Discovery and the QuarkNet Data Portfolio

or:

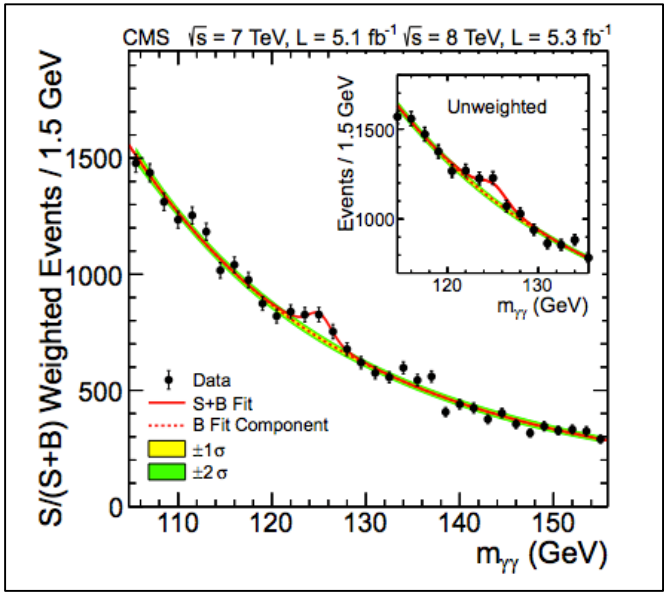
Discovering discovery before a discovery is discovered. (Got that? Good!)

Kenneth Cecire, University of Notre Dame

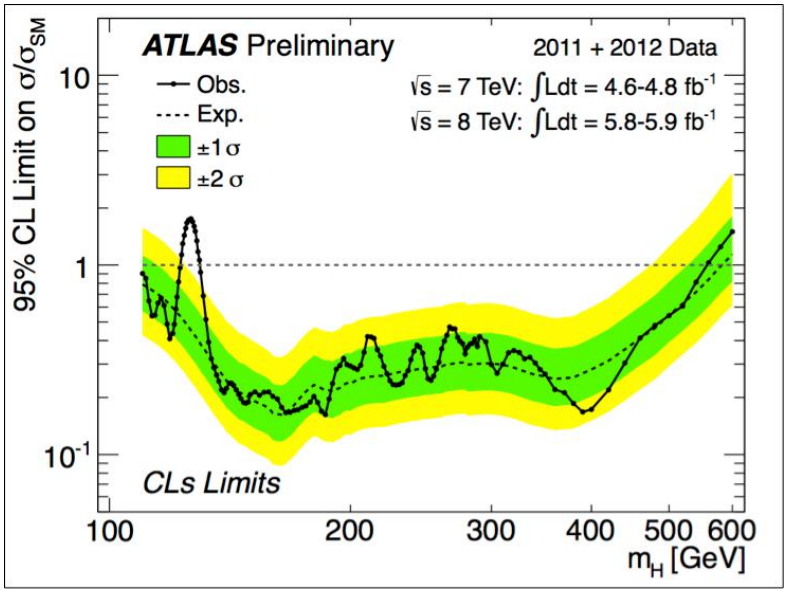
Ramp-up to Discovery

Too late.

- The announcement is not the time to ramp up.
- Prepare students and teachers *before* discovery.



Huh?



Huh?

Data Portfolio

Help is available.

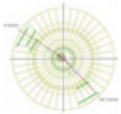
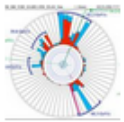
- One activity can make a difference.
- Long-term engagement can make a big difference.
- QuarkNet Data Portfolio: https://quarknet.i2u2.org/data-portfolio

QuarkNet

Data Portfolio

Filter Activities

Data Strand: <Any>
Level: <Any>
Next Generation Science Standards (NGSS): <Any>
Apply
Topic: <Any>

Activity Name	Data Strand	Level	NGSS Practices	Topic
 Calculate the Z Mass (0 comments) Students use conservation laws and vector addition to calculate the Z mass from event displays.	LHC	Level 1	1 4 5 7	Data Analysis, Momentum Conservation
 Plotting LHC Discovery (0 comments) Students explore features of mass plots of a well-understood particle and apply what they have learned to plots from new discoveries.	LHC	Level 1	4 6 7	Data Analysis, Momentum Conservation
 Calculate the Top Quark Mass (1 comment) Students use conservation laws and vector addition to calculate the top mass from event displays.	Cosmic Ray, LHC	Level 1	1 4 5 7	Data Analysis, Momentum Conservation
 Quark Workbench (0 comments) Students use Standard Model rules to build hadrons and mesons from quarks.	Cosmic Ray, LHC	Level 1	2 6	Particle Composition

Create Content

Add Activity

Recently Read

- CMS Data Express
- Rolling with Rutherford
- TOTEM Data Express
- CMS e-Lab
- Plotting LHC Discovery
- Calculate the Z Mass
- Calculate the Top Quark Mass

Plotting LHC Discovery

Activity to connect to particle discovery

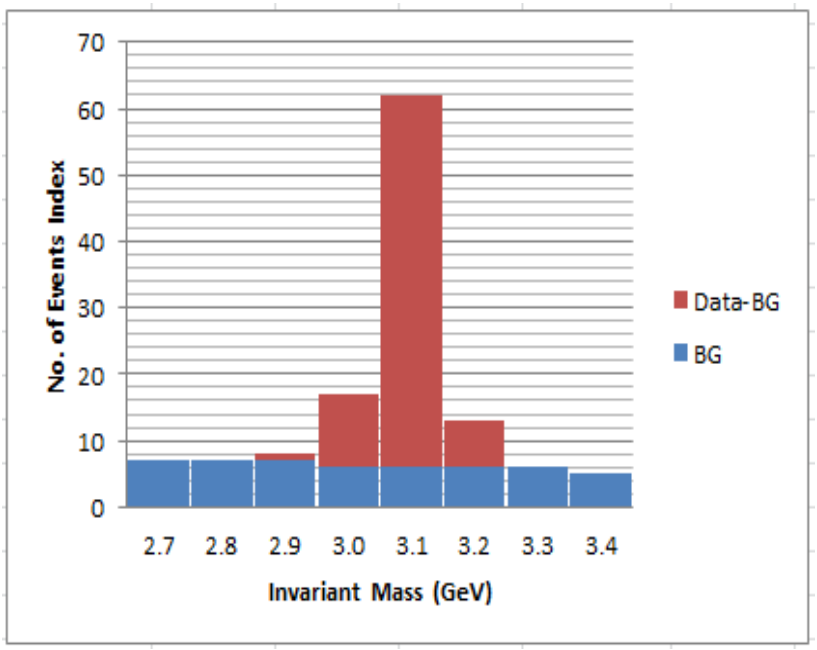
- Start: J/Ψ mass plot with background
- Connection: B_s and B_0 meson decay rates in LHCb and CMS
- Bonus: Pentaquarks in LHCb!

PLOTTING LHC DISCOVERY
INTERPRET THE LATEST FROM LHC.

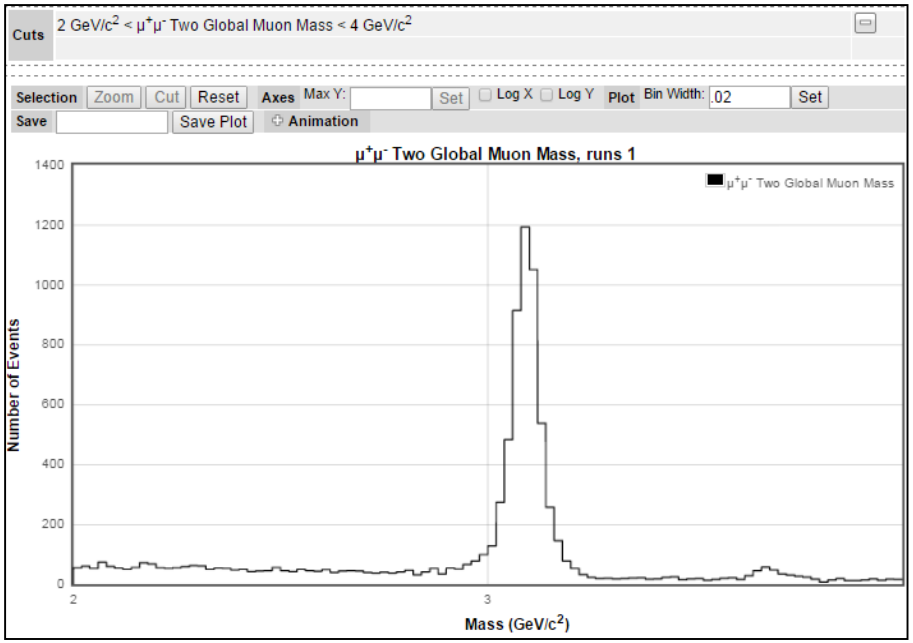
mass (GeV)	bg model	data	data-bg
2.7	7	7	0
2.8	7	7	0
2.9	7	8	1
3.0	6	17	11
3.1	6	62	56
3.2	6	13	7
3.3	6	6	0
3.4	5	5	0

Let's build it!

Plotting LHC Discovery



Our result

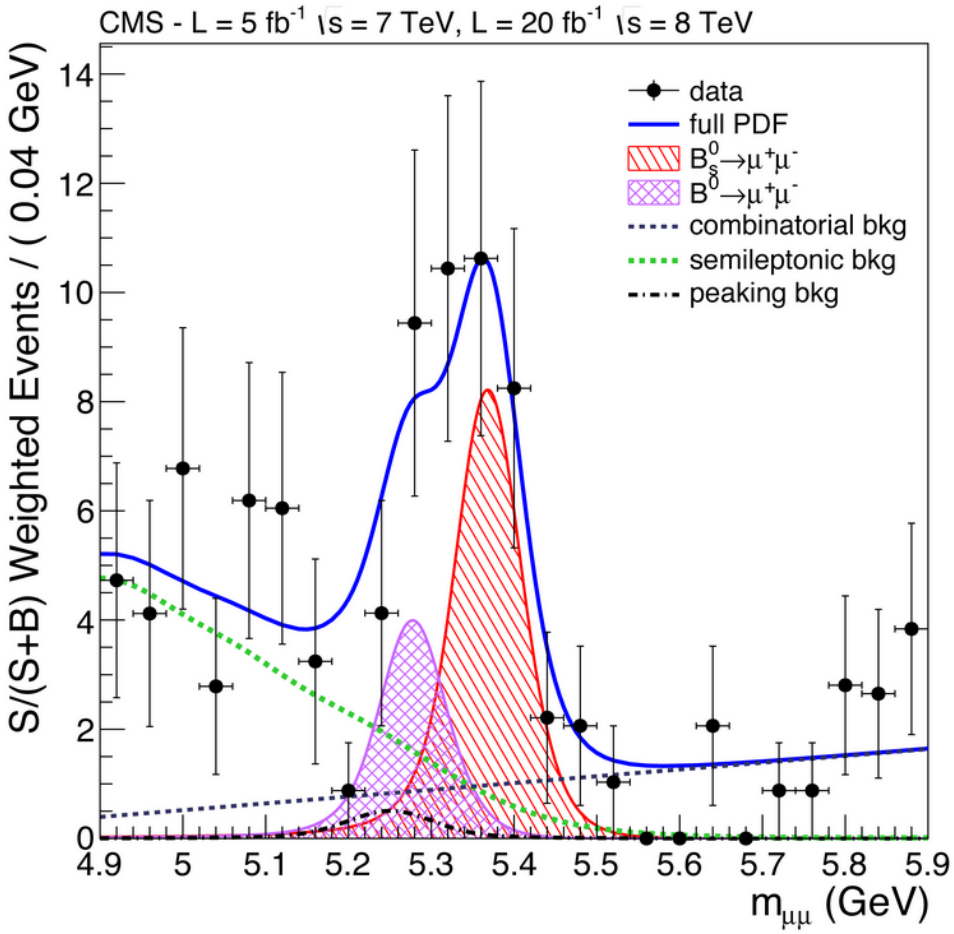


CMS e-Lab result

Rare B Decays

Evaluating a result:

- What might a student see and understand?
- What might they miss?
- What can a physicist explain?



Pentaquarks

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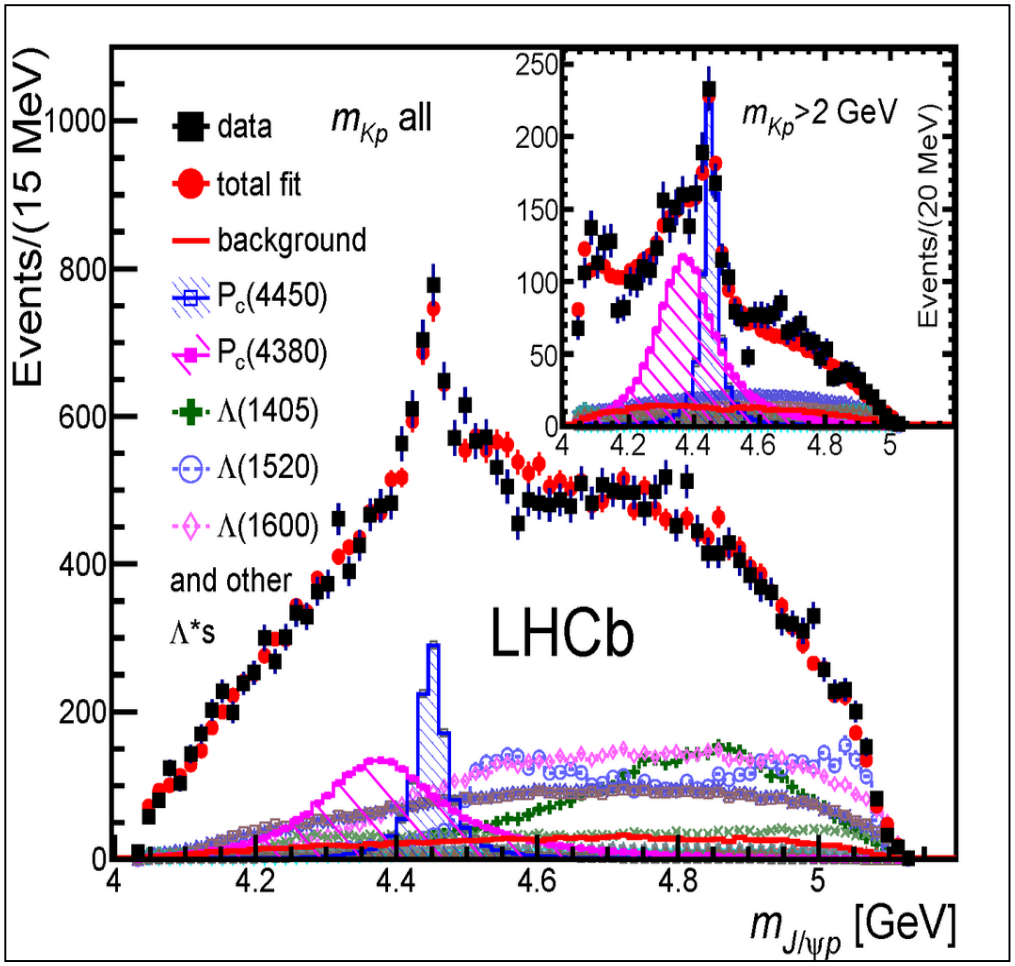
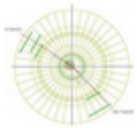
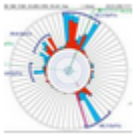


Data Portfolio



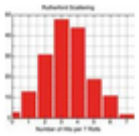
Calculate the Z Mass (0 comments)

Students use conservation laws and vector addition to calculate the Z mass from event displays.



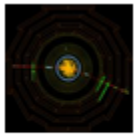
Calculate the Top Quark Mass (1 comment)

Students use conservation laws and vector addition to calculate the top mass from event displays.



Rolling with Rutherford (1 comment)

Students use statistics to make an indirect measurement they can easily confirm.

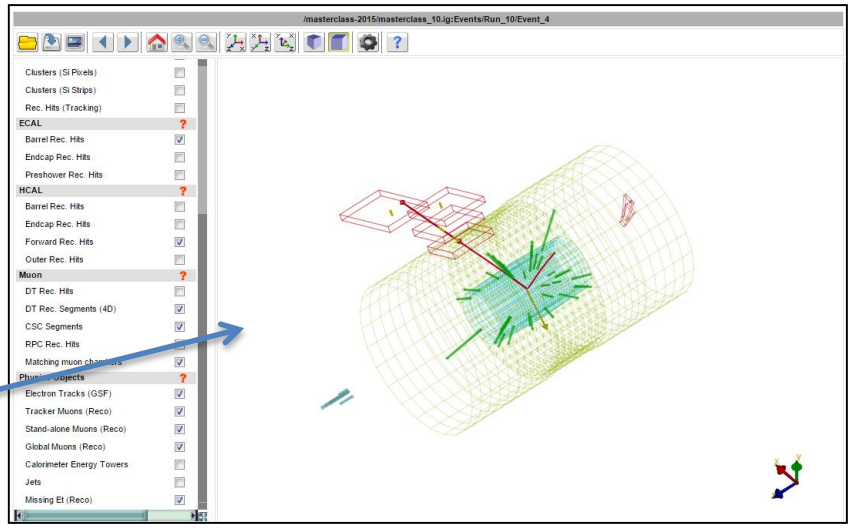


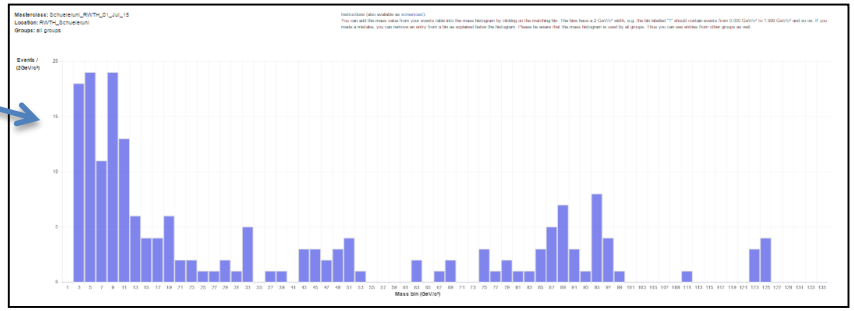
CMS Masterclass (0 comments)

Students are physicists for a day at a university or lab where they work with physicists to learn how to analyze real particle physics data in the form of event displays.

CMS e-Lab (0 comments)

Students have an opportunity to learn how to analyze data to calibrate the CMS detector and participate in discovery science (as particle physicists do).





The End . . . or Just the Beginning

Learn more:

- https://quarknet.i2u2.org
- kcecire@nd.edu

Thanks!

ATLAS masterclass!