

DOE HEP REVIEW

BNL

High Energy Physics Overview

S. Dawson

April 17, 2007

Overview

- The big picture
 - *We have recovered from RSVP cancellation with strong program*
- Experimental program tightly focused on ATLAS and neutrinos (MINOS/DAYA BAY)
 - Significant amounts of detector R&D: LHC upgrades, far forward detector for ILC, neutrino detectors, sensors for LSST camera

Overview

■ Accelerator R&D

- Operate Accelerator Test Facility
- Advanced Accelerator research for Neutrino Factory
- ILC work in magnet division
- Talks by Yakimenko/Fernow/Peggs/Wanderer

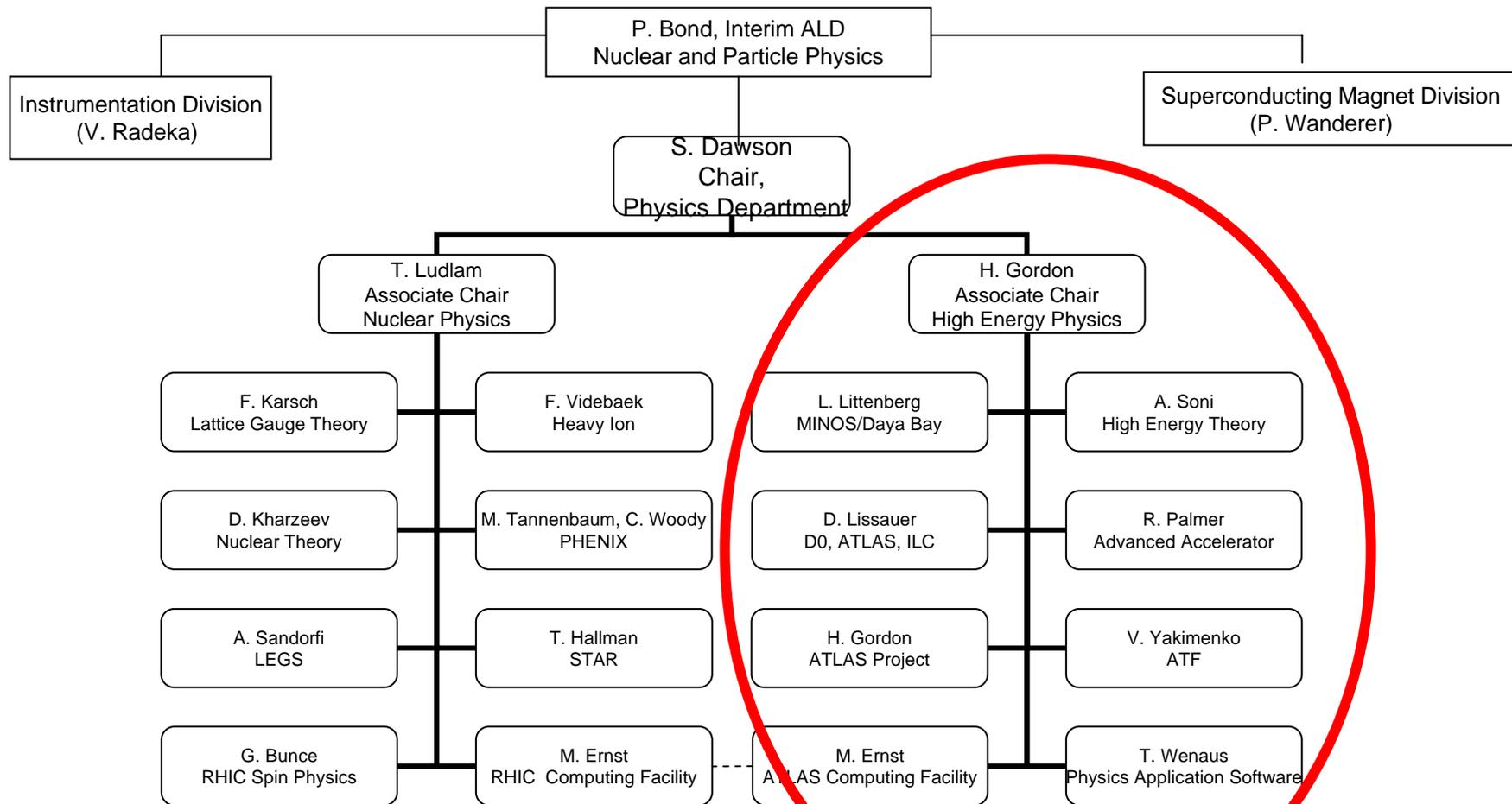
■ Theory

- Mainly LHC phenomenology & lattice QCD
- Tightly coupled to experimental program

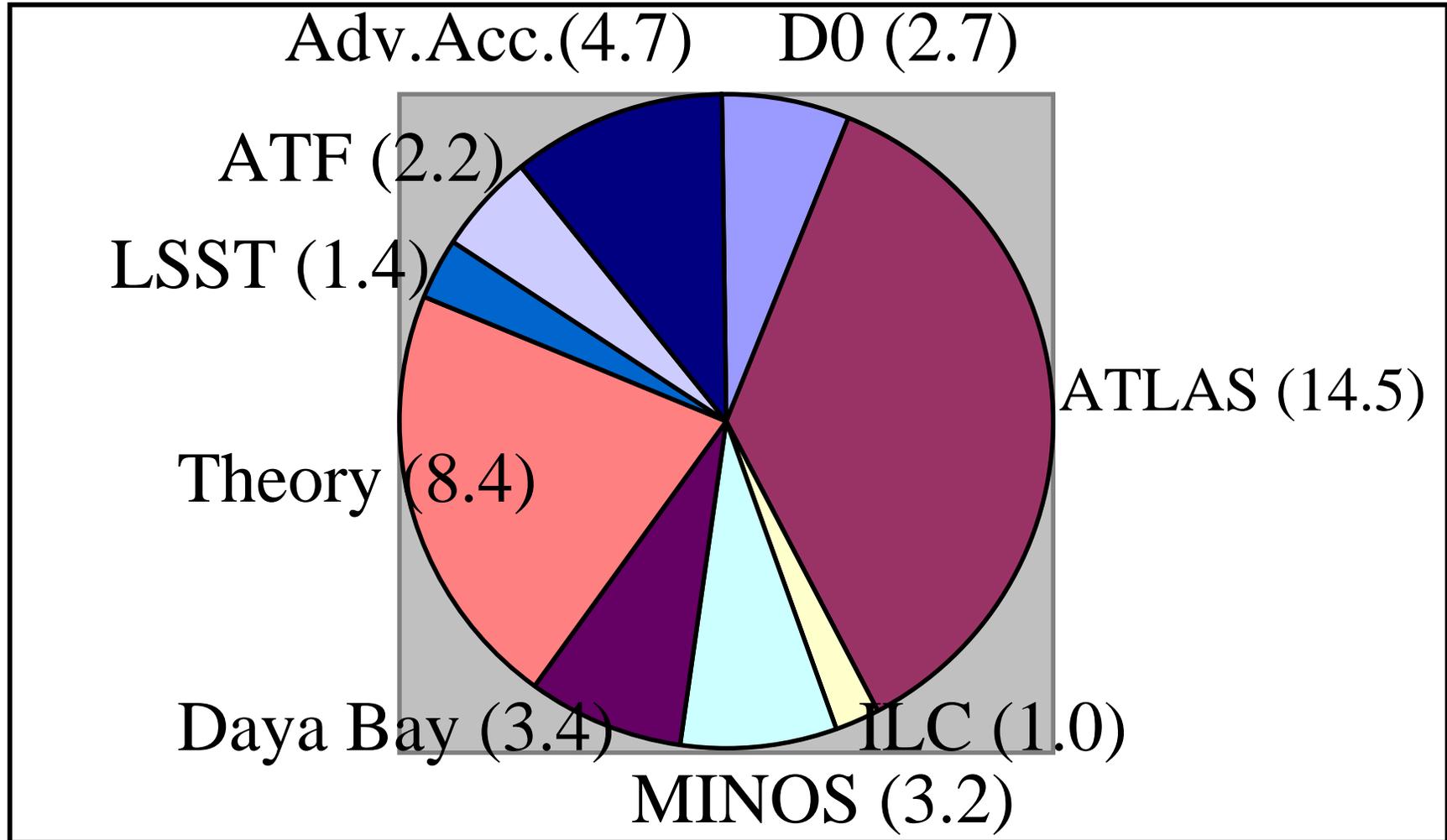
■ Instrumentation Division

- Supported by lab overhead
- Major contributions to detector R&D/LSST
- Talks by O'Connor/Smedley/deGeronimo

HEP Efforts @ BNL



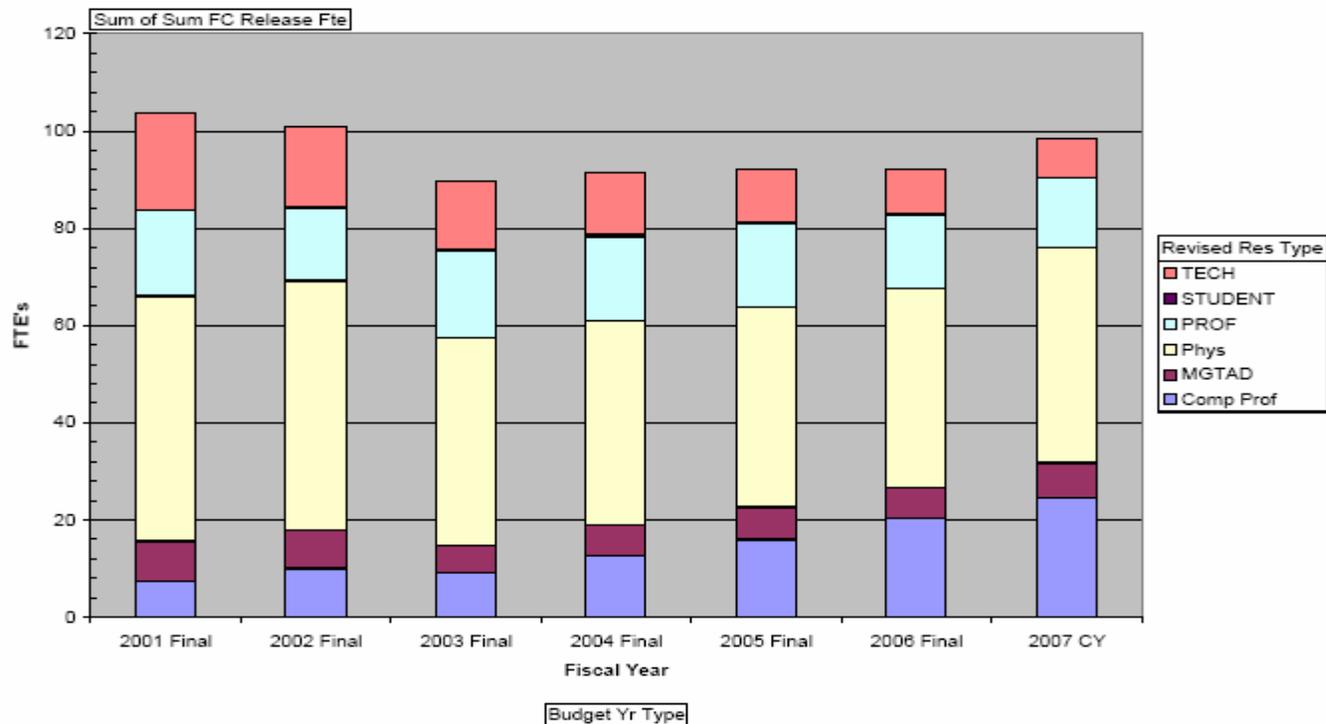
Physicist FTEs (Total=54.1)



* Doesn't include Magnet division or

HEP Staff in Physics Department

Note: Decline in technicians, increase in computer professionals



* Does not include FTEs in Superconducting Magnet Division

Age Distribution

Age	20-29	30-39	40-49	50-59	60-69	>70	Total
Permanent staff	0	2	9	4	15	2	32
Post-doc; junior staff	3	15	5	0	0	0	23
Total	3	17	14	4	15	1	55

A priority is maintaining post-doc strength

Big Picture of the FY07 & FY08 Budget

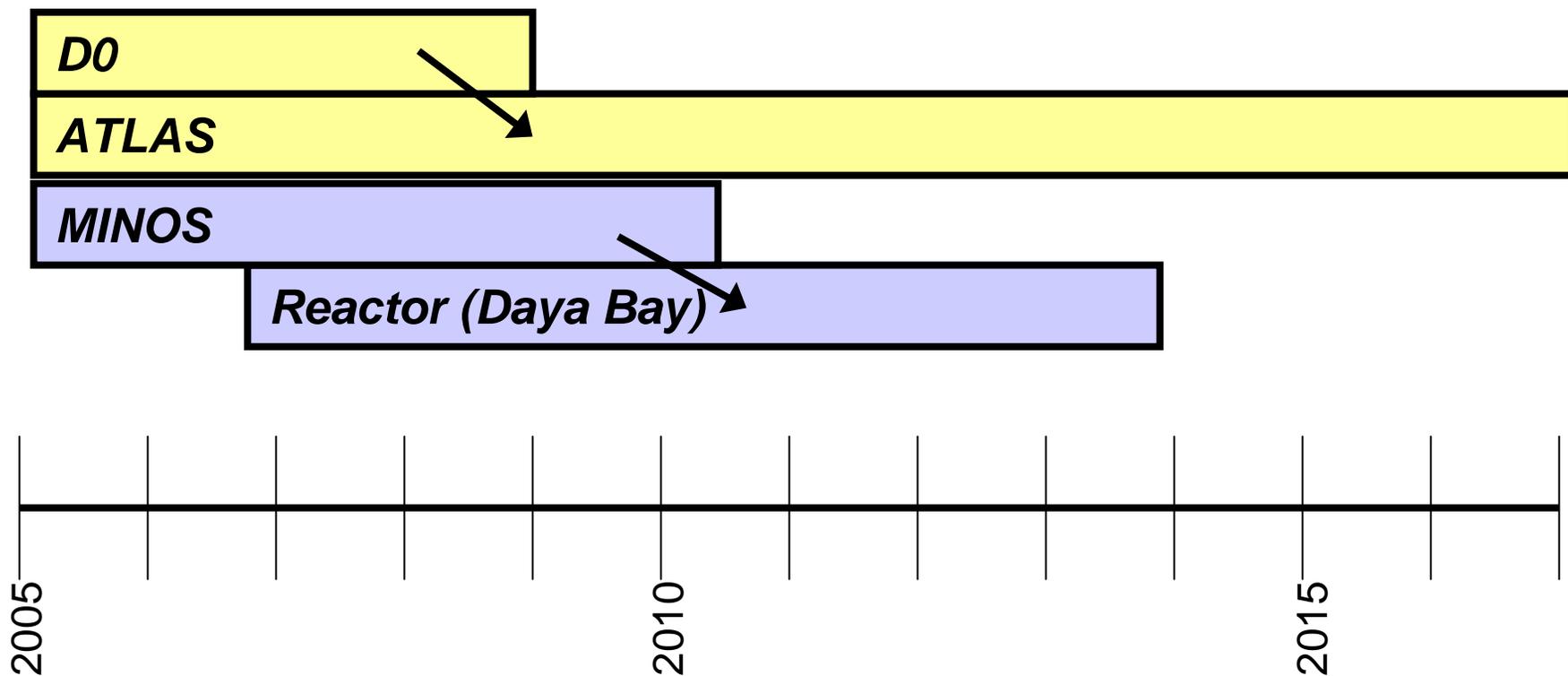
Exclude LHC Project:

FY07 \$17,584K Projected Expenditures \$17,859

FY08 PR: \$17,849K Lab Request \$21,820K

- Our budget sheets do not include Daya Bay project and R&D, LSST R&D, DUSEL R&D, OSG
- Increases in funding in accelerator areas
- Difficulties in core experimental program

Experimental Efforts



Big Picture in the Physics Department

- ATLAS is transitioning from construction to the Research Program
 - Technical coordination
 - Largest Tier 1 computing facility in ATLAS
 - BNL receives 23% of ATLAS raw data
 - Development of Analysis Support Center at BNL
 - **PHYSICS**
 - Computing and software to get there!
- DAYA BAY proceeding towards CD-2 review in October, 2007
 - Successful completion of Physics Review, Oct. 2006
 - *Successful CD-1 Review, April 10-11, 2007*

Budget for Experimental Programs

■ ATLAS/D0/MINOS/Daya Bay

- Core funding, non-LHC project, non-Daya Bay R&D
- FY07 \$7.5M
- FY08 President's Request \$7.6M
- Lab Request \$8.9M

Lab request for FY08 reflects desire to build up ATLAS (+ 3 FTEs in FY08) and Daya Bay post-docs (+1 FTE in FY08) plus significantly increased travel costs

ATLAS - Overview

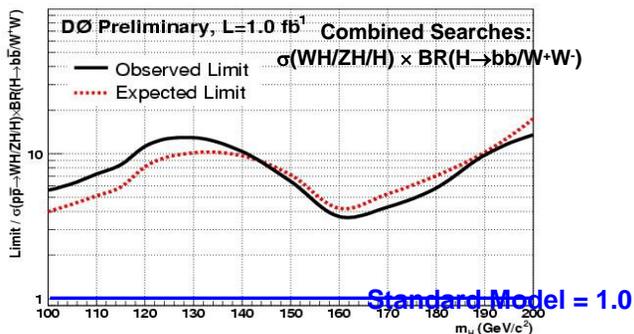
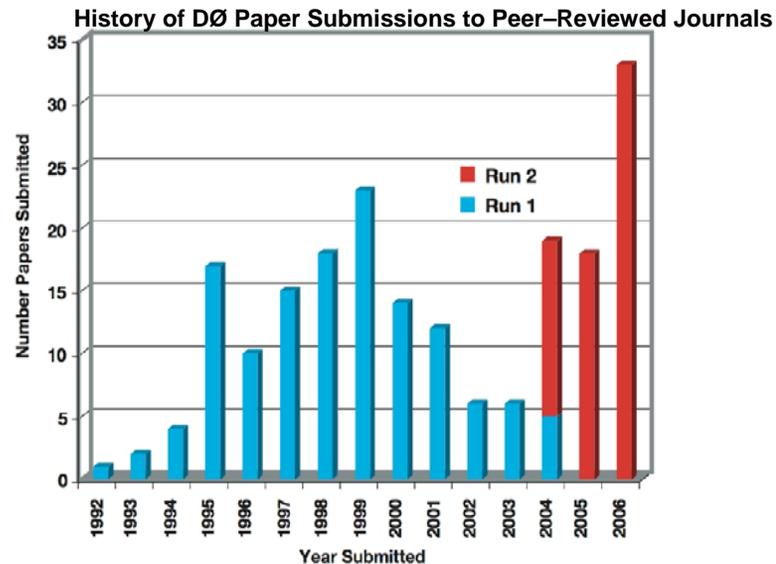
- Progress in computing software and hardware
 - See talks by Gordon/Ernst/Ma/Rajagopalan/Cranmer
 - Tier 1 Computing Center is building up
 - New director, Michael Ernst, in residence
 - Issue is space and infrastructure
- Physics Analysis
 - BNL's Analysis Support Center is active
 - Many tutorials, meetings and visitors
 - Helps US ATLAS community to use ATLAS software
 - We would like to build up group to capitalize on Tier 1 and software expertise to maximize physics output

2006 was record-breaking year for DØ publications:

- Evidence of single top
- Direct limits on B_s oscillation

2007, thus far:

- Measurements of top quark mass
- CP violation study in the B_s System
- $BR(B_s \rightarrow \mu\mu)$ limit with 2 fb^{-1}



Higgs with 1 fb^{-1} data

- Combined limits for WH, ZH with $H \rightarrow bb$ and $H \rightarrow WW$

D0 @ BNL

■ D0 effort fairly constant

- Effort will transition to ATLAS
- Transition date determined by national priorities
- See talk by Patwa

FTEs:	FY07:	2.7
	FY08:	2.3
	FY09:	1.0
Budgets:	FY07:	\$.54M
	FY08PR:	\$.57M

■ BNL responsibilities in D0

- Forward pre-shower hardware and software
- Leadership of τ ID group

Plus .2 FTE supported by Nuclear Physics
in CA-D

ILC R&D

- ILC R&D detector effort (1 FTE)
 - Within ATLAS group
 - Expect effort to remain small
 - Synergy with US ILC detector effort
 - Work on far forward ($\theta < 140$ mrad) calorimetry
 - Luminosity normalization from forward Bhabba pairs
 - Instantaneous luminosity from beamsstrahlung gammas
 - BNL role in Experiment Conceptual Design
 - Have joined SiD Collaboration
 - Simulation and integration studies
 - Physics Dept effort coordinated with BNL Instrumentation Division and SMD effort

Neutrinos

MINOS:

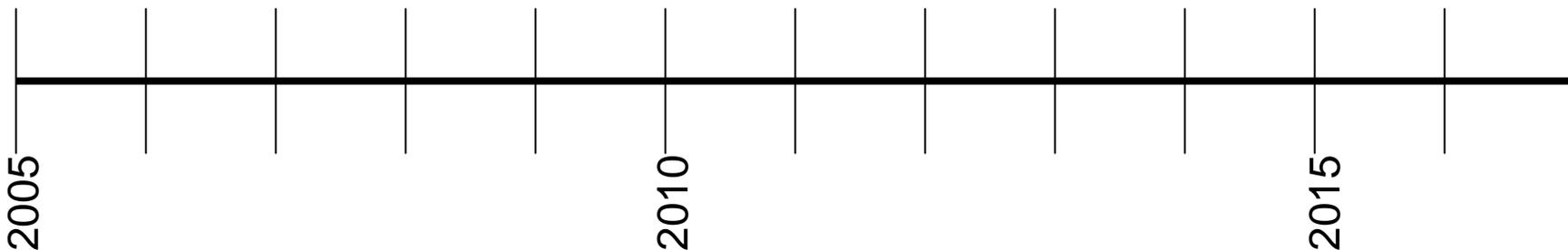
Data taking and analysis

Daya Bay:

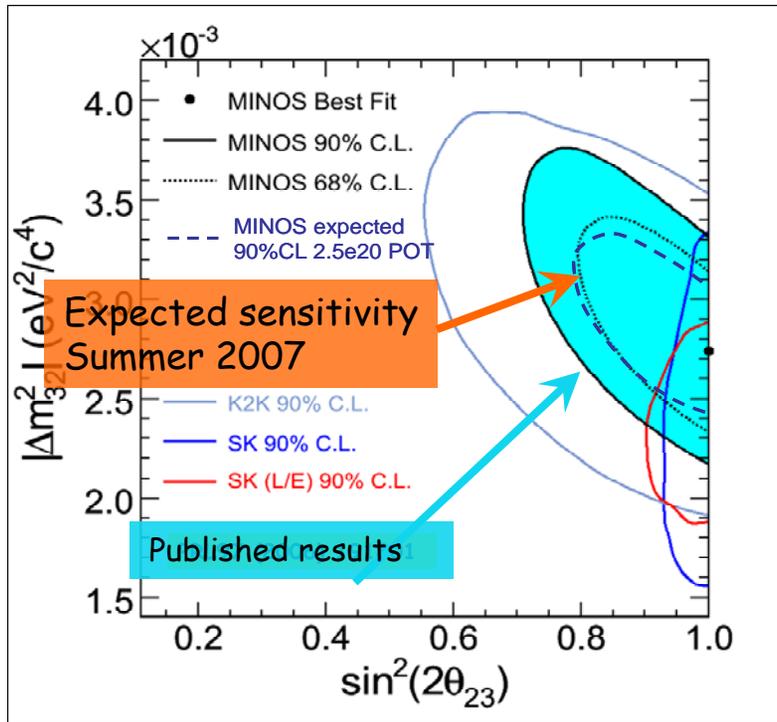
Construction

Data taking

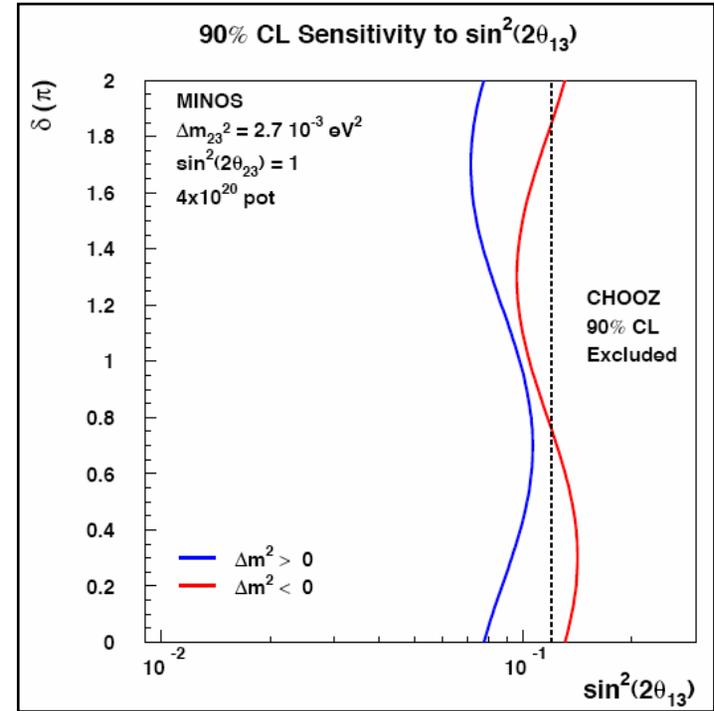
R&D for future long baseline neutrino experiments



MINOS: Improving our knowledge of neutrinos



Muon neutrino disappearance



Electron neutrino appearance

Expected sensitivity summer 2008

MINOS @ BNL

Ramps down in 2010 (?)

- Gradual transition from MINOS to DAYA BAY
- Post-docs get data on MINOS/ work on Daya Bay
- MINOS budget:
 - FY07 \$986K
 - FY08 (PR) \$1035K
 - FY08 Lab Request \$1284K

BNL leads NuMI beamline monitoring, and data logging

- Lead search for ν_e appearance in far detector and systematic error group
- See talk by Jaffe

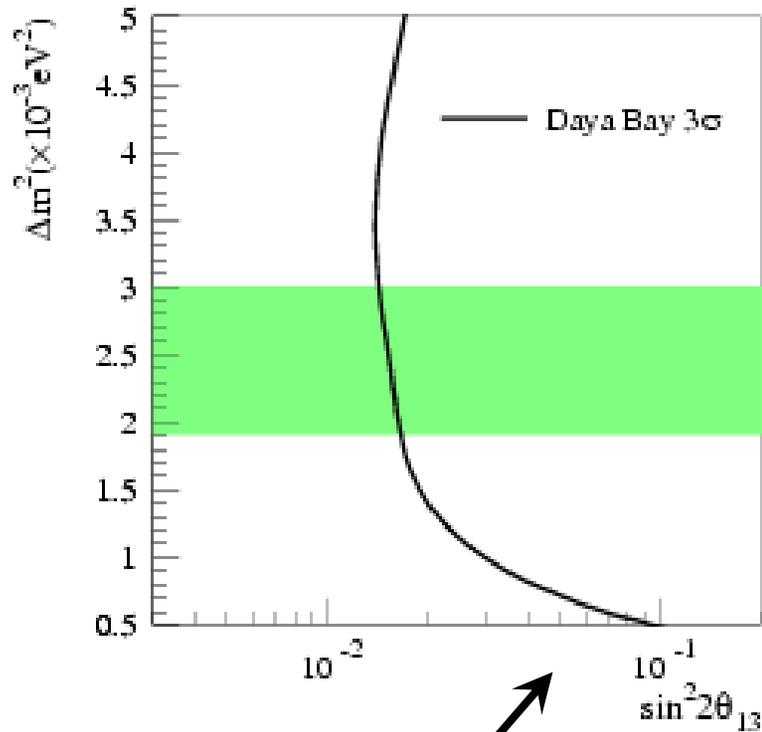
Daya Bay Reactor Experiment

- Goal is to measure $\sin^2 2\theta_{13}$ to a precision of .008
 - BNL is playing a leading role (with LBNL)
 - Joint leadership structure with Chinese
 - Steve Kettell: Chief Scientist/ Ralph Brown: Chief Engineer
- Successful CD-1 April 10-11, 2007
- See S. Kettell talk for details
 - Funding from both core program and R&D

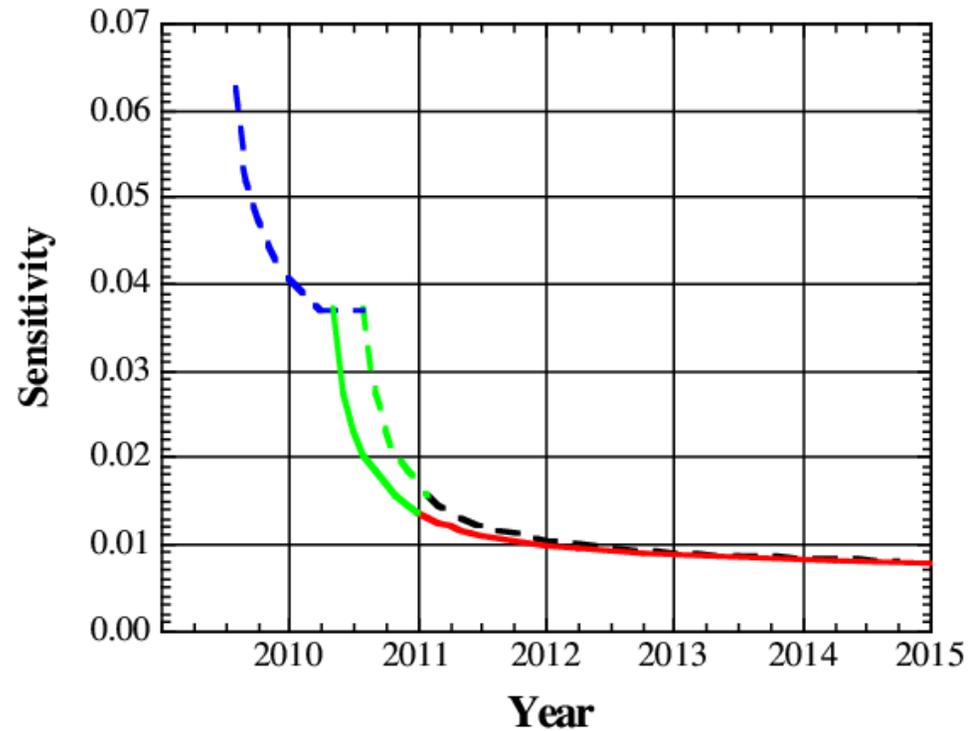
The Daya Bay Site



Sensitivity of Daya Bay



3 years running



Neutrinos and the Future

- Joint BNL/FNAL study on long baseline neutrinos
 - What is “the next big thing” after Nova?
 - Build a second detector off-axis near the Nova site?
 - Build a new beam at Fermilab pointed to DUSEL?
 - How do sensitivities for CP violation in the neutrino sector compare in the two approaches?
 - What R&D do we need to do now to be ready?
- Study chaired by M. Diwan (BNL) & Gina Rameika (FNAL)
 - A national program
 - See talk by Diwan

Neutrino Physicists

HEP base supported Physics Scientific Staff

	FY06	FY07	FY08R	FY09
Daya Bay	0.0	2.9	3.9	4.9
MINOS	3.9	2.7	2.7	2.7
E949/RSVP	2.6	0.5	0.0	0.0

Other BNL scientific staff on Daya Bay

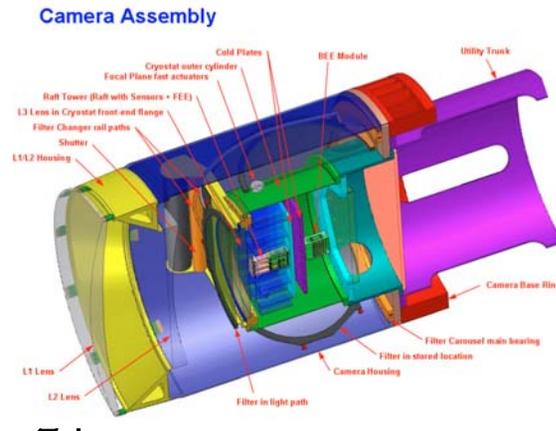
	FY06	FY07	FY08	FY09
Physics (LDRD)	0.0	0.5	0.8	0.2

Plus nuclear physics supported FTEs in
Chemistry

LSST

- Small effort in physics department
 - FY07: \$.376M
 - FY07 FTEs: 1.4
 - Have lab approval to use program development funds to hire experimental cosmologist to lead group
 - Post-doc stationed at Harvard supported by LSST funds
 - Science effort will focus on camera and data management
- Sensors for camera designed in Instrumentation Division

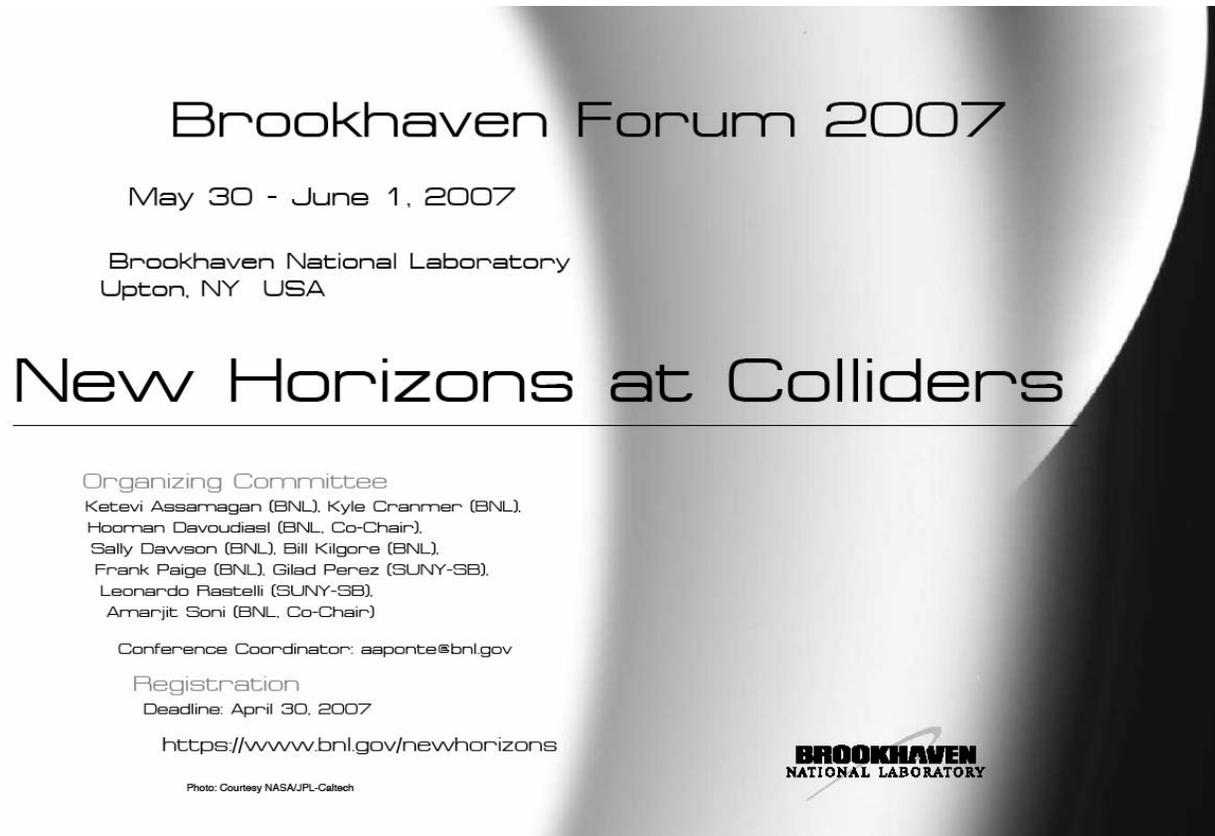
- See talk by P. O'Connor



Looking forward to LHC Physics

- Close connections between experimentalists & theorists

Jointly
organized by
theorists and
experimentalists

A poster for the Brookhaven Forum 2007. The background is a grayscale image of a particle detector or collider component. The text is centered and reads: "Brookhaven Forum 2007", "May 30 - June 1, 2007", "Brookhaven National Laboratory", "Upton, NY USA", "New Horizons at Colliders", "Organizing Committee", "Ketevi Assamagan (BNL), Kyle Cranmer (BNL), Hooman Davoudiasl (BNL, Co-Chair), Sally Dawson (BNL), Bill Kilgore (BNL), Frank Paige (BNL), Gilad Perez (SUNY-SB), Leonardo Pastelli (SUNY-SB), Amarjit Soni (BNL, Co-Chair)", "Conference Coordinator: aaponte@bnl.gov", "Registration", "Deadline: April 30, 2007", "https://www.bnl.gov/newhorizons", "Photo: Courtesy NASA/JPL-Caltech", and the Brookhaven National Laboratory logo.

Brookhaven Forum 2007

May 30 - June 1, 2007

Brookhaven National Laboratory
Upton, NY USA

New Horizons at Colliders

Organizing Committee
Ketevi Assamagan (BNL), Kyle Cranmer (BNL),
Hooman Davoudiasl (BNL, Co-Chair),
Sally Dawson (BNL), Bill Kilgore (BNL),
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Amarjit Soni (BNL, Co-Chair)

Conference Coordinator: aaponte@bnl.gov

Registration
Deadline: April 30, 2007

<https://www.bnl.gov/newhorizons>

Photo: Courtesy NASA/JPL-Caltech

BROOKHAVEN
NATIONAL LABORATORY

High Energy Theory

- Group is oriented towards experimental results
 - Hadron colliders and ILC
 - Electroweak physics
 - Lattice gauge theory for weak interaction matrix elements
 - Issue is maintaining post-doc strength (4 post-docs next year)
- FY07: \$2.44M
- FY08 PR: \$2.48M
- Lab Request: \$3M
- FTEs, FY07: 8.4

Large lattice Effort

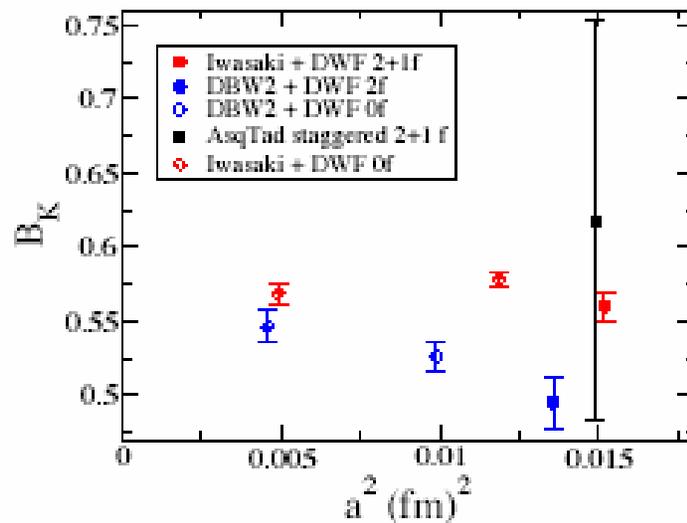
Lattice effort

HEP group, SCIDAC, Riken-BNL Center, Karsch group

QCDOC machines; soon BlueGene machine

HEP effort focused on weak matrix elements such B_K

Trick is to add 5th dimension (domain wall quarks)



$$B_K^{\overline{MS}}(2GeV) = 0.557(12)(29)$$

RBRC/UKQCD hep-
ph/0702042
27

Conclusion

- Successful reorganization of experimental program into two major efforts following RSVP cancellation
 - Collider physics: ATLAS/D0/ILC
 - Neutrinos: MINOS/Daya Bay
 - *Budgets are tight*
- Healthy theory program
- Significant accelerator research program
 - ATF understaffed, but has budget increase in FY08 PR

Community Service

- **Creutz:** US Lattice Gauge Theory Executive Committee
- **Dawson:** EPP2010, Fermilab PAC, AAAS Section Board, KITP Advisory Board, FNAL Steering Group for Accelerator Futures
- **Diwan:** Homestake DUSEL executive board, co-chair BNL/FNAL long baseline study
- **Gibbard:** DOE EsNet review, LHC computing committees
- **Gordon:** Deputy US ATLAS Research Program Manager; Member Open Science Grid Council, Ice Cube Project Advisory Panel, NSF Advisory Committee on Governmental performance; DOE SLAC operations review
- **Harrison:** Regional director for ILC GDE, LHC Machine Advisory Cmte, LHC Cost & Schedule Cmte, DESY Machine Advisory Cmte, ILC Executive Cmte
- **Kettell:** Chief scientist Daya Bay experiment
- **H. Kirk:** Co-spokesperson for Neutrino Factory and Muon Collider Collaboration; co-spokesperson CERN nTOF11 experiment

Doesn't include positions within experiments or conference

Community Service

- **Littenberg:** Particle Data Group
- **Marciano:** Homestake DUSEL PAC, Particle Data Group, Coordinator fundamental symmetries group for NSAC long range plan
- **Morse:** Coordinator for very forward calorimeter for ILC SiD detector, APS Fellow
- **Ozaki:** HEPAP, International Linear Collider Steering Group, Deputy Chair LCSGA, Chair LCSGA regional interest panel
- **Palmer:** Co-spokesperson for Neutrino Factory and Muon Collider
- **Peggs:** LARP program manager, FNAL Fermilab AAC, Chair APS Wilson Prize Cmte, Chair SciDAC Advisory Cmte
- **Samios:** HEPAP, Director RIKEN BNL Research Center
- **Semertzidis:** BNL PAC, Working group leader for Flavor in the LHC Era
- **Yakimenko:** ORNL Machine Advisory Committee

Doesn't include positions within experiments or conference

Hit Parade (Papers written since 2002 with > 50 citations by BNL authors)

- Measurement of the negative muon anomalous magnetic moment to .7 ppm (g-2 collaboration), PRL 92 (2004) 161802, 228 citations
- Measurement of the positive muon anomalous magnetic moment to 0.7 ppm (g-2 collaboration), PRL 89 (2002) 101804, 325 citations
- Refinements in electroweak contributions to the muon anomalous magnetic moment PRD67, (2003) 073006, (Czarnecki and Marciano), 53 citations
- Precise determination of V_{us} from Lattice Calculations of Pseudoscalar decay constants PRL93 (2004) 231803 (Marciano), 53 citations
- Very long baseline neutrino oscillation experiments for precise measurements of mixing parameters and CP Violating Effects (Diwan et al) PRD68 (2003), 012002 , 92 citations
- Recent Progress in Neutrino Factory and Muon Collider Research (Berg, Fernow, Gallardo, Kahn, Palmer), PR ST Acc. Beams 6 (2003) 081001, 117 citations

Hit Parade #2

- Further Evidence for the Decay $K^+ \rightarrow \pi \nu \nu$ (E787), PRL 88 (2002) 041803, 118 citations
- Improved Measurement of the Decay $K^+ \rightarrow \pi \nu \nu$ (E787), PRL 93 (2004) 031801, 65 citations
- Physics Potential and Experimental Challenges of the LHC Luminosity Upgrade Eur. Phys. J. C39 (2005) 293, (...Paige...), 74 citations
- Isajet 7.69, A Monte Carlo Generator for pp, pp and e^+e^- Reactions (Paige, Protopopescu, Baer, Tata), hep-ph/0312045, 134 citations
- Next-to-next-to-leading order Higgs production at hadron colliders (Harlander and Kilgore), PRL 88, (2002) 201801, 215 citations
- Physics Interplay of the LHC and the ILC, Phy. Rept. 426 (2006) 47, (...Davoudiasl, Dawson...), 141 citations
- QCD Corrections to tth Production at the Tevatron Reina, Dawson and Wackerroth, PRD65, (2002) 053017, 63 citations
- One Loop Corrections to the ρ parameter in the Littlest Higgs Model Chen and Dawson, PRD70 (2004) 015003, 94 citations
- Final State Interactions in Hadronic B Decays (Cheng, Chua, Soni), PRD71 (2005), 014030, 101 citations

Hit Parade #3

- Kaon Matrix elements and CP violation from quenched lattice QCD (RBRC collaboration) PRD68, 114506 (2003), 123 citations
- Lattice QCD with two dynamical flavors of domain wall fermions (RBRC Collaboration) PRD72 (2005) 114505, 55 citations
- Domain Wall Fermions with Improved Gauge Actions PRD69 (2004) 074504 (RBRC collaboration), 71 citations
- First Direct Two-Sided Bound on the B_0^s Oscillation Frequency (D0), PRL97 (2006) 021802, 106 citations
- A Precision Measurement of the Mass of the Top Quark (D0), Nature 429 (2004) 638, 137 citations
- Observation and Properties of the $X(3872)$ Decaying to $J/\psi \pi^+\pi^-$ in pp Collisions (D0) PRL 93 (2004) 162002, 130 citations
- The Upgraded D0 detector (D0) Nucl. Inst. Meth. A565 (2006) 463, 85 citations
- A Search for the Flavor Changing Neutral Current Decay $B_0^s \rightarrow \mu^+\mu^-$ (D0) PRL 94 (2005) 071802, 58 citations

