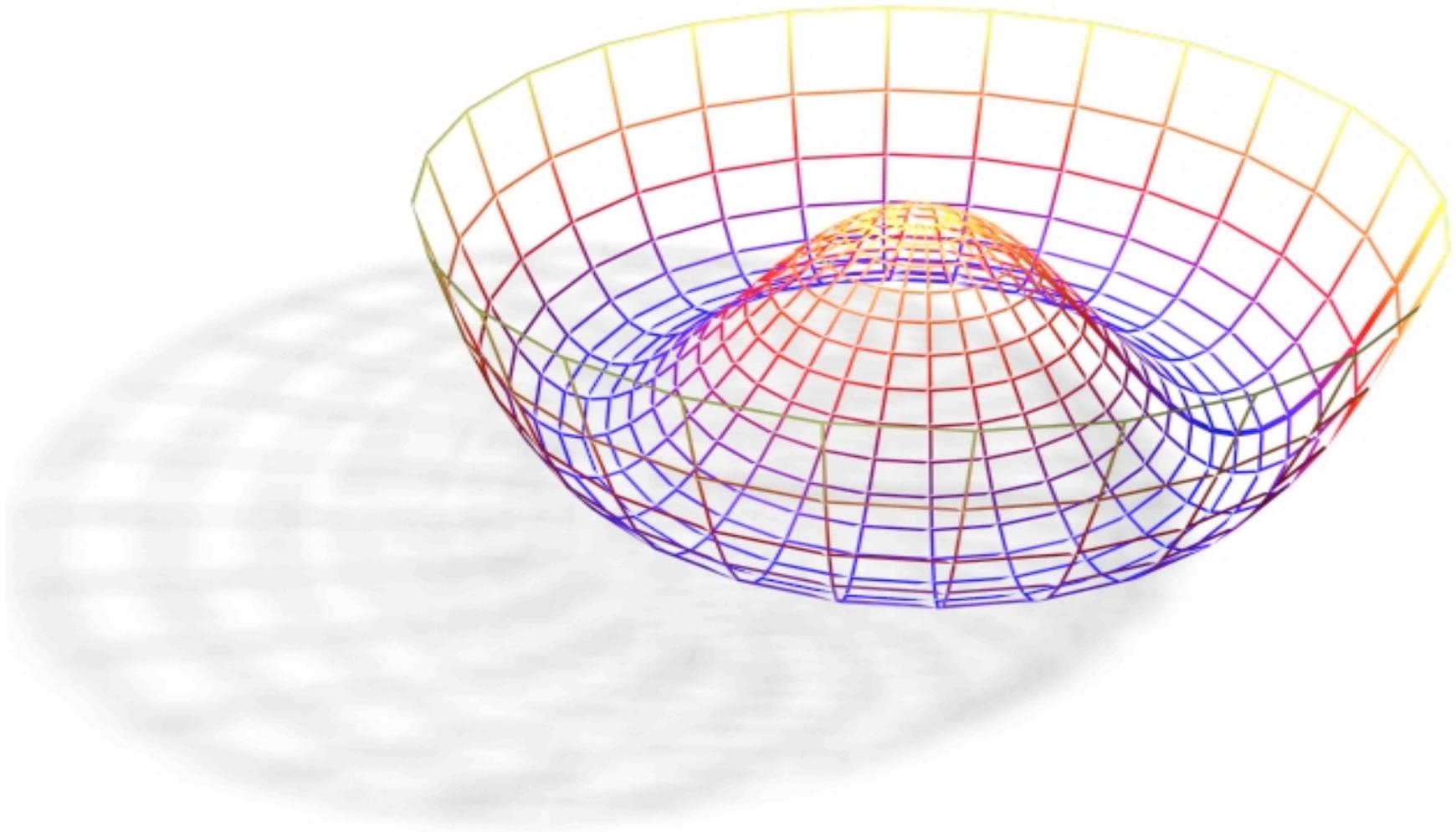


# *BNL's role in ATLAS physics*



This talk will review BNL's involvement in Atlas Physics

Physics topics and highlights from ongoing analyses

BNLs growing role within the ATLAS High Level Trigger

New activities within the lab

BNL's role in Analysis Support

- ▶ The Analysis Support Center
- ▶ Analysis Jamborees
- ▶ Our role in the Analysis Forums

## Invited plenary talks at international conferences

- ▶ Kyle Cranmer, “Impact of Early Higgs Discovery on ILC”, LHC/ILC Interplay, Fermilab, 2007
- ▶ George Redlinger, “Physics Beyond the Standard Model with ATLAS”, La Thuile, 2007
- ▶ David Lissauer, “Status and Plans of the ATLAS”, Jacksonville APS 2007
- ▶ Kyle Cranmer, “The ATLAS Analysis Model”, at HCP, 2007
- ▶ Kyle Cranmer, “Statistical Challenges of LHC Physics”, PhyStat 2007
- ▶ Ketevi Assamagan, “Discovery Prospects of the LHC”, Dallas APS, 2006
- ▶ Arthur Moraes, “SUSY at the LHC”, LISHEP 2006

## Heavy Ion Program

- ▶ Pavel Nevski, “Heavy Ion Physics with ATLAS”, SQM 2006
- ▶ Peter Steinberg, “The ATLAS Heavy Ion Program”, QM 2006
- ▶ Helio Takai, “Quarkonium Physics with ATLAS Heavy Ions”, HQWS 2006
- ▶ Helio Takai, “Hard Probe capabilities of ATLAS”, Hard Probes 2006

In addition, numerous talks in ATLAS overview and Trigger & Physics weeks

ATLAS is in the process of a Computing System Commissioning (CSC), which will produce a broad range of “CSC Notes”

- ▶ they are aimed at assessing our sensitivity to early physics and exercising our current reconstruction and analysis software

## BNL editors of CSC notes

- ▶ Arthur Moraes: **Jets and Minimum Bias**
- ▶ Denis Damazio: **Electron/Photon Reconstruction in the High Level Trigger**
- ▶ Scott Snyder: **EM Cluster Corrections**
- ▶ Kyle Cranmer: **Vector Boson Fusion Higgs to Tau Tau**
- ▶ Frank Paige: **Inclusive SUSY Searches**
- ▶ Hong Ma & Sriniraj Rajagopalan: **overseeing calorimeter performance notes**

In addition to the CSC Note editors, BNL is actively involved in several other CSC Notes:

## Tau Performance

- Abid Patwa, Adam Cunha, Kyle Cranmer

## Muon Performance

- David Adams

## ttbar backgrounds to inclusive searches & QCD backgrounds to inclusive searches

- George Redlinger

## VBF Higgs to Tau Tau

- Abid Patwa, Adam Cunha, Fabien Tarrade, Kyle Cranmer

## W/Z+Jets

- Kyle Cranmer & George Redlinger

## Single Top Production

- Ketevi Assamagan

## Charged Higgs Searches

- Ketevi Assamagan

## Di-Bosons

- Hong Ma

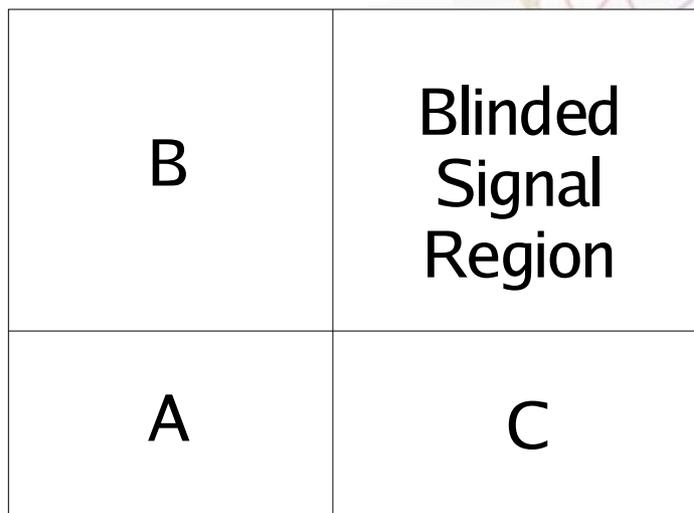
# Physics Highlights

# SUSY Background Determination

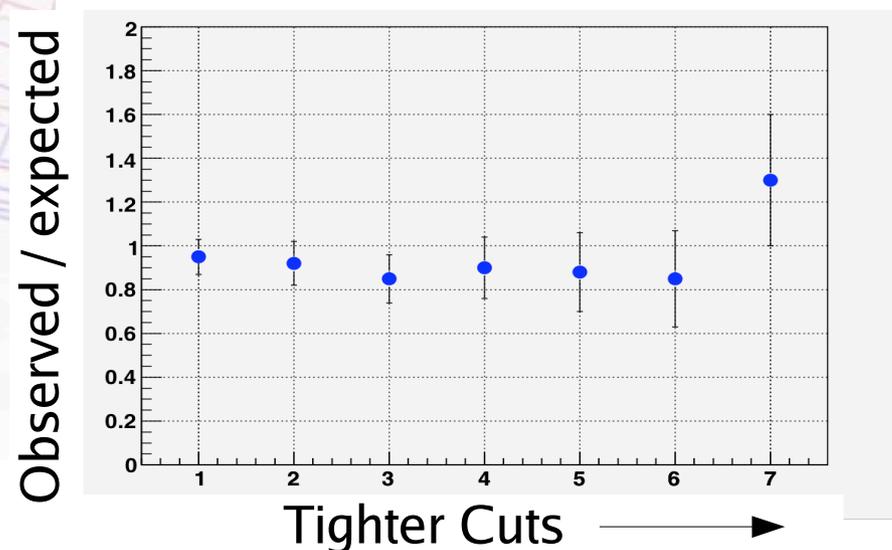
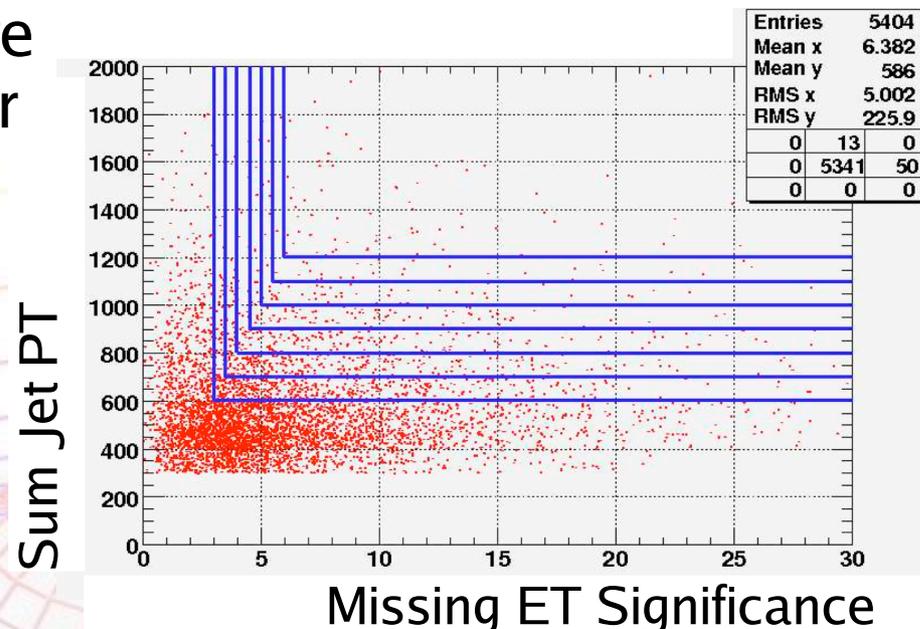
George Redlinger is exploring alternate methods to determine backgrounds for inclusive SUSY searches

Identify two uncorrelated variables

Use “double-side-band method” to extrapolate to signal region

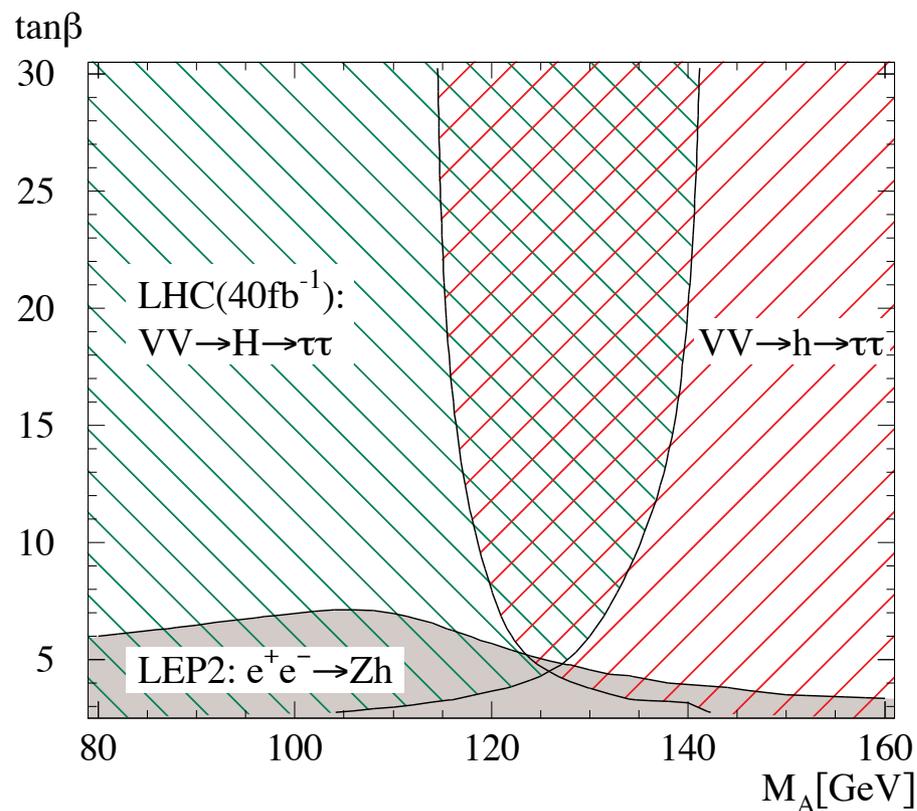
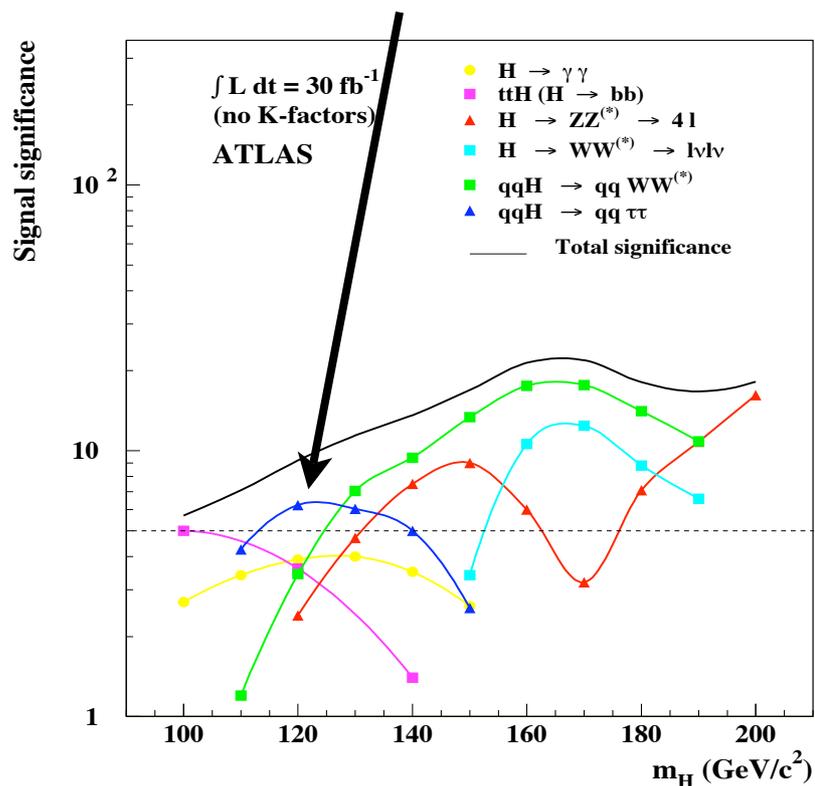
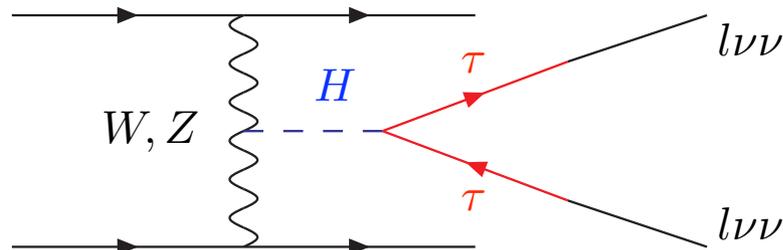
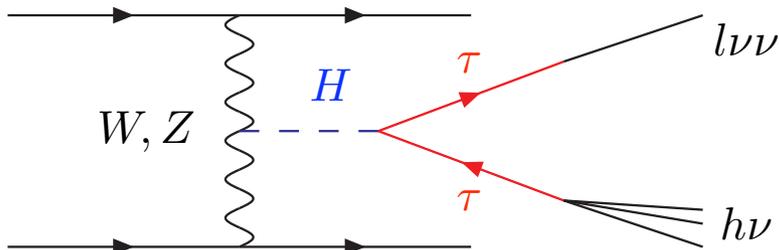


Background in Signal Region =  $C \times B / A$



**Data-driven methods are an over-arching theme**

# Vector Boson Fusion $H \rightarrow \tau\tau$



Standard Model (Atlas Scientific Note)

Plehn, Rainwater, Zeppenfeld hep-ph/9911385

Most powerful channel near LEP limit and very important for MSSM.

Kyle Cranmer is the co-editor of the CSC note on the subject

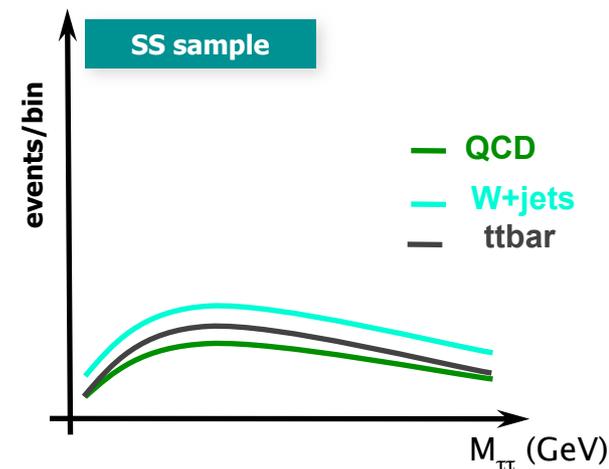
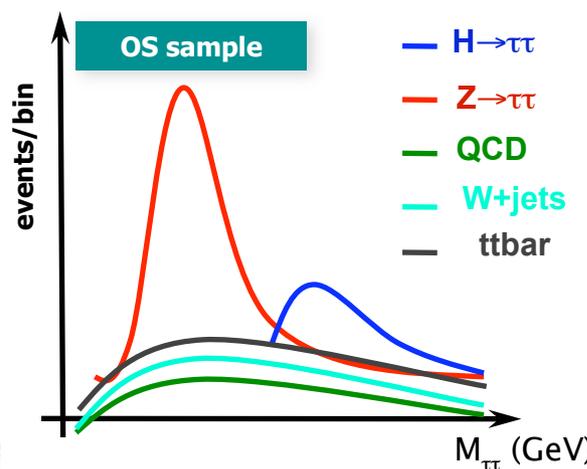
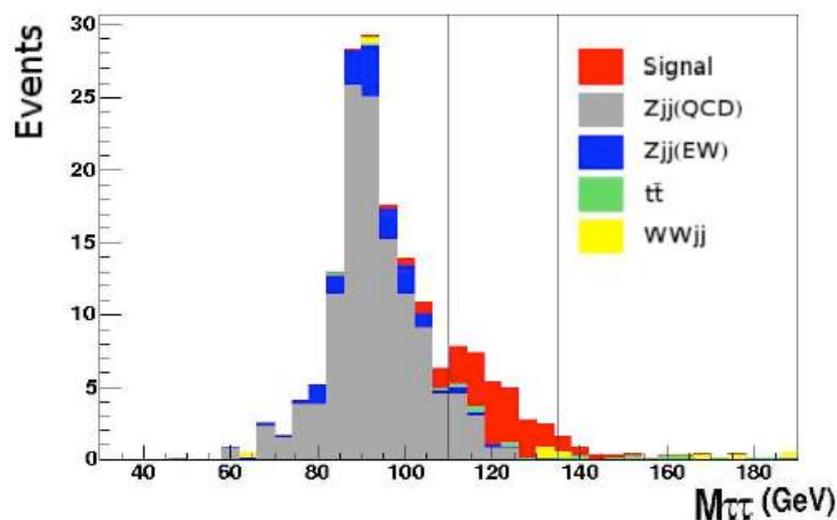
- ▶ The note has 42 contributors from 13 institutions

BNL has taken an active role in this channel

- ▶ Fabien Tarrade just joined BNL as a postdoc
  - he worked on this analysis for his thesis
- ▶ Abid Patwa just joined BNL's Atlas efforts
  - he brings expertise from  $Z \rightarrow \tau\tau$  measurements at D-Zero
- ▶ Adam Cunha's contributions are also being included in the CSC note on tau performance
  - presenting work at tau performance meeting in Poland
- ▶ Kyle Cranmer has been active in the note for several years
  - developing new techniques for mass measurement

We are developing a comprehensive strategy for estimating our backgrounds

- ▶ Dominant  $Z \rightarrow \tau\tau$  background estimated from  $Z \rightarrow ee/\mu\mu$
- ▶ Same-Sign sample sensitive to QCD+(W+jets)+ttbar
  - independent methods for QCD & W+jets individually
  - Need to understand relative contribution of ttbar background with real & fake tau
- ▶ Over-constraining the system allows us to study systematics

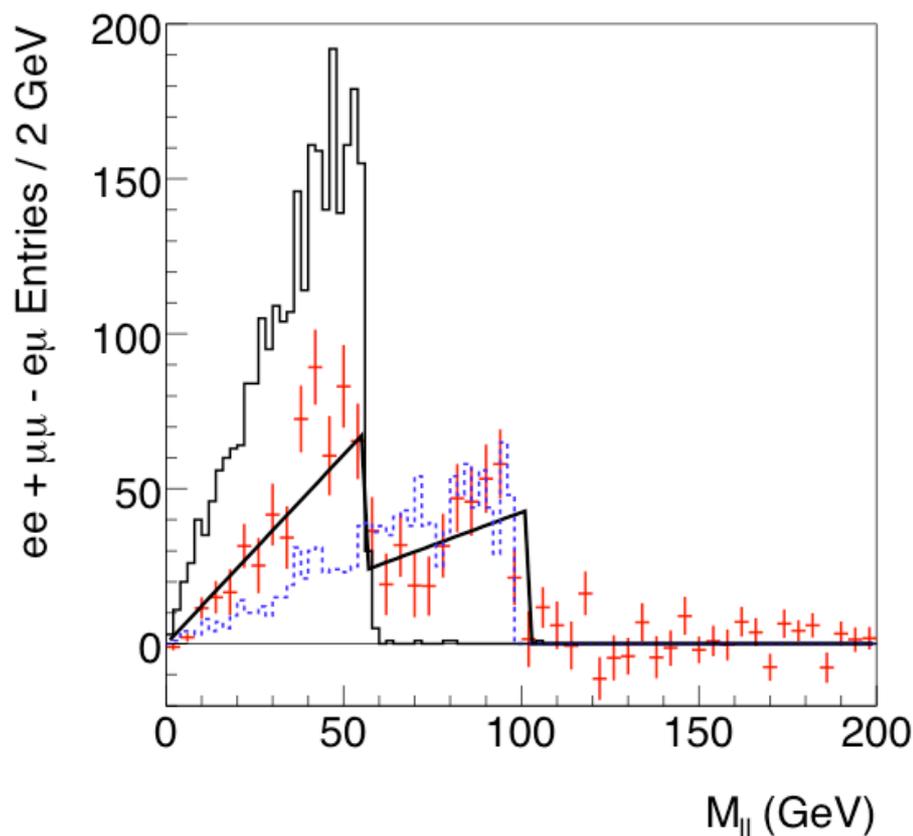


## Endpoint Analysis for Coannihilation Point

Frank Paige continues to be a leader in the effort to determine SUSY parameters from data

Cascade decay  $\tilde{\chi}_2^0 \rightarrow \tilde{\ell}^\pm \ell^\mp \rightarrow \tilde{\chi}_1^0 \ell^+ \ell^-$  gives endpoint at

$$M_{\ell\ell}^{\max} = \frac{1}{M_{\tilde{\ell}}} \sqrt{(M_{\tilde{\chi}_2^0}^2 - M_{\tilde{\ell}}^2)(M_{\tilde{\ell}}^2 - M_{\tilde{\chi}_1^0}^2)}$$



Enhance edges via “flavor subtraction”

Observe expected edges at 58 and 100 GeV

Low efficiency with respect to MC truth (in black), needs work.

The Analysis Object Data (AOD) is a format of the ATLAS data that will be used for physics analysis and distributed to the Tier 2s.

- BNL has led the effort in developing the AOD classes for electrons, photons, muons, taus, and jets
- This has been done in close collaboration with combined performance groups and physics analysis groups

In addition to the AOD classes, BNL has led the effort in developing tools for physics analysis:

- The “Event View” is an analysis helper with a powerful toolkit for performing complex analysis tasks
- The “ATHENA-Aware Ntuple” provides convenient access in ROOT while maintaining compatibility with the framework
- Distributed analysis tools like PANDA

ATLAS held its first Statistics Workshop this January:

- ▶ review current practices and challenges
  - combinations, systematics, blind analysis, “look elsewhere effect”
- ▶ Kyle Cranmer presented recent developments in the treatment of systematics and RooStats initiative

After the meeting:

- ▶ George Redlinger addressed potential for blind analysis in SUSY searches
- ▶ ATLAS statistics forum was formed, Kyle appointed as an expert

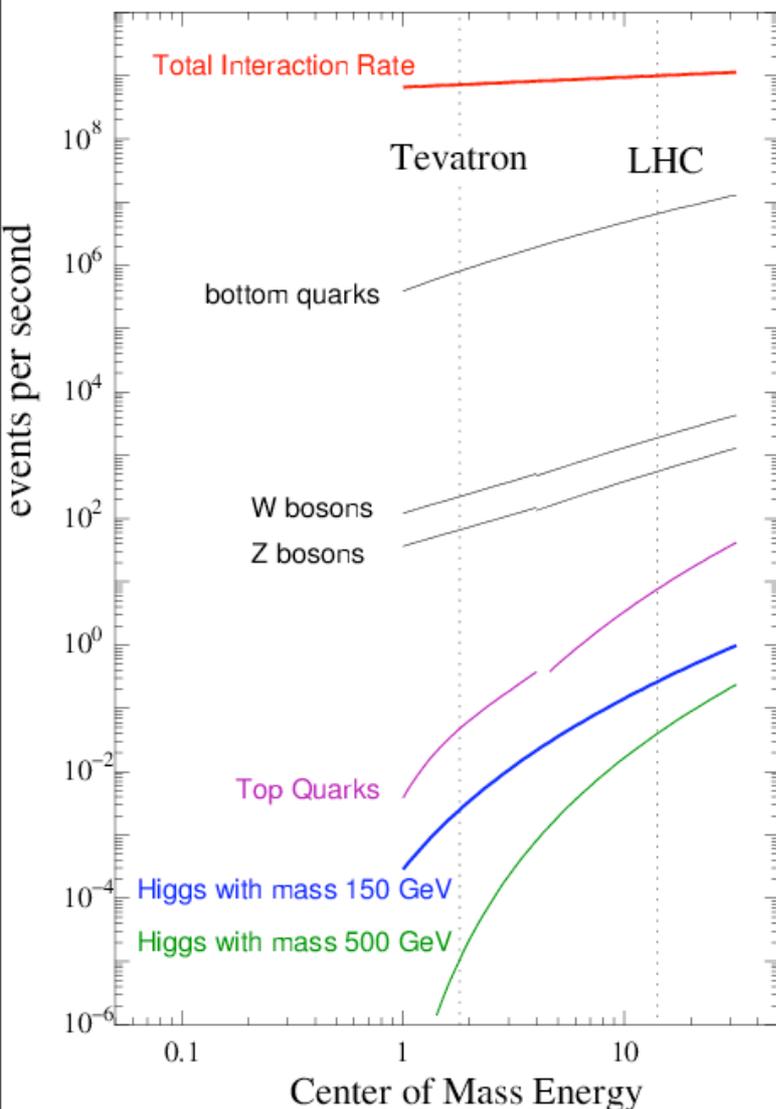
There is growing support for a joint ATLAS/CMS statistics committee and the development of common tools

- ▶ Kyle was invited to present RooStats at the Root users workshop

PhyStat 2007 organized for this summer at CERN

Only about 1 in 500,000 events will be stored to disk

The Trigger is a vital part physics program



- ▶ Kyle Cranmer, co-coordinator of Jet/Tau/Etmiss in the High Level Trigger
- ▶ George Redlinger, Active in trigger rate estimates and trigger menu studies for SUSY
- ▶ Abid Patwa, Joining tau effort in High Level Trigger
- ▶ Sriniraj Rajagopalan, Coordinating Trigger Menus
- ▶ Denis Damazio, Electron & Photon trigger algorithms and low-level data access

Early this year we organized a joint theory/experiment meeting at BNL

- ▶ an effort to catalyze the interaction between BNL's experimental group and the theoretical expertise at BNL and Stony Brook

This has led to experimental talks at the theory lunch seminar

- ▶ Kyle Cranmer on Higgs searches and statistical methods
- ▶ George Redlinger on ATLAS SUSY searches

Expect to incorporate more theoretical interaction in upcoming Analysis Jamborees at BNL

The Brookhaven Forum a further example of this interaction

## 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 Rastelli (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



**BROOKHAVEN**  
NATIONAL LABORATORY

Consider the physics potential of the LHC, the ILC, and their synergy

## US-ATLAS Analysis Forum Conveners

- Kyle Cranmer: Trigger Forum Convener
- Frank Paige: Beyond the Standard Model Convener

## BNL is a US-ATLAS Analysis Support Center

- Hong Ma: BNL Support Center Coordinator

## US-ATLAS Analysis Support Group Contacts

- Ketevi Assamagan: Physics Analysis Tools
- Tadashi Maeno: Distributed Analysis
- Alex Undrus: Software Support

**Srini Rajagopalan: US-ATLAS L2 Software & Analysis Support Manager**

BNL started a series of Analysis Jamborees to go beyond basic tutorials. Nearly a full week long, the emphasis is on physics and participants come with specific goals in mind

- ▶ Trigger Aware Analysis, BSM Physics, CSC Notes
- ▶ roughly 25 participants in each of the Jamborees

Since the introduction of the idea, other support centers have picked up the idea

- ▶ two at Argonne
- ▶ two at LBNL
- ▶ one at SLAC



BNL Continues to play an active role in analysis within ATLAS

Our focus is on preparing for analysis with real data

- commissioning, reconstruction, calibration, and trigger
- growing effort in physics analysis & data-driven methods

Dedicated effort to leverage local theoretical resources

As an analysis support support center

- BNL introduced concept of Analysis Jamborees
- provide expertise for support groups & analysis forums

We eagerly anticipate data taking in 2008