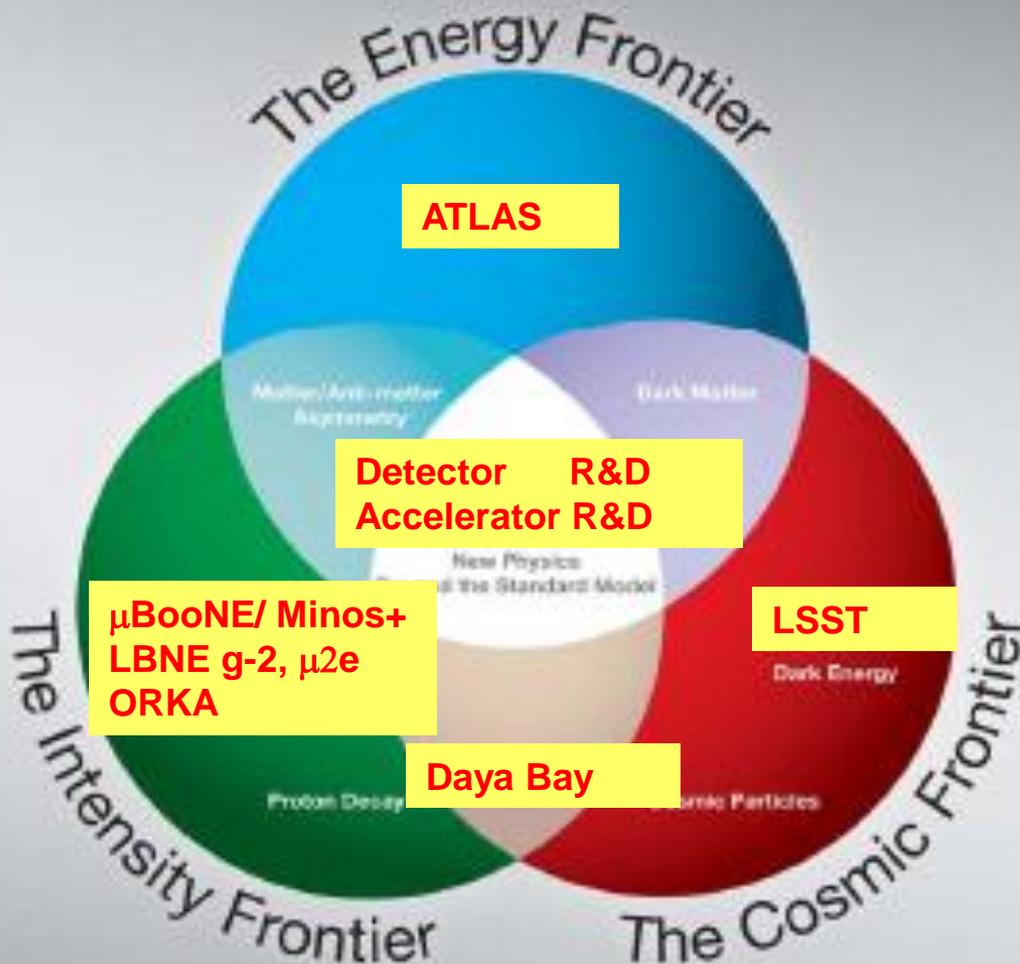


# BNL role in the US HEP Present and future.

*David Lissauer*



**Enabling and leading experiments in HEP.**

**Leverage expertise from :**

**Physics analysis – simulation and data**

**HEP Theory**

**Accelerator R&D**

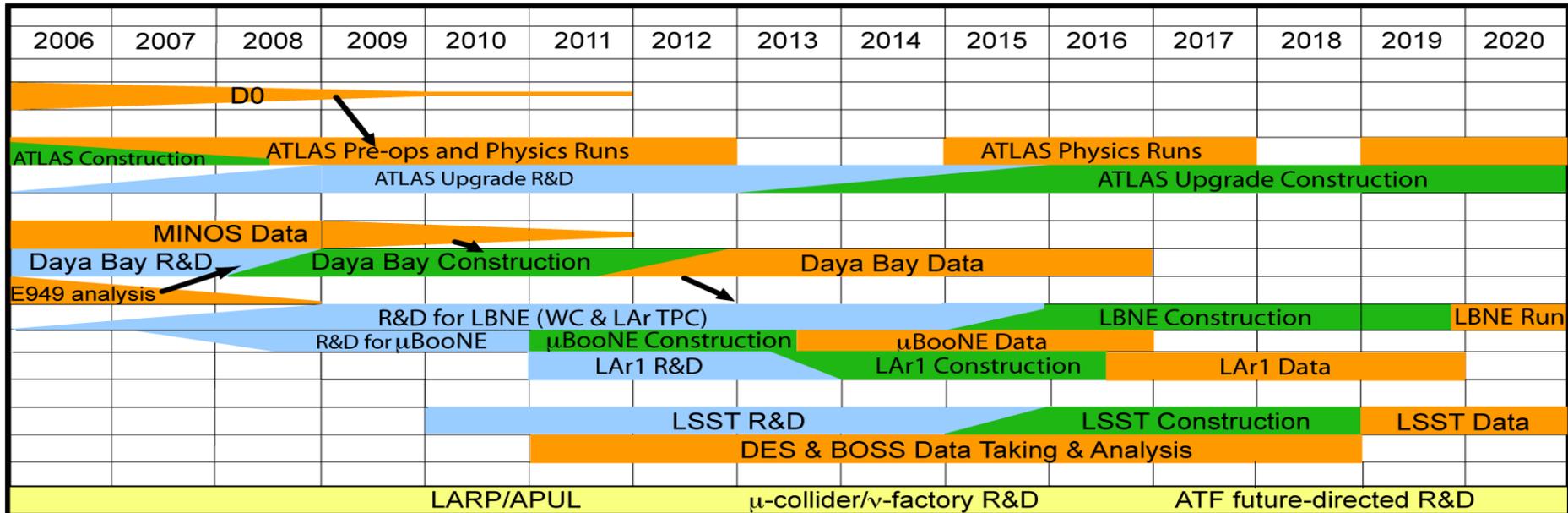
**Detector R&D**

**Computing facilities**

**project Management.**

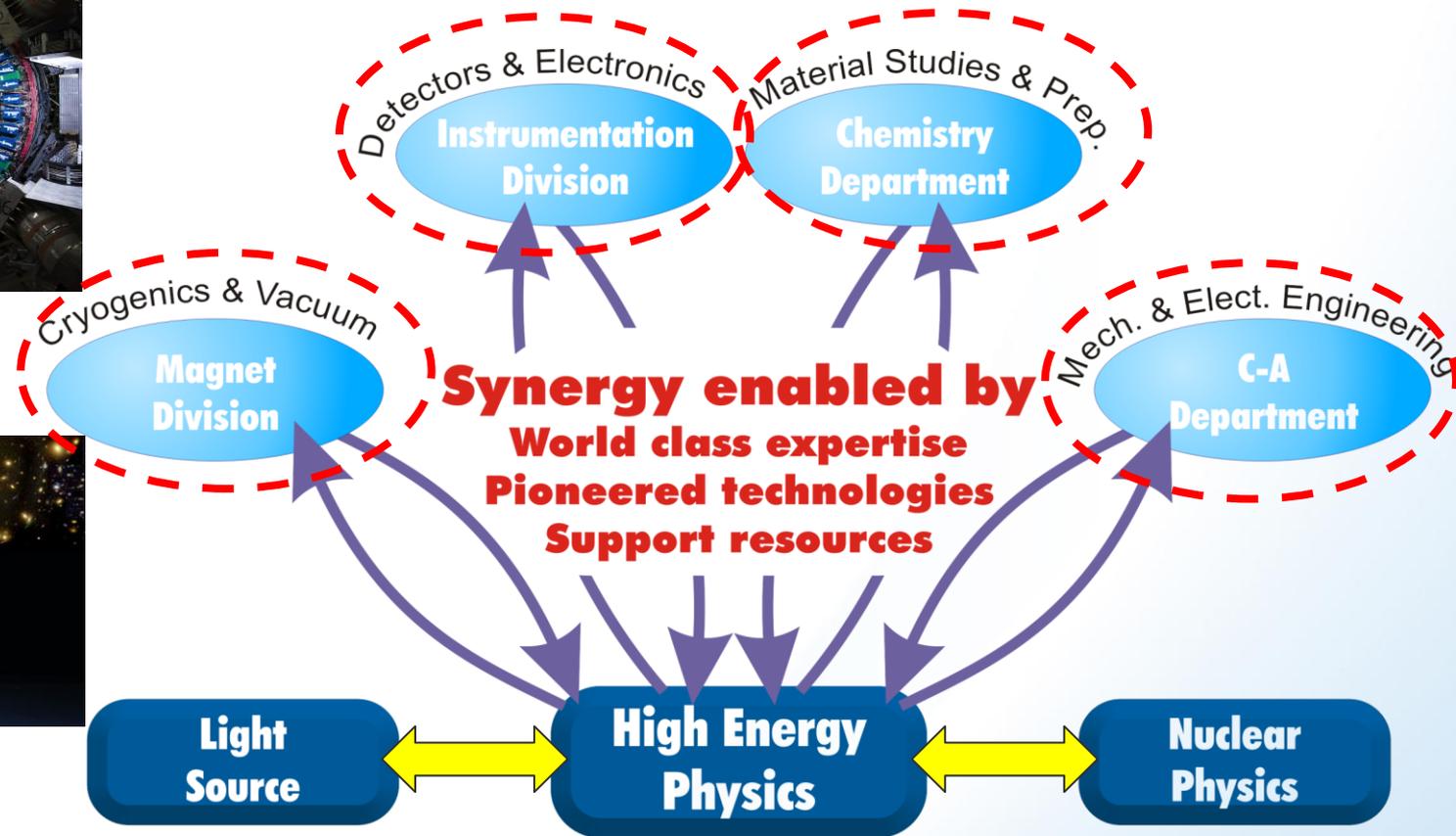
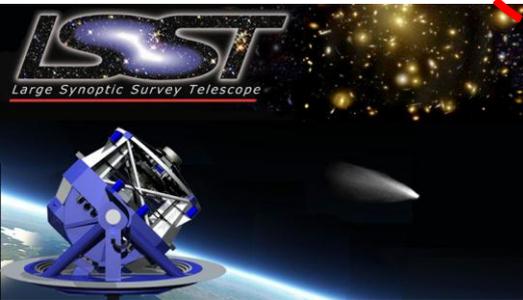
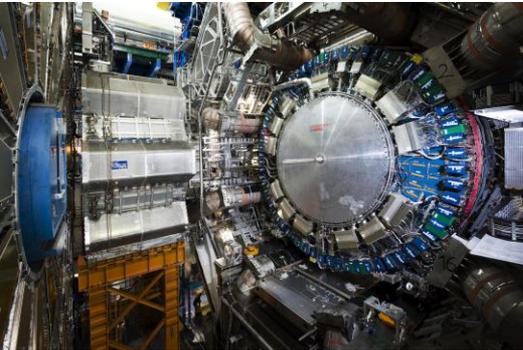
# Long-Term Vision for BNL HEP

**Goal:** *technical & intellectual leadership in key experiments at the three frontiers (energy, intensity, cosmology), supported by theory and by critical advanced accelerator and detector R&D.*



- **ATLAS, LBNE, LSST are our physics priorities in the three frontiers for the coming decade.**
- **Driven by science the BNL program is well aligned with the national HEP priorities**
  - **Program built on unique capabilities at BNL.**

# One Lab – Many Strengths



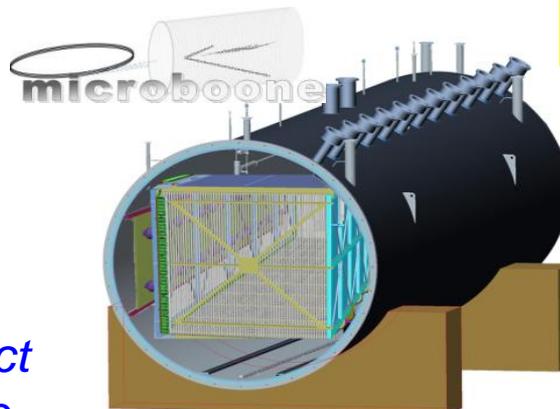
**HEP program leverage laboratory expertise to develop and implement the physics program.**

**In particular the program leverage the Instrumentation and the Collider and Accelerator Divisions to develop and implement new technologies for detectors and accelerators.**

# BNL Roles at Intensity Frontier

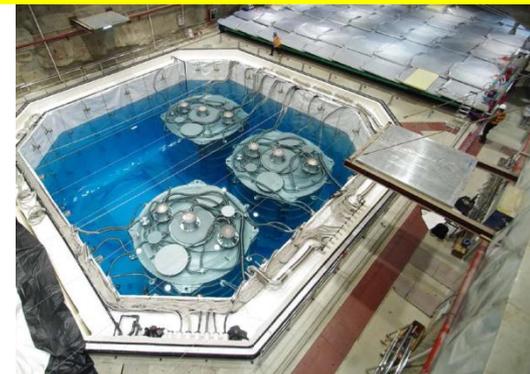
## ➤ $\nu$ Program:

- **MINOS** Analysis/Data
- **Daya Bay** Analysis
  - Co Host Daya Bay Project
  - Project Scientist S. Kettle
- **$\mu$ BooNE** In Construction
- **LAr1** Proposal in preparation
- **LBNE** CD1 preparation



Design of  $\mu$ BooNE  
LAr TPC

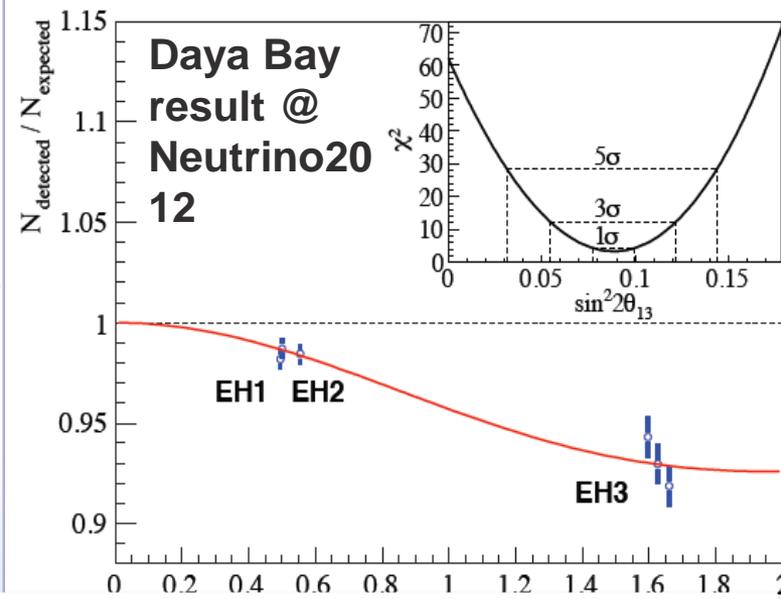
## Daya Bay - Far Det.



## ➤ Rare Processes:

- **g-2** CD0, Transfer experiment to FNAL
- **$\mu$ 2e** CD2
- **ORKA** ( $K^+ \rightarrow \pi^+ \nu \nu$ ) Scientific Approval 12/11

## Daya Bay - Large $\sin^2 2\theta_{13}$



$$\sin^2 2\theta_{13} = 0.089 \pm 0.010 \text{ (stat)} \pm 0.005 \text{ (syst)}$$

**BNL has a long history of working at the intensity frontier at AGS**

# LBNE

➤ **Significant contributions to LBNE from the initial ideas.**

➤ **Physics Leadership**

- **Milind Diwan Co-Spokesperson**
- **Mary Bishai Project Scientist**

➤ **Project Leadership**

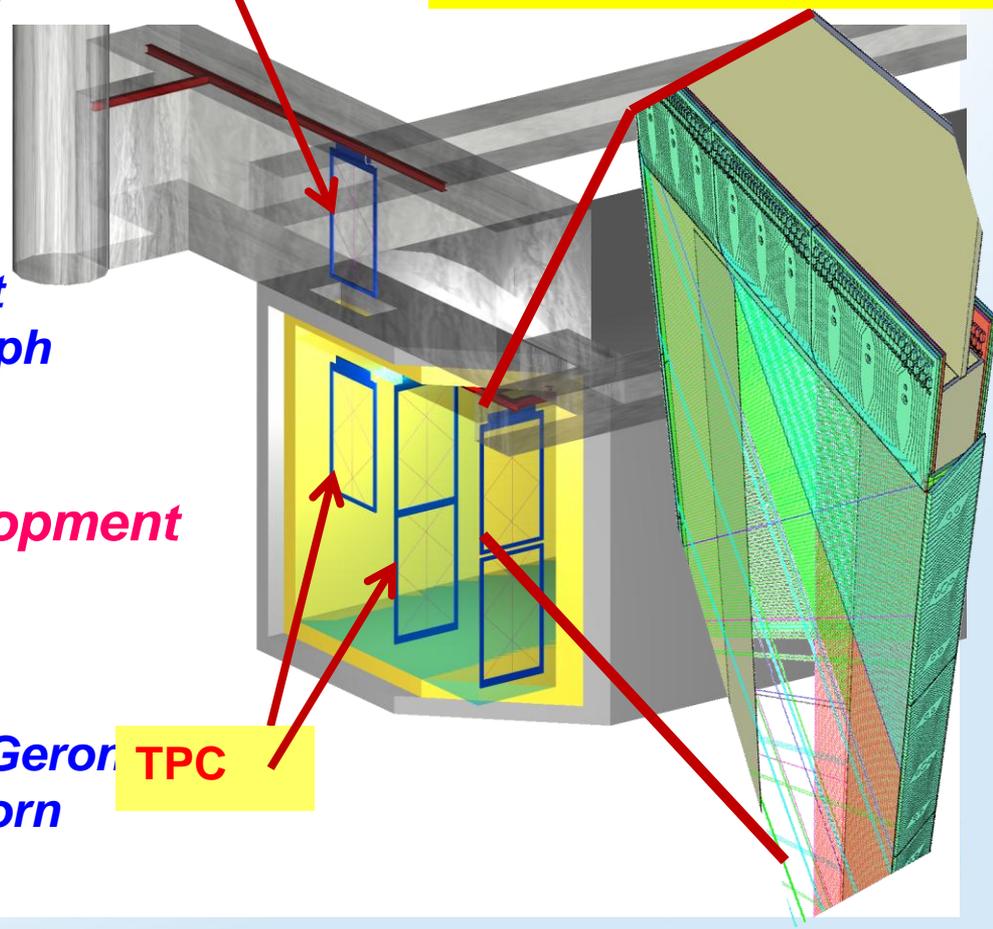
- **L2 Far Detector PM Jim Stewart**
- **LBNE System Engineer Jeff Dolph**

➤ **Leadership in Technology development**

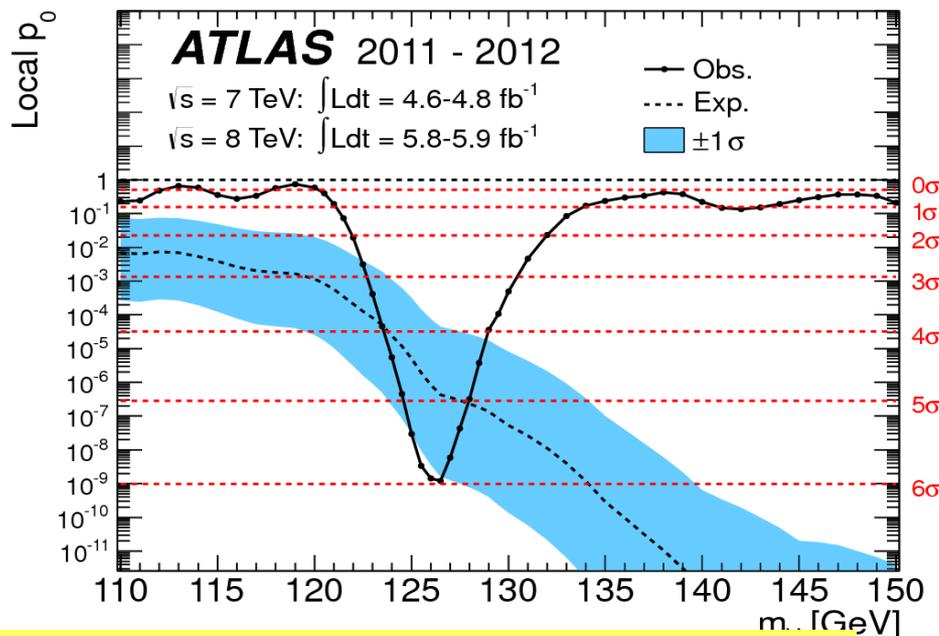
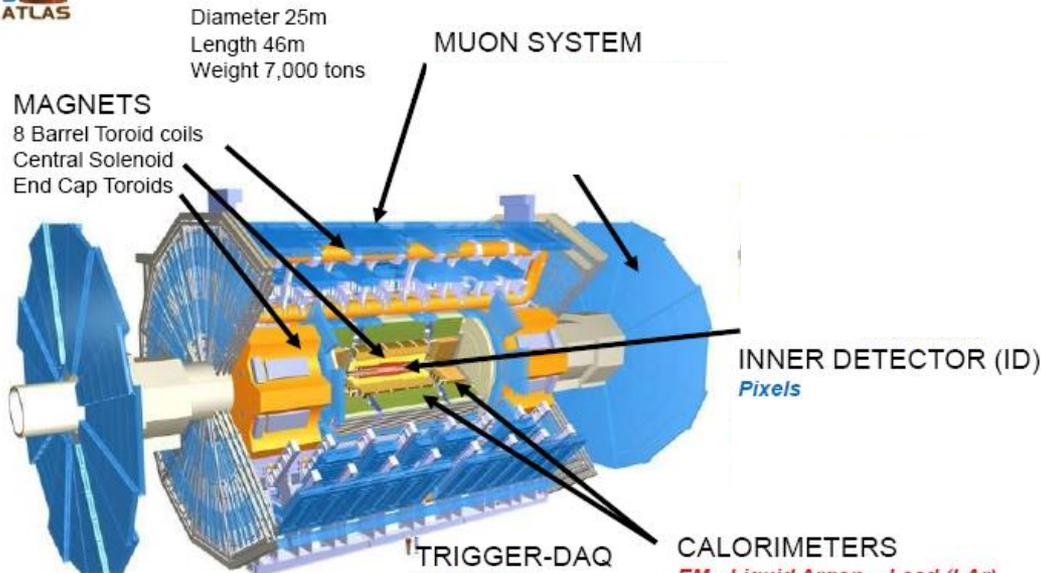
- **Beam Design - Mary Bishai**
- **TPC design – Bo Yu**
- **Cold Electronics – Gianluigi De Gerona**
- **Readout Electronics – Craig Thorn**

Cryostat access

BNL Cold Electronics enabling technology for large LAr TPC's.



# BNL's roles in Energy Frontier



**ATLAS – New Boson at 126 GeV**

**BNL is the host Lab for  
U.S. ATLAS**

**Project office:**

Mike Tuts (OPM),  
Srini Rajagopalan (DOPM)

**Upgrade Project office:**

CPM start – 1/13

**Tier I Computing Center:**

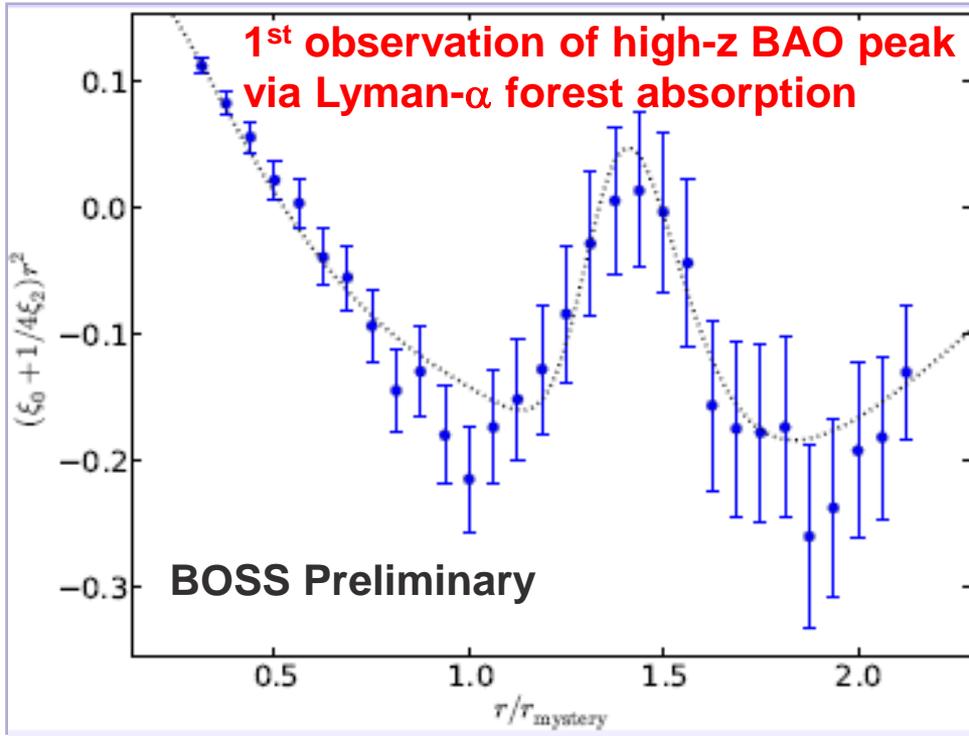
M. Ernst

**L1 Manager for Physics  
Support & Computing:**

Torre Wenaus

**LHC science program will  
be the focus of the energy  
frontier through ~2030.**

# BNL Roles at Cosmology Frontier

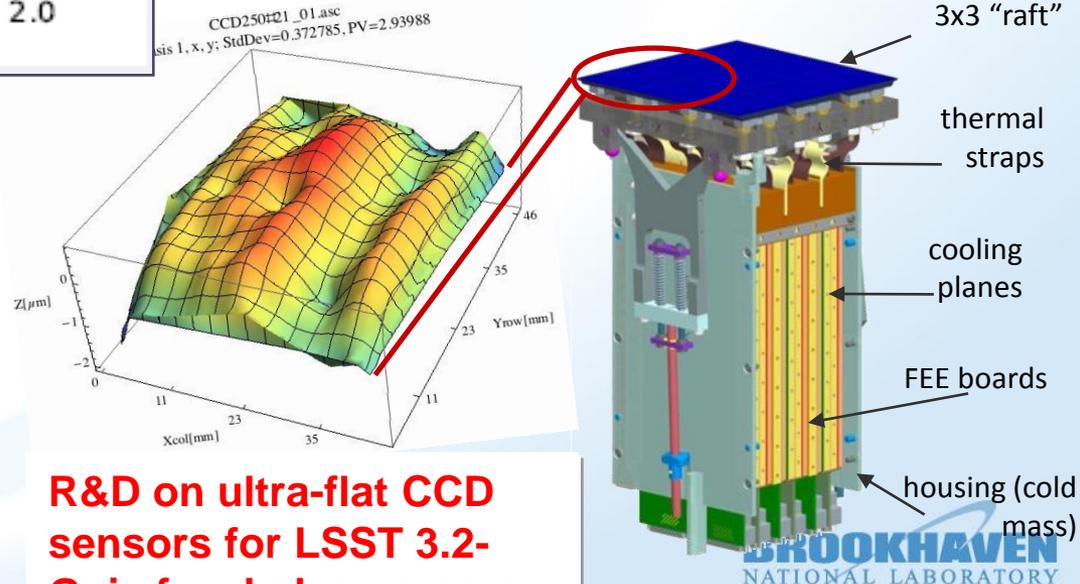


**Very active Cosmology group.**  
**Ongoing Experiments: BOSS, DES**

**LSST significant project responsibilities leading to our main science focus in the future.**

- **Lyman- $\alpha$  forest analysis in BOSS**
- **Gravitational lensing pipeline for DES**

- **Science raft R&D and production for LSST**
- **Deputy PM for LSST focal plane sensor "towers"**



**R&D on ultra-flat CCD sensors for LSST 3.2-Gpix focal plane camera**

# HEP Theory

Mission: Leadership in defining the HEP experimental program

- Lattice gauge theory
  - Highly focused on connection with experimental observables
  - Hardware/software/algorithm/theoretical contributions
- Higher-order QCD corrections for LHC phenomenology
- LBNE, Mu2e, neutrinos,  $(g - 2)_\mu$ , EDM's
  - The intellectual leadership in precision experiments.
- Model building for electroweak symmetry breaking
  - Model building is also tightly connected to experiment
- Super B factories, CKM and CP violation

# Instrumentation Division

## Sensors

- Silicon Sensors
- CCD development

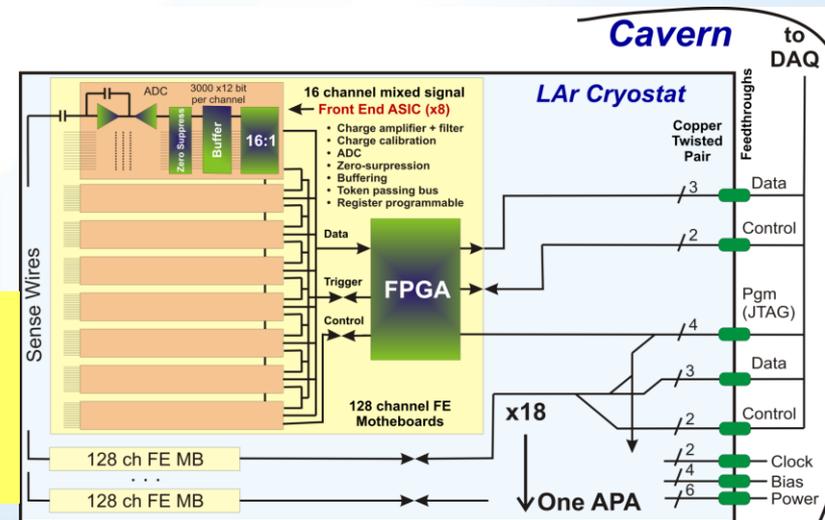
## ■ Detector Systems

- Fundamental properties of noble liquids for detectors
- Long drift noble liquid detectors
- Micro-pattern gas detectors (bulk micromegas)
- Water-based & metal-loaded liquid scintillators (Chemistry)

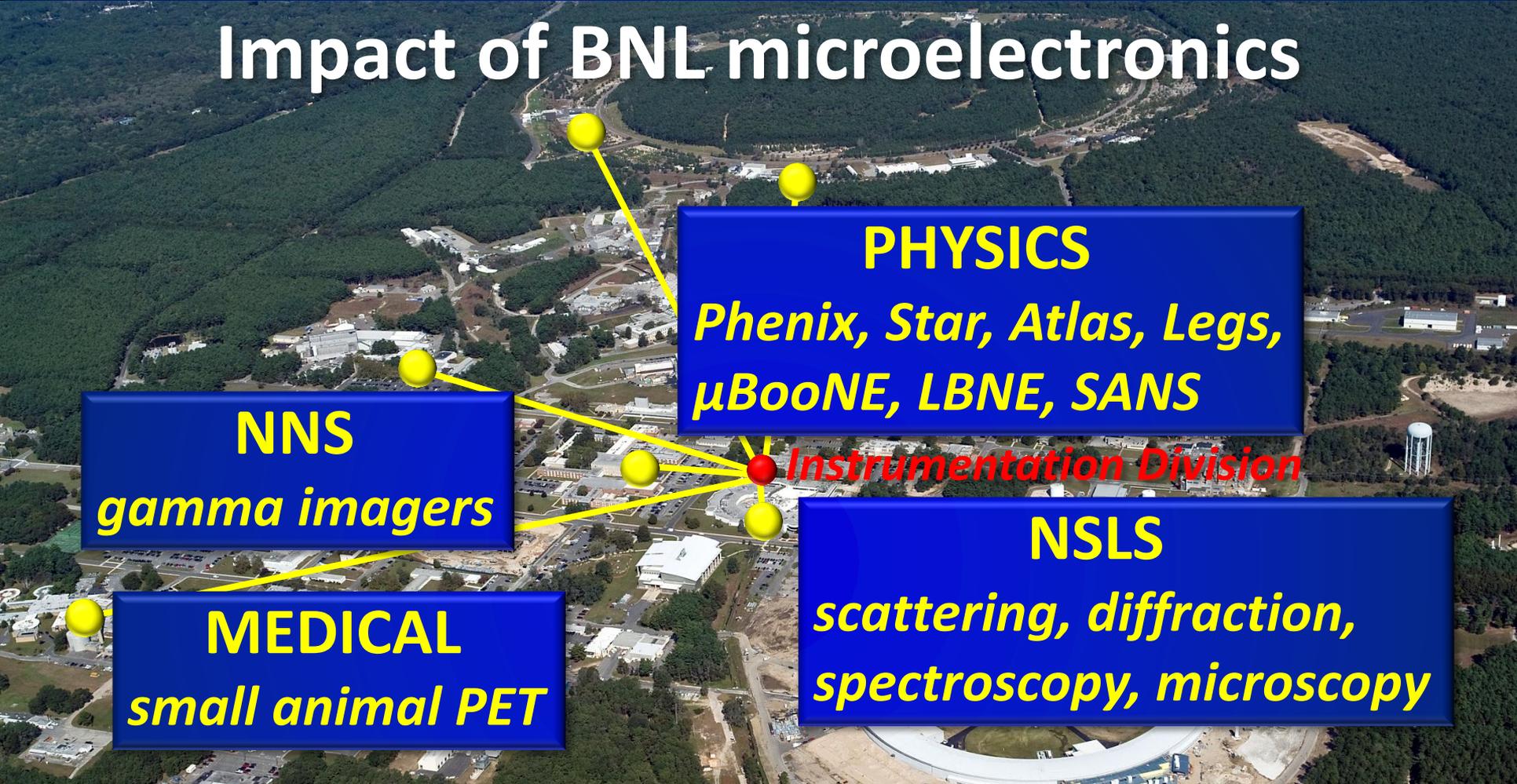
## ASIC Development

- Cold Electronics
- Gas detector readout

**Enabling technology  
Low noise – cold  
electronics.**



# Impact of BNL microelectronics



## PHYSICS

*Phenix, Star, Atlas, Legs,  
μBooNE, LBNE, SANS*

## NNS

*gamma imagers*

## MEDICAL

*small animal PET*

## NSLS

*scattering, diffraction,  
spectroscopy, microscopy*

*Instrumentation Division*

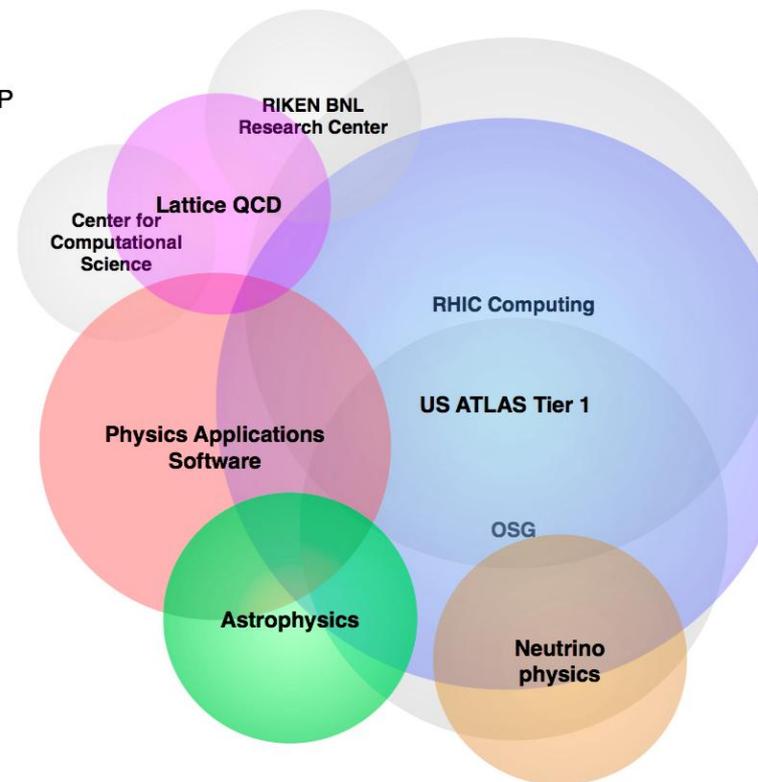
- DHS, DoD - *directional gamma-imagers*
- NASA - *spectrometers for elemental mapping*
- CRADAs - *medical, industrial applications*
- *14 patents (OTCP)* •

# HEP Computing

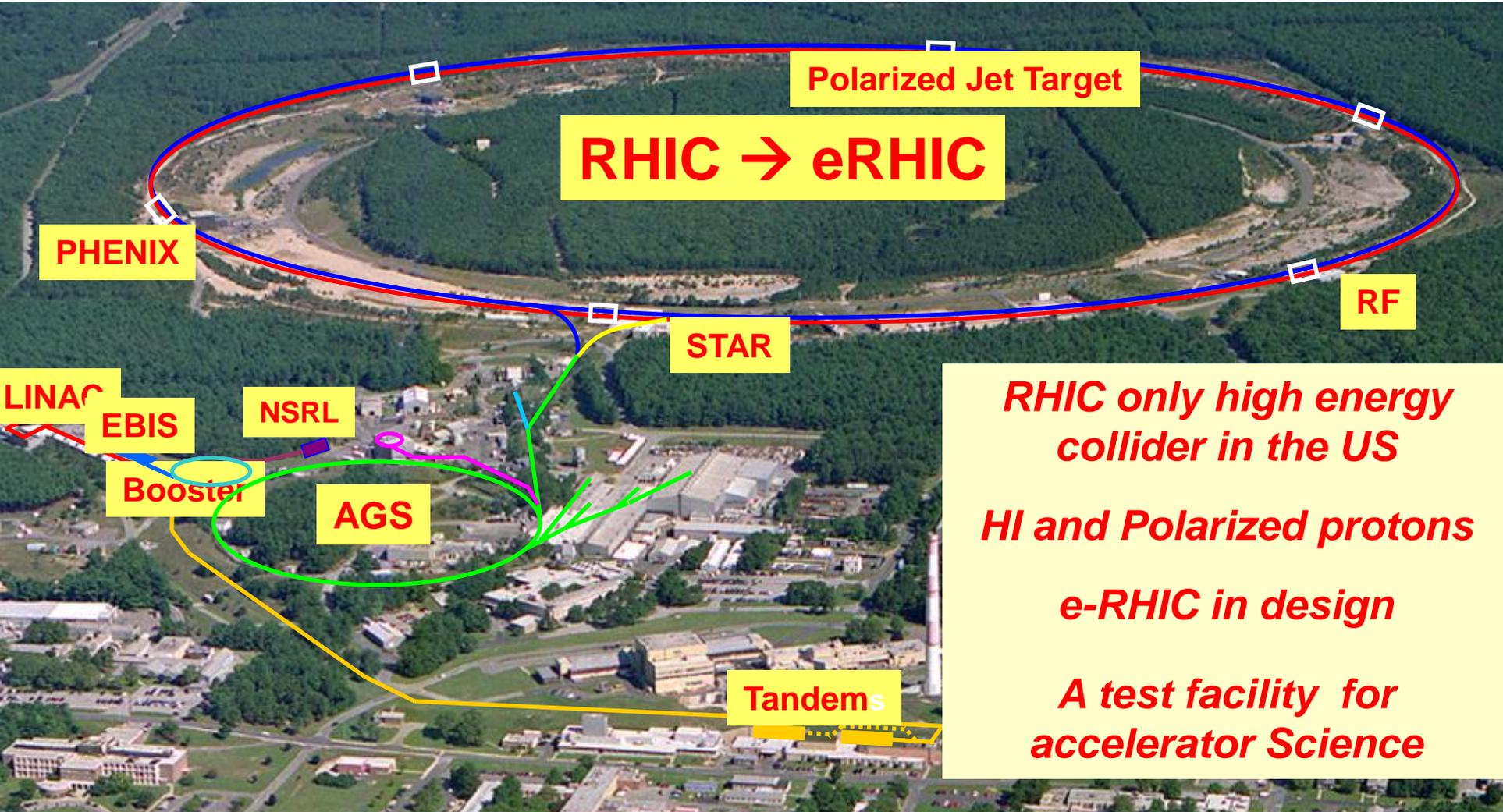
- **HEP Computing dominated by ATLAS Tier I – synergy with RHIC computing.**
  - Largest and most successful ATLAS Tier 1. (8M CPU walltime hours/month, ~8PB disk space)
- **Maintain leadership in Facilities and distributed computing**
  - Provide peta- to exascale computing and storage capacities and performance to HEP (and NP) programs
- **PanDA** production and distributed analysis (nM jobs/day)
- **Green Computing**
- **Lattice QCD:** Long history of developing dedicated hardware in collaboration with RBRC, Columbia, IBM, U Edinburgh.

## HEP Computing at BNL

Colors: HEP  
Grey: non-HEP



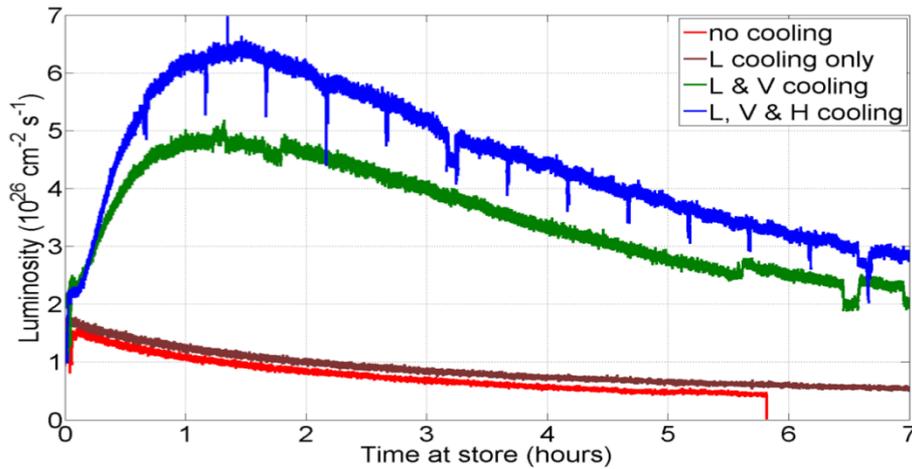
# Accelerator Science- CAD



**LARP** –  $Nb_3Sn$  strand cable, Large Quadrupoles, Crab cavities, Accelerator Science.

**ILC** – IR SC magnets, Machine Detector Interface,

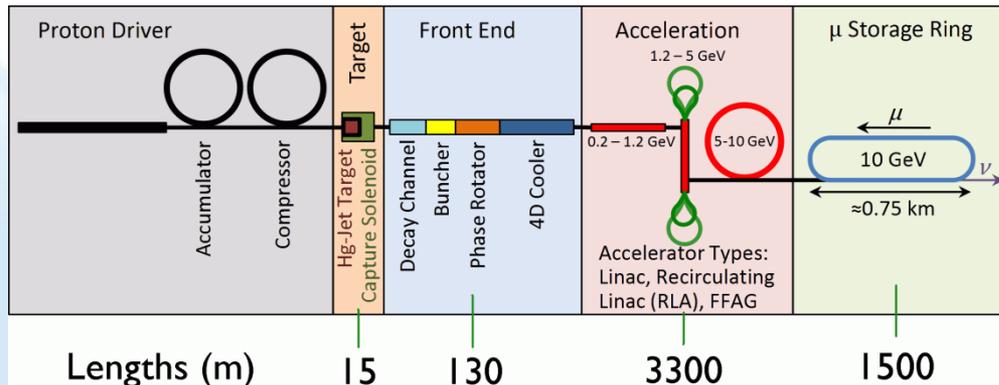
# Accelerator Science & Technology at BNL



1<sup>st</sup> 3D Stochastic Cooling in a Collider  
 Note: Luminosity Increase!!

- **RHIC:**
  - Beam cooling techniques (Stochastic CeC)
  - ERL design and test
- **ATF: Accelerator Test Facility.**
  - Users facility
  - e-beam experimental program
  - Fast CO<sub>2</sub> laser interactions with beams and targets.
- **MAP:**
  - Muon collider design
  - High power targetry

## MAP – $\nu$ Factory, $\mu$ Collider



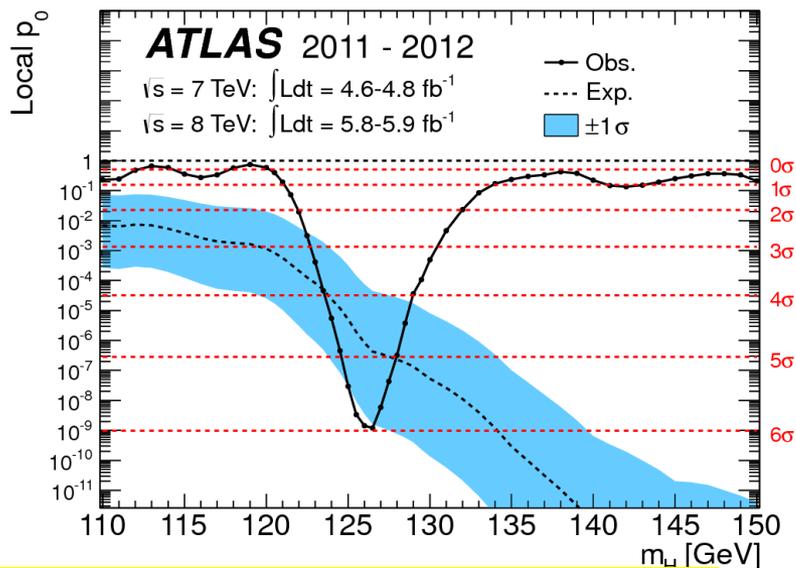
Collaboration with industry on  
 medico, energy and defense  
 applications.

# Conclusion BNL Roles in HEP

***Vibrant HEP program that is well aligned with the National priorities and is well represented in the three frontiers.***

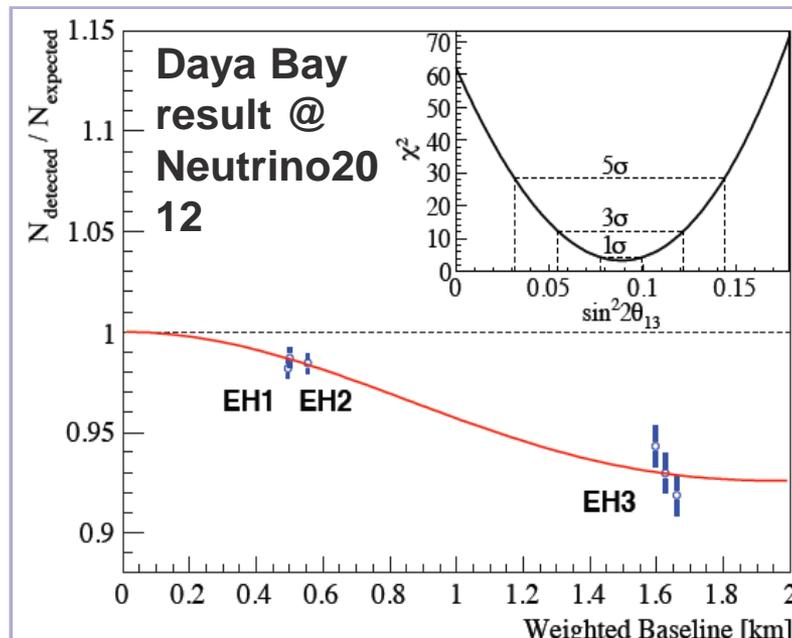
- ***Program leverage and builds on the synergy and strength of a multidisciplinary Laboratory:***
  - ***Strong Instrumentation Division supporting state-of-the-art technology. (LAr calorimeter & TPC, ASIC development, Si /CCD)***
  - ***Synergy with RHIC only operating high energy collider in the U.S. with extensive experience and strong ongoing advanced accelerator design.(superconducting (incl. HTS) magnets, high-power fast-pulsed lasers for acceleration, Crab cavities, SRF)***
  - ***High-performance computing capabilities (RHIC-ATLAS Computing Facility, New York Blue, LQCD work)***

# 2012 has been a good year!!



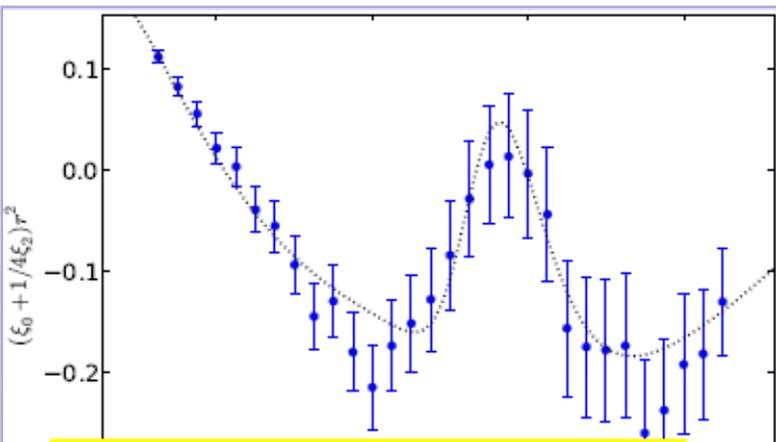
**New Boson at 126 Gev**

**Daya Bay - Large  $\sin^2 2\theta_{13}$**



$\sin^2 2\theta_{13} = 0.089 \pm 0.010$  (stat)  $\pm 0.005$  (syst)

**BNL had leadership roles in major discoveries at the three frontiers in 2012.**



**BOSS Preliminary**

**High-z BAO peak via forest absorption**

**ATLAS – New Boson at 126 GeV**