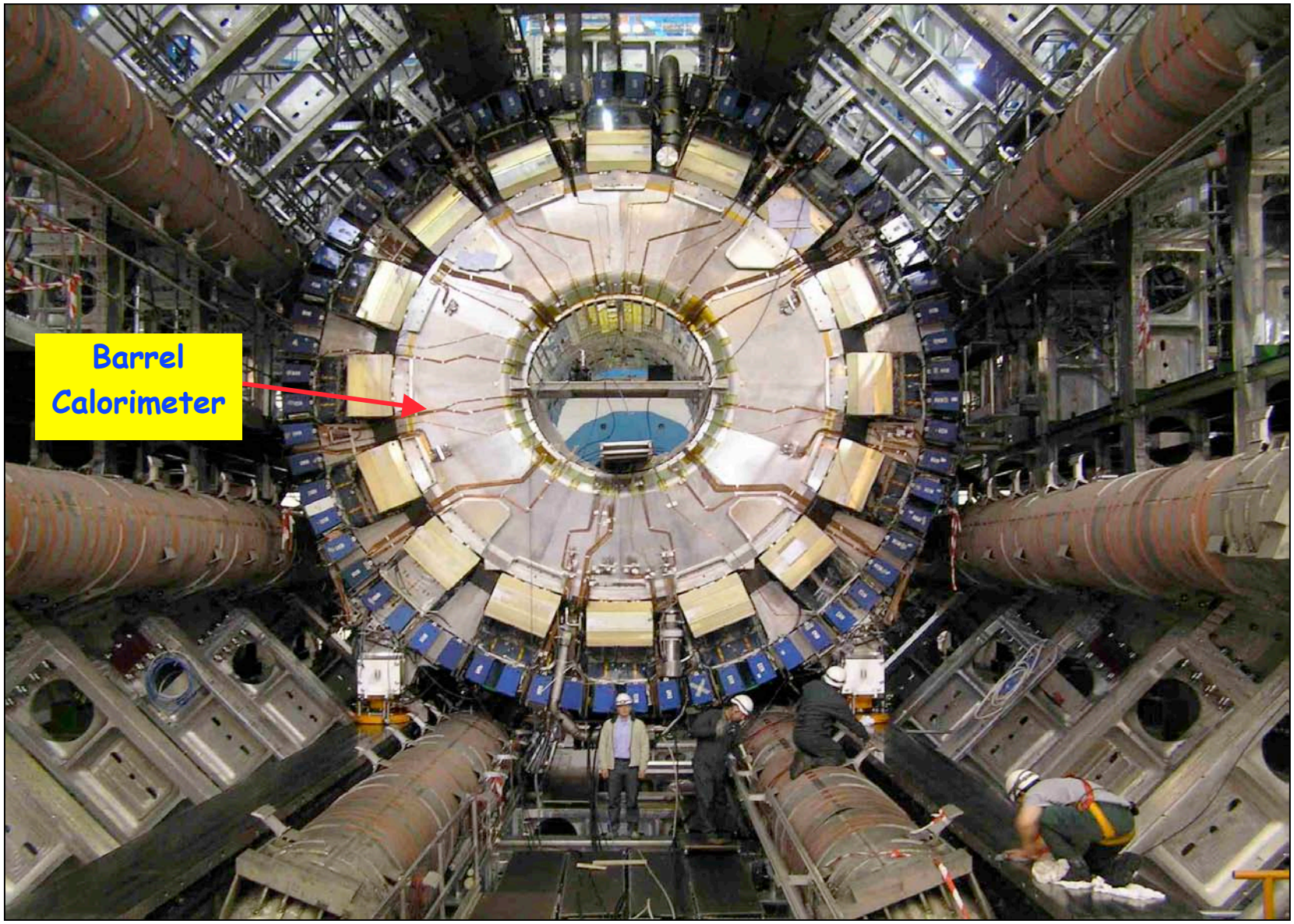
CERN: LHC
Geneva,
Switzerland
pp at 14 TeV



The ATLAS detector is being assembled in the "pit", about 100 m below surface



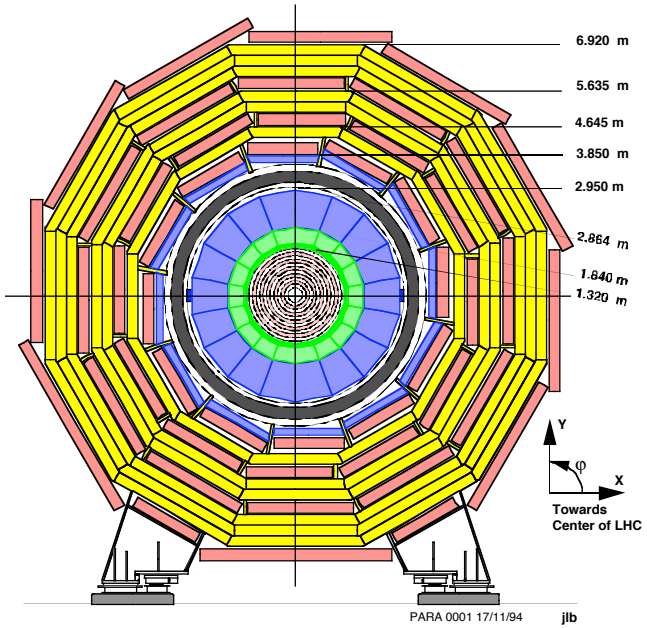
Barrel calorimeter already in final position:



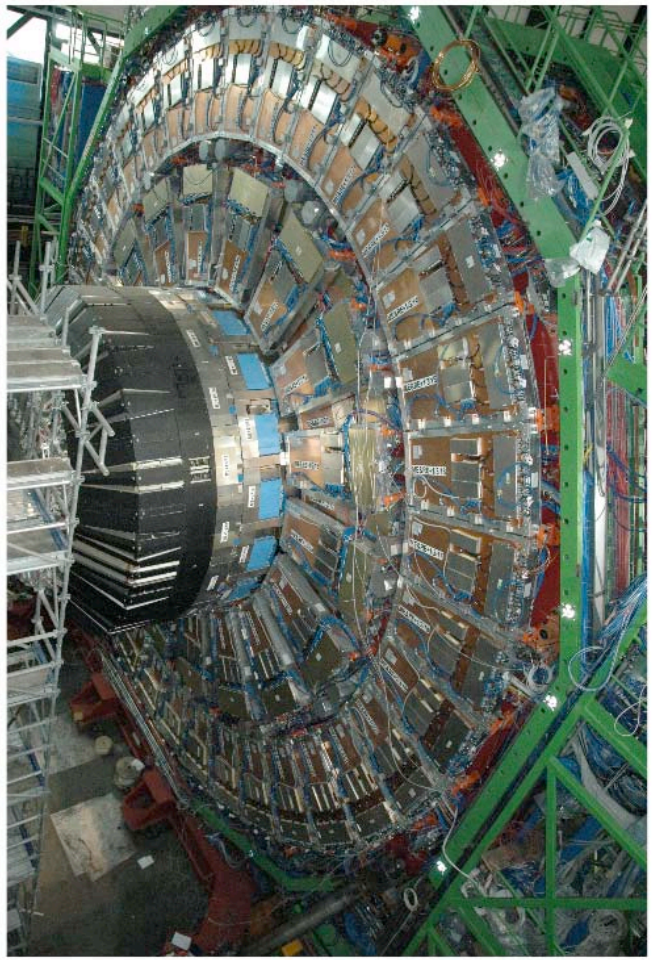
New Frontier @ CMS

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

CERN: LHC Geneva, Switzerland: pp at 14 TeV



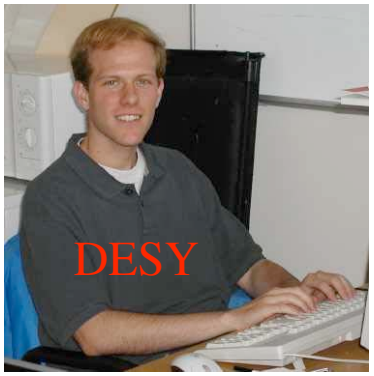
Transverse View

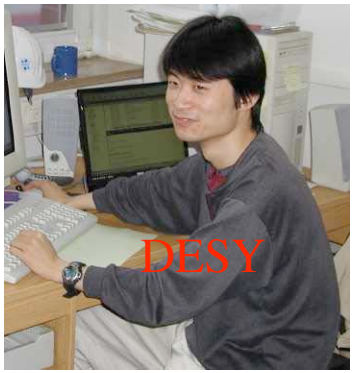


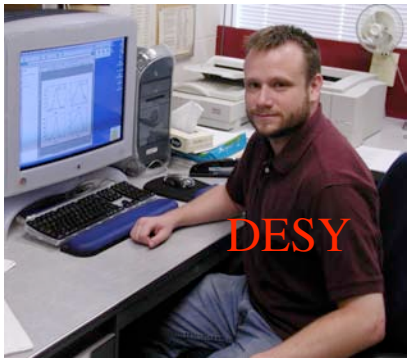
Physics at LHC

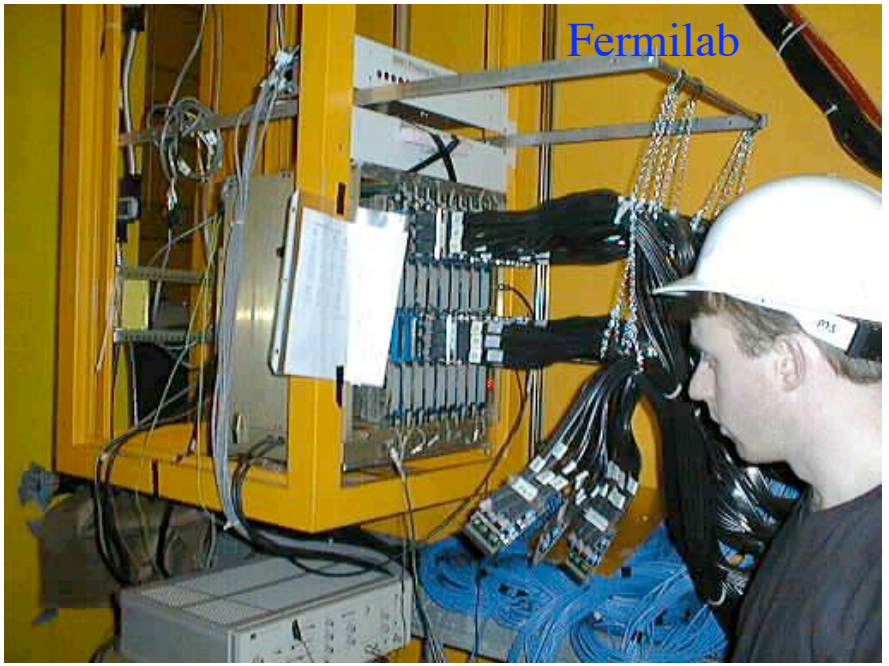
- Search for Standard Model Higgs
  - $120 < m_H < 1000$ GeV
- Search for Supersymmetry and other physics beyond the Standard Model
  - quark/lepton compositeness
  - new W'/Z' bosons or heavy quarks, leptons
  - extra Dimensions
  - ?

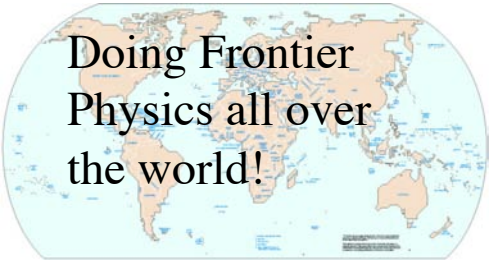
HEP Students at work











Summary

Lots of opportunity

Good Physics &

Good Travel &

Communication skills &

Good friends &

Good jobs

…fun and a rewarding education

Welcome to the adventure!