RESPONSIBLE CONDUCT OF RESEARCH

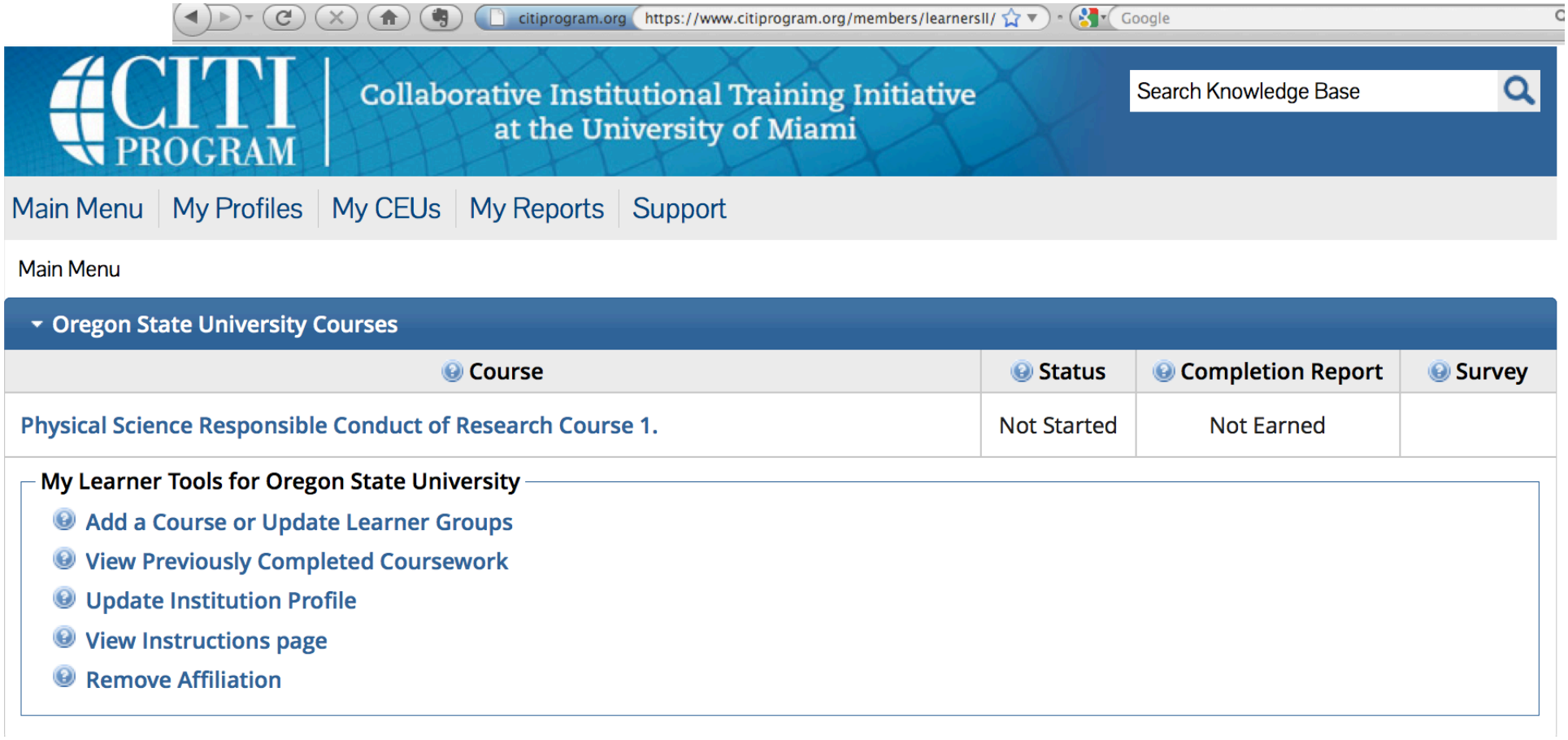
4/14/15

Heidi Schellman - Oregon State Physics

Responsible Conduct of Research

- NSF funded postdocs and students are required to take an RCR course
- Online component – modules with quizzes
  - https://www.citiprogram.org/
  - Takes about 20 minutes/module
  - Print out your final page and give to Kelly so that we have a record of completion.
- In person component – this course
    - 1 PM on Fridays
  - Faculty and other students are welcome to join us and participate

https://www.citiprogram.org/



Modules

Required Modules		
	Date Completed	Score
Responsible Conduct of Research (RCR) Course Introduction (ID: 1522)	Incomplete	0/0 (0%)
Research Misconduct (RCR-Basic) (ID: 16604)	Incomplete	0/0 (0%)
Data Management (RCR-Basic) (ID: 16600)	Incomplete	0/0 (0%)
Authorship (RCR-Basic) (ID: 16597)	Incomplete	0/0 (0%)
Peer Review (RCR-Basic) (ID: 16603)	Incomplete	0/0 (0%)
Mentoring (RCR-Basic) (ID: 16602)	Incomplete	0/0 (0%)
Conflicts of Interest (RCR-Basic) (ID: 16599)	Incomplete	0/0 (0%)
Collaborative Research (RCR-Basic) (ID: 16598)	Incomplete	0/0 (0%)
Responsible Conduct of Research (RCR) Course Conclusion (ID: 1043)	Incomplete	0/0 (0%)

Some resources if you are concerned about academic integrity

- People you trust in your group or elsewhere
- Dept – Chair, Kelly, Erin, Graduate advisor
- Office of Research Integrity
  research.oregonstate.edu/ori
- Technically I'm the official person you report to

Classic Scientific method

- Form hypothesis
- Test it
  - For consistency with existing knowledge
  - Via experiment
  - Publish with sufficient details to reproduce it
- Iterate

Exploratory method

- Get to a new regime
  - See what's new
  - Then explain it…

Basics

- A scientific observable
  - Measurable
  - Verifiable
  - Reproducible
- Can you verify and reproduce your result?
- Can you quantify the uncertainty?
- Can others verify and reproduce your result?

9 Data Acquisition, Analysis and Management

Before you start taking data

- Think about experiment design
- Get appropriate safety and IRB permissions
- Assemble the equipment, materials and people you need to do the experiment

- If a theorist, read the literature!

Data taking

- Keep a notebook – either online or on paper
  - Must be permanent – ink and special software
  - You can't modify entries, only comment on them
- Describe your work, write down data not logged electronically
- Record calibrations, batch #s, who is doing it and other relevant auxiliary information
- If human subjects are involved make certain that you maintain anonymity.

Data preservation

- Save your data
- Back up your data
- Back up your data in several places
- Catalog your data so you can remember where you put it.

- Example:
  - Data_2015_01_02_Run_II_uncalibrated_v07.dat

Method preservation

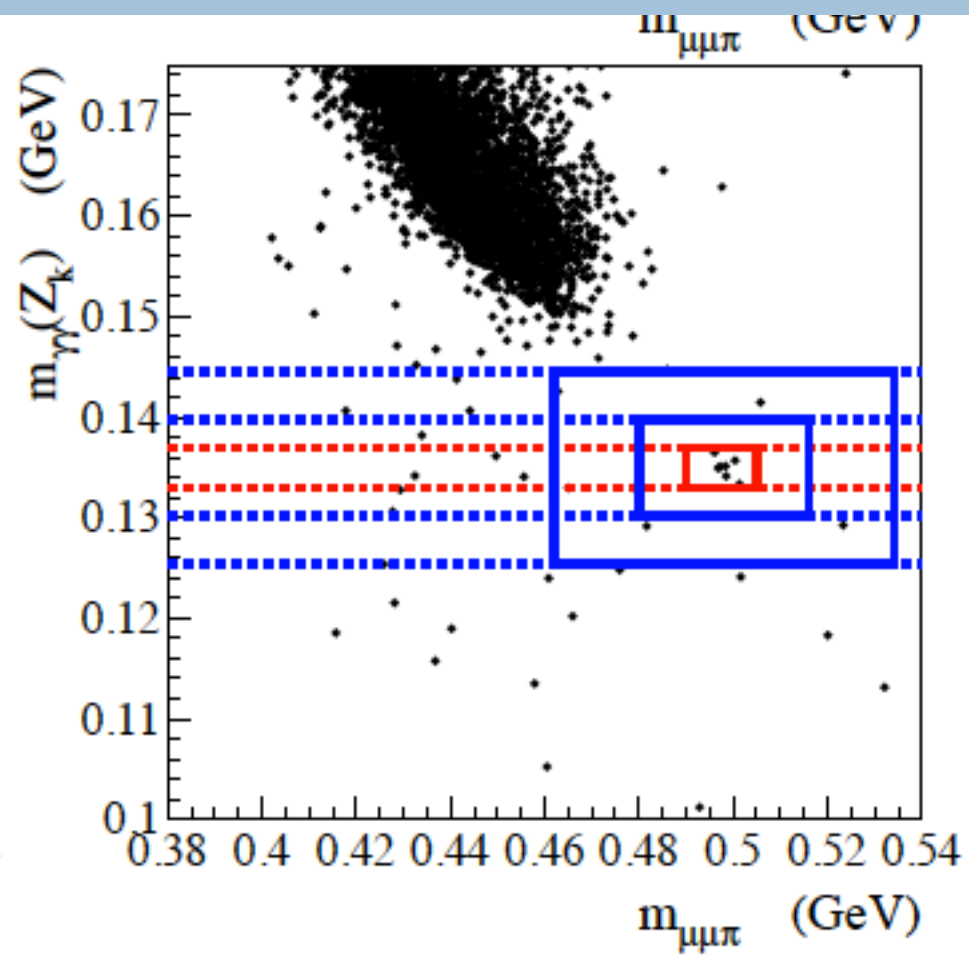
- Log software used, including version and modifications
- Best practice is to keep your software in a repository such as CVS or git and make certain you know the version you used for any data run.

Data analysis

- Use all data unless you have a very good reason for rejection
- Best practice is to determine data selection criteria before looking at the data.

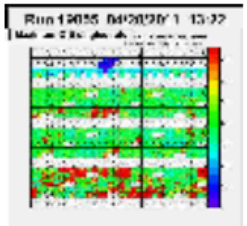
Blinded analysis (T. Fonseca NU 2005)

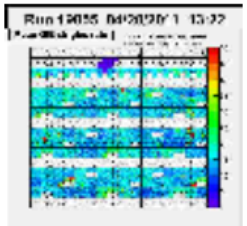
- Looking for $K \rightarrow \mu\mu\pi^0$
- Huge background
- Study everything for the blue control regions
- Only look in red area once all is understood



18298, Benjamin Ziemer (bziemer), 04/20/2011 17:23:14 Shift_Notes

The "Maximum QIE singles rate" plot for Minos looks odd due to a high values of the rates especially for crates 6 and 7. However the "Mean QIE singles rate" plot looks fine. I have attached these plots.





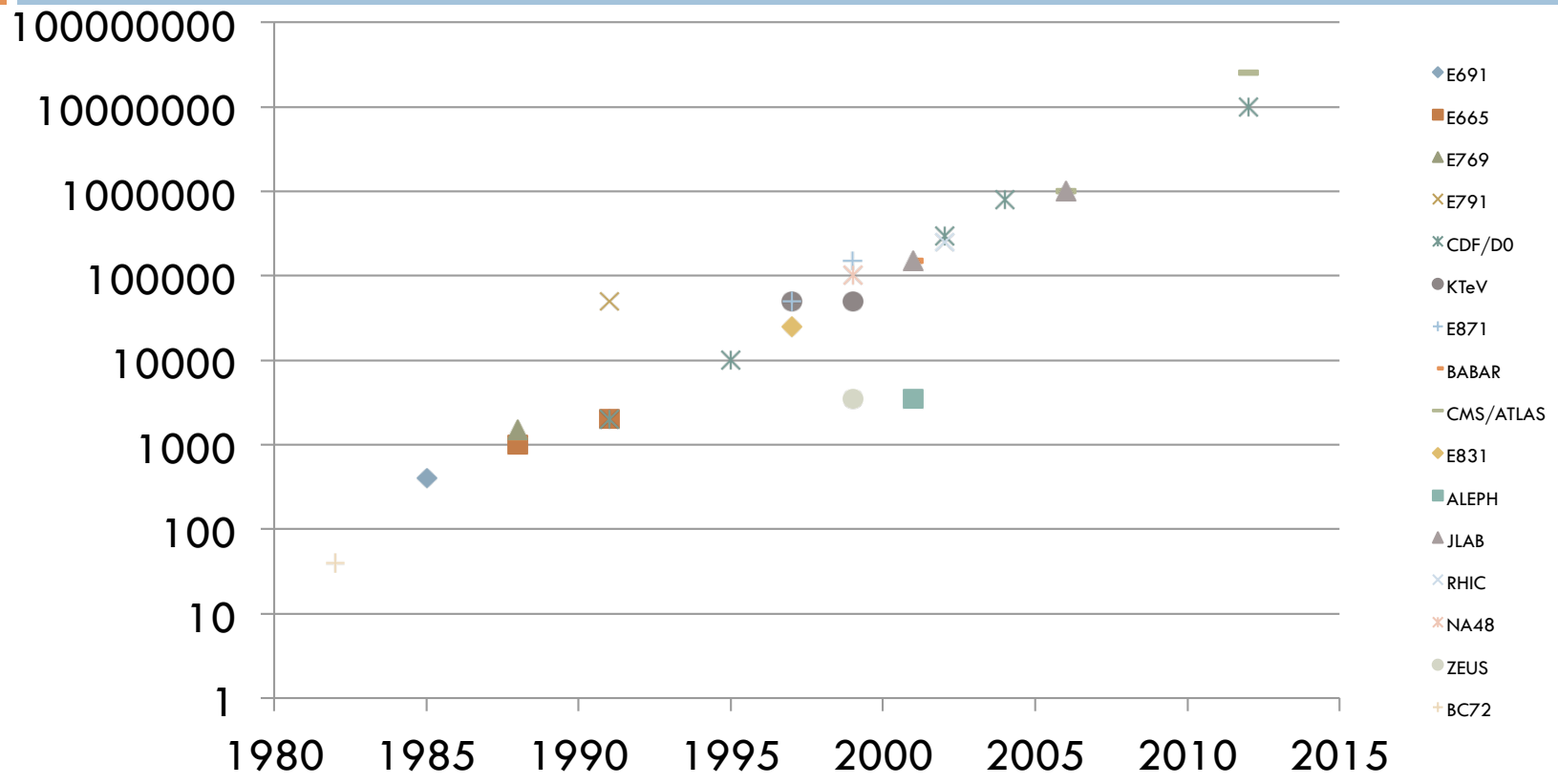
18278, Leo Aliaga (laliagasoplin), 04/19/2011 23:04:42 Shift_Notes

Form:	**ShiftForms/MINERvA_End_Shift**
Shifter 1:	Leo Aliaga
Shifter 2:	none
Beam up time:	8
Avg beam intensity:	15.7E12
good beam runs:	3100/17- 3101/8
good pedestal runs:	3101/1 numip
good MaxPE LI runs:	run 3100 and 3101 were numi beam and LI runs
good OnePE LI runs:	and 3101 were numi beam and LI runs
good other runs:	
Hardware problems:	

What I do with data

- 10 Petabytes of data
  - Cataloged in database, stored on tape
- Several million lines of code
  - In CVS repository – use tagged versions for official work
- Calibrations
  - In database – with version tags where possible
- Job control
  - Tagged versions for official work
- Goal is ability to reproduce a result

Data Volume per experiment (in Gbyte)



Some of these are guesses, some predictions prior to data runs. But they are not too far off.

STORAGETEK
STORAGETEK
STORAGETEK
STORAGETEK

Newer server farms

What can I do at OSU?

- Back up your machines. Best practice is to have major backups offsite.
- Use Cosine or departmental data and computing facilities – 10 GB FREE on the T drive!
- Very important – make certain you can find your data!
  - Label files
  - Note in logbook
- Make your data as available as reasonable
  - Share with collaborators now
  - Assume you may need to share with competitors after publication

When is a result a result?

Am I fooling myself?

- Honest but avoidable mistakes are much much more common than malfeasance

- See a pattern in the data – is it real?

Statistics

- Sportscaster: Player X does great against left-handed pitcher, he's had a 10 game hitting streak!
- What are odds that a player who gets a hit in ½ his games has just had a 10 game hitting streak against left handers?
  - 1/1024
- How many players are there in MLB? ~ 750
- Odds of a 10 hit streak due to random noise are pretty high.

Moral

- At any time someone will have a "streak" of 10 games due to something.
- **All you have to do is find the guy with the streak and then find out what makes him unique. Might be night games, games in Cleveland, games with Mom present …**
- You can't just look at the streak
- You have to consider how many 'experiments' you did before you saw an interesting result.
- In this case the sportscasters see the random streak and then try to match a behavior to it.

Design experiment to avoid fooling yourself

- Study control samples like “magnet off”
- Generate simulated data and see how often you see a signal
- If you “know” what you’re looking for, hide the signal region and understand the data before you look in that region.
- Get new data or only study subsamples first
- Make certain others have information to reproduce your result.
- Do a thorough error analysis so that you can quote uncertainties.

Conclusions

- Do it right… document document document
- Don't lose your work … backup backup backup
- Do it again… if you can
- Make certain others can check your results

- Trust no one – especially yourself

You can't fool Mother Nature

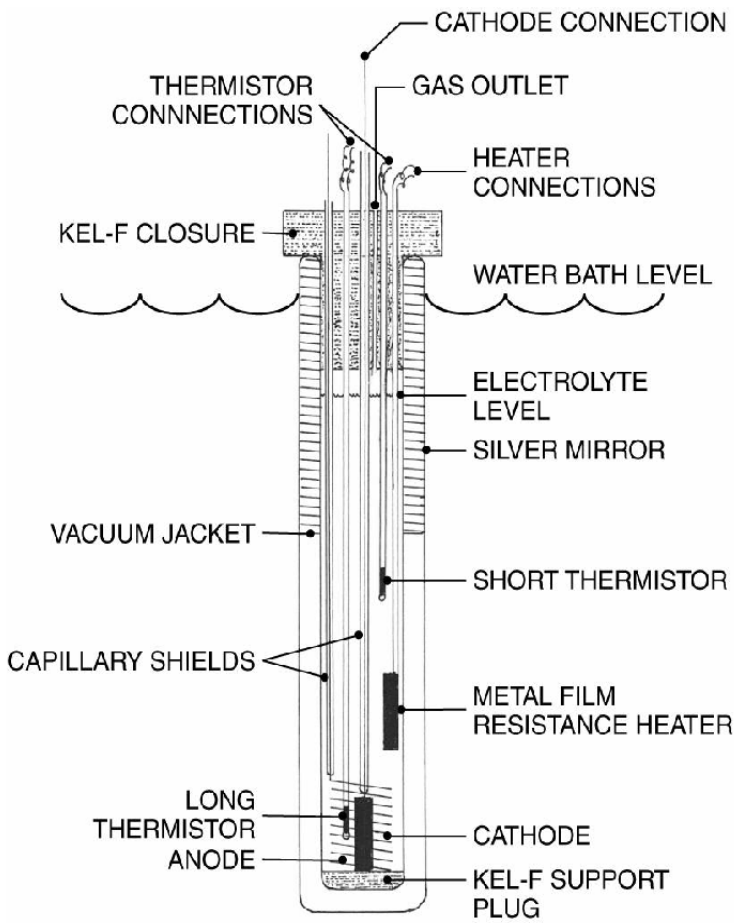
- In the long run you can't lie in physics
- Can't keep your story straight
- Mother Nature will find your out sooner or later

Case studies in physics

- Cold fusion (1989)
- Element X (2002)
- Schoer (2002)
- Premature Higgs (2011)

1989

- Pons and Fleischmann announce Cold Fusion
- Electrolysis of heavy water
- Deuterium enters palladium cathode
- See temperature rise
- Detect fusion products like Helium in water



Show the movie

- https://www.youtube.com/watch?v=8M0i2fh8lGI

Big press conference

Motivations

- Stanley Pons and Martin Fleischmann are not quite ready to report
- But other groups may also be seeing something
- University Tech transfer people push them to get there first!
- And it all goes downhill from there

Not consistently reproducible

- Stephen Jones (Brigham Young) sees slight neutron excess
- John Bockris Texas A&M sees tritium
- Nathan Lewis (Caltech) sees nothing
- General consensus that no fusion is occuring
- Probable cause
  - Liquid not mixed leading to hot spot near thermometer
  - Helium was probably naturally occurring
  - Neutron counters were crude
- Legitimate experimental errors

What made it bad?

NY Times May 3, 1989

"Many speakers at the meeting reported failure in their efforts to elicit information or comments from Dr. Pons. "

"Pons would never answer any of our questions," Dr. Lewis told an audience of 1,800 physicists, "so we asked Los Alamos National Laboratory to put our questions to him instead, since they were in touch with him."

NY Times **June 15, 1990**

"The response of the A&M researchers and administration to these concerns was limited at best," the magazine said. "Instead of taking positive steps to guard their results against fraud, Bockris and his co-workers principally offered arguments as to why they thought fraud was unlikely, sometimes exaggerating their case in the process."

Much worse
outright fabrication in nuclear physics

Element 118 discovered

VOLUME 83, NUMBER 6 PHYSICAL REVIEW LETTERS 9 AUGUST 1999

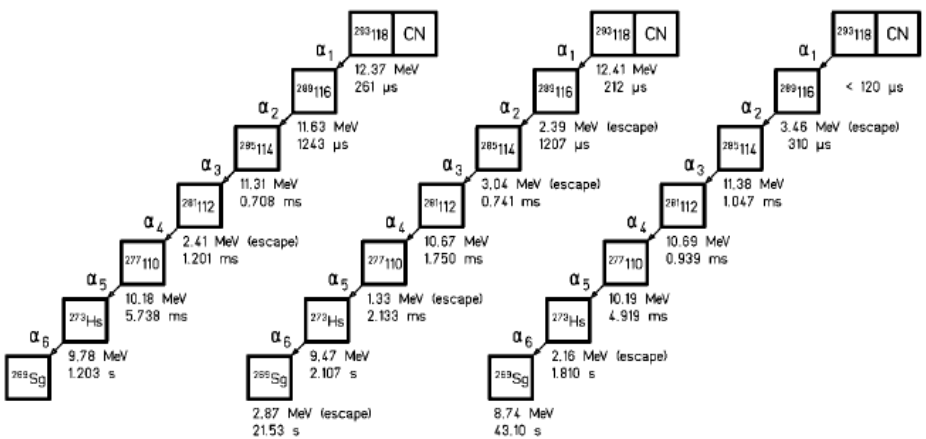
Observation of Superheavy Nuclei Produced in the Reaction of ^{86}Kr with ^{208}Pb

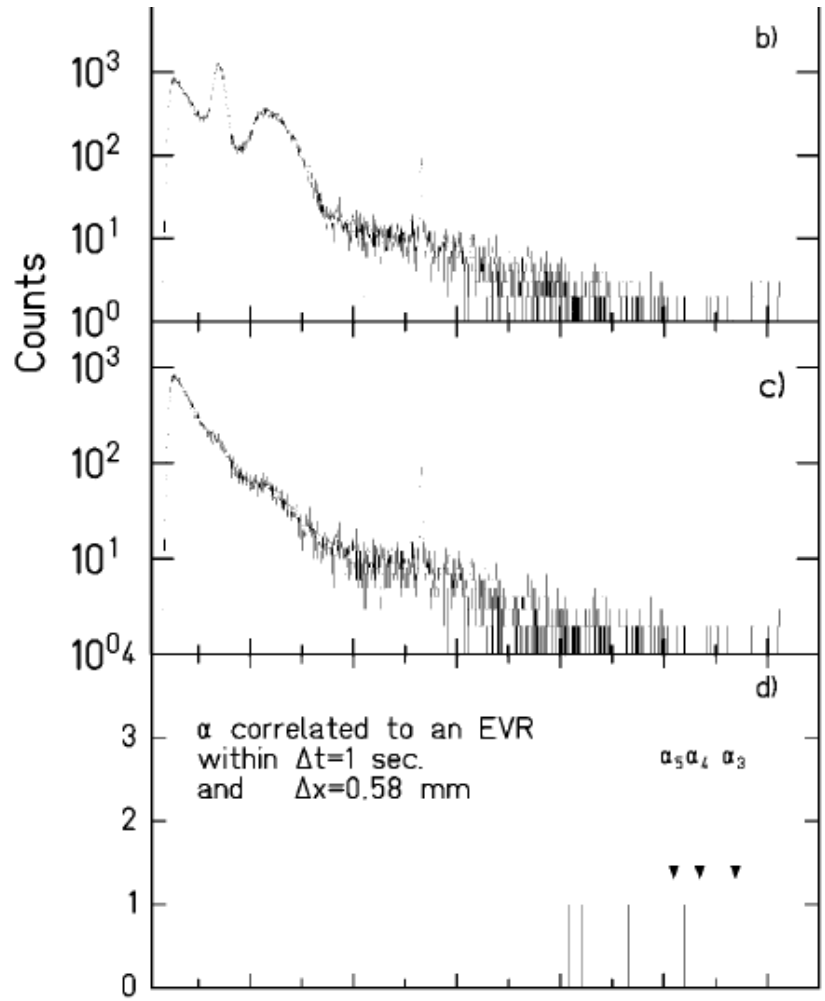
V. Ninov,[1] K.E. Gregorich,[1] W. Loveland,[2] A. Ghiorso,[1] D.C. Hoffman,[1,3] D.M. Lee,[1] H. Nitsche,[1,3] W.J. Swiatecki,[1] U.W. Kirbach,[1] C.A. Laue,[1] J.L. Adams,[1,3] J.B. Patin,[1,3] D.A. Shaughnessy,[1,3] D.A. Strellis,[1] and P.A. Wilk[1,3]
[1]*Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720*
[2]*Department of Chemistry, Oregon State University, Corvallis, Oregon 97331*
[3]*Department of Chemistry, University of California, Berkeley, California 94720*
(Received 27 May 1999)

yclept.ucdavis.edu/course/280/Ninov_Yashar.pdf has an interesting longer version

See element 118 through cascade of α particles in Kr-Pb collisions

- Unusually high cross section predicted by R. Smolanczuk
- Ninov et al. see 3 decay chains in original runs





Element 118

- NY Times, July 28, 2002
- Scientists at the Lawrence Berkeley National Laboratory in California yesterday retracted a 1999 claim that they had created a new, superheavy element.
- Not only did subsequent experiments at Berkeley and other laboratories fail to reproduce the findings, but, on second look, the original data did not support the claim for the new element, with 118 protons and 175 neutrons. The heaviest element found in more than trace amounts in nature is uranium, with 92 protons.
- After the Lawrence Berkeley announcement two years ago, other laboratories tried collisions of krypton and lead atoms, but did not detect any signs of Element 118.

- "Smolanczuk suggested this strange reaction that no one thought would go," Mr. Ghiorso recalled. "But because it was relatively easy, we thought, 'What the heck, we have nothing to lose."
- Over five days in early April 1999, the experimenters bombarded a lead target with a beam of krypton nuclei. The debris from the tiny collisions passed through the gas-filled separator, and various detectors recorded the energy, position and timing of each "event."
- A result was an enormous amount of raw data that Dr. Ninov processed using software he had mastered at GSI. As the only one on the team familiar with the program, he was put in charge of the analysis.
- Then, in the spring of 2000, the Berkeley scientists tried repeating their own experiment. This time they found not a trace of element 118.
- By now Dr. Loveland had learned to use the special software. He was stunned when the team couldn't find the pattern that Dr. Ninov had reported.
- By now a third committee had scrutinized the experiments, confirming that the chains didn't exist in the raw data files.

result

- Ninov fired
- My advisor, George Trilling, says the co-authors share some responsibility in an editorial
- ***APS guidelines "all coauthors share some degree of responsibility for any paper they coauthor" and that "some coauthors have responsibility for the entire paper. These include, for example, coauthors who are accountable for the integrity of the critical data reported in the paper,[and] carry out the analysis"***

Morals?

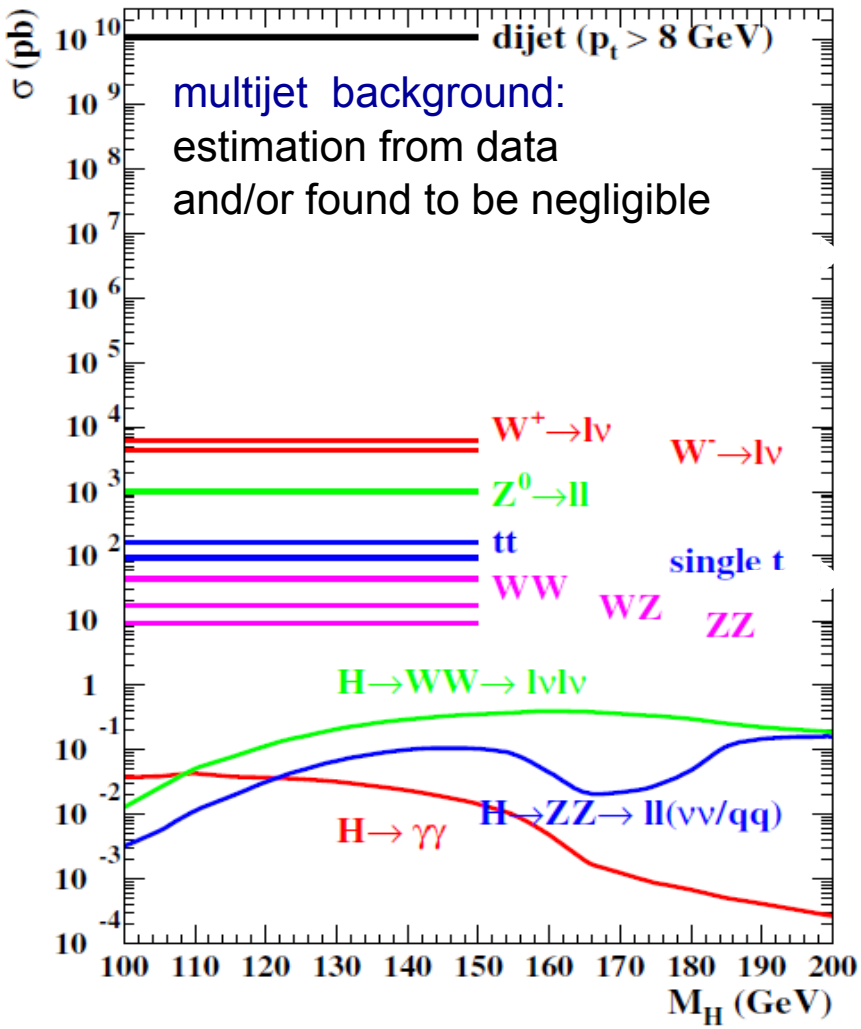
- #1 don't fabricate data
  - Co-authors on Element 118 were not diligent in evaluation the work they signed off on.
- #2 don't rush
  - Pons and Fleischmann may have been true believers, blind to problems with their work and then unable to back down.
- #3 don't take amazing new results on faith – check if you can

Avoiding misconduct

- Obvious – don't fake data yourself
- Less obvious – just because a theorist predicted it doesn't make it more true.
- Co-authors need to check each other
- You must make it possible for others to reproduce your results by being complete in experimental details and answering questions

Case study in wishful thinking

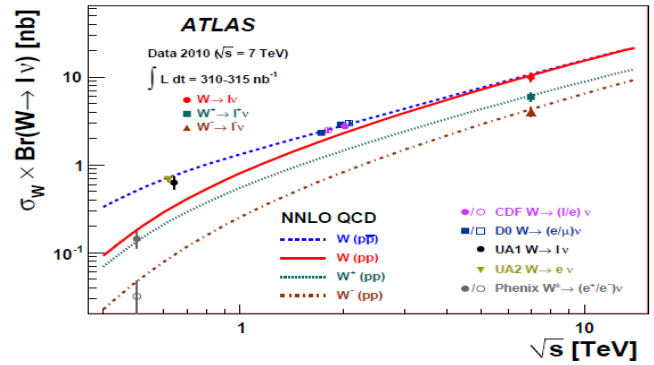
The Higgs Challenge: Tiny Signal-to-Background Ratio



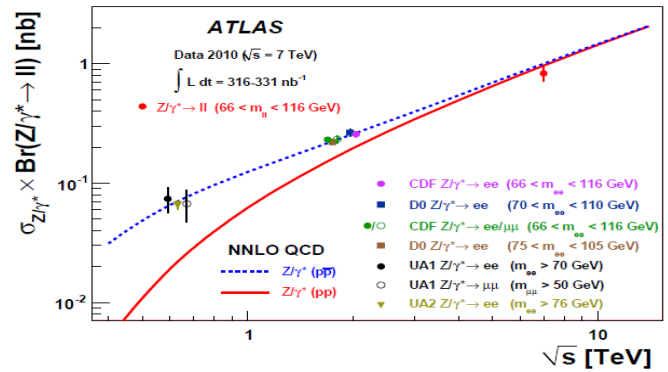
< 1 detectable Higgs boson per 10^{12} collisions

measurements of "EW" backgrounds

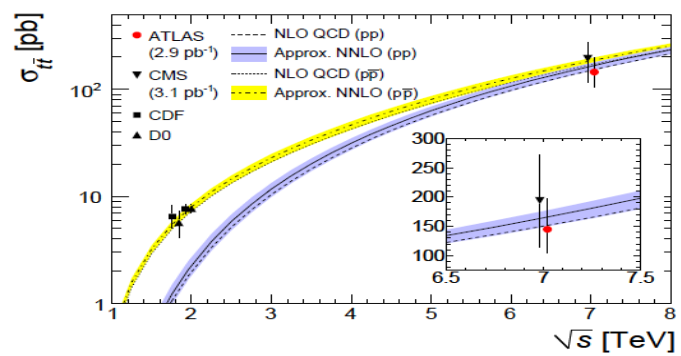
W^+, W^-



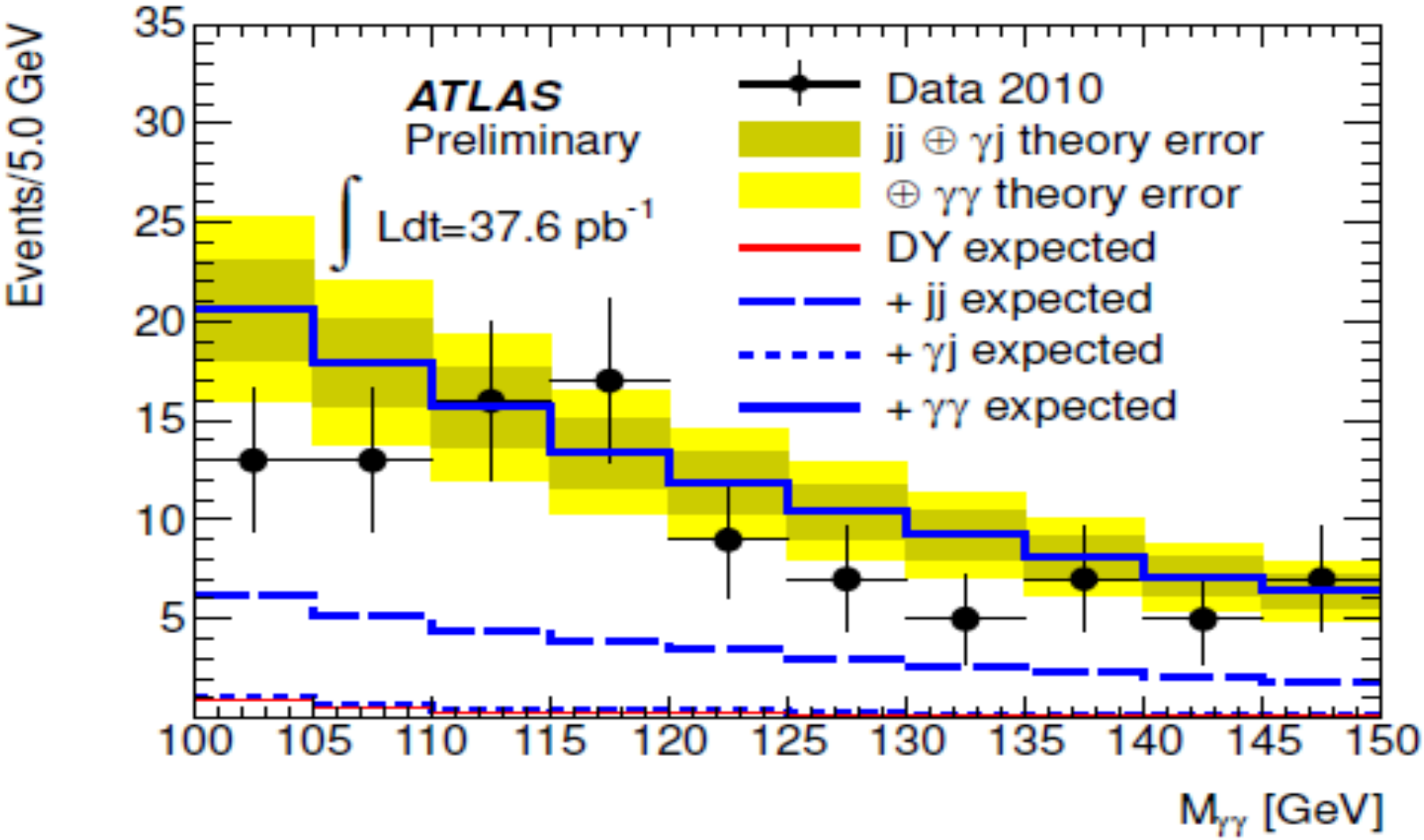
Z/γ^*



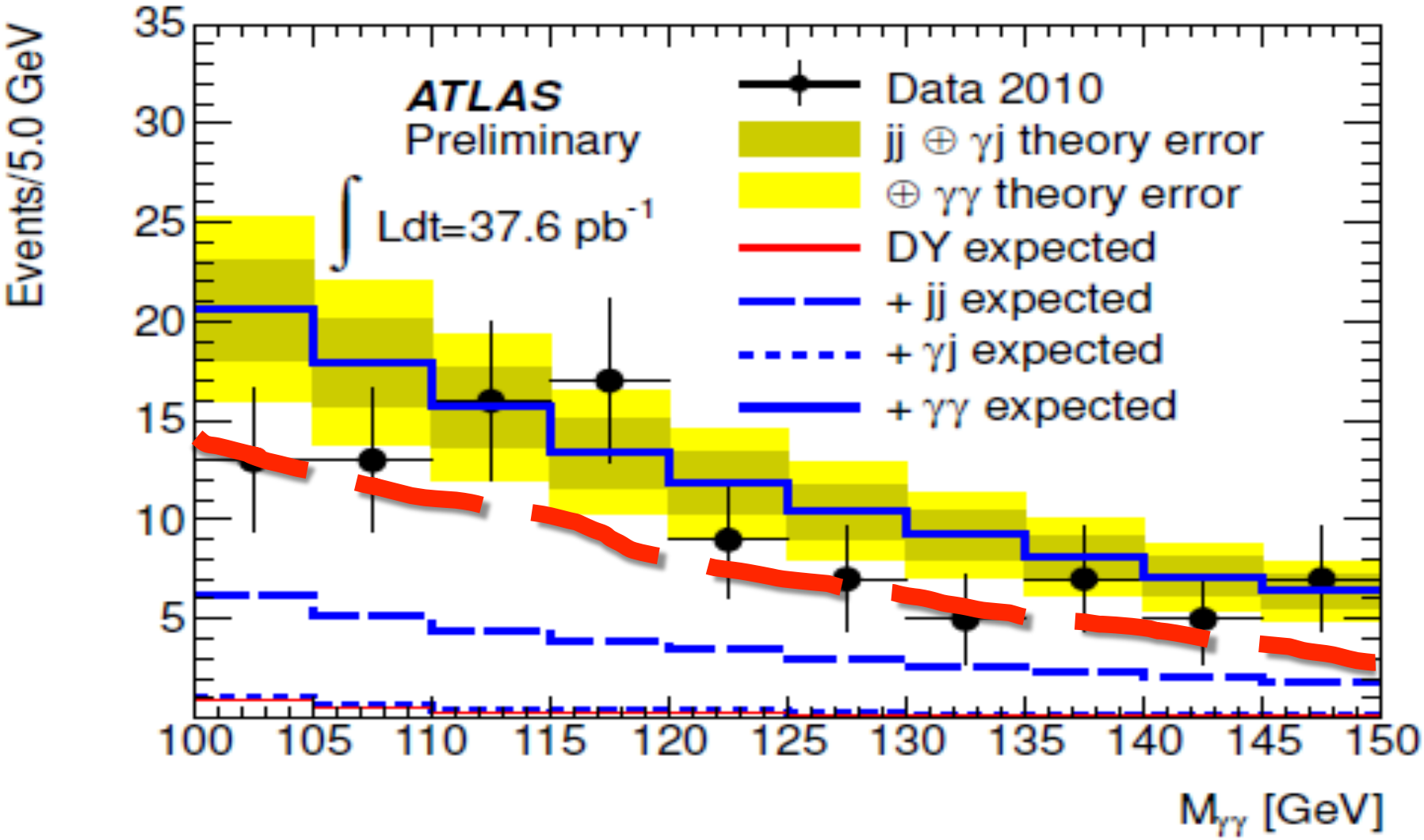
top pairs



Data compared to background calculate the normal way



But what if the background were lower?



“not even wrong” blog…

This Week’s Rumor

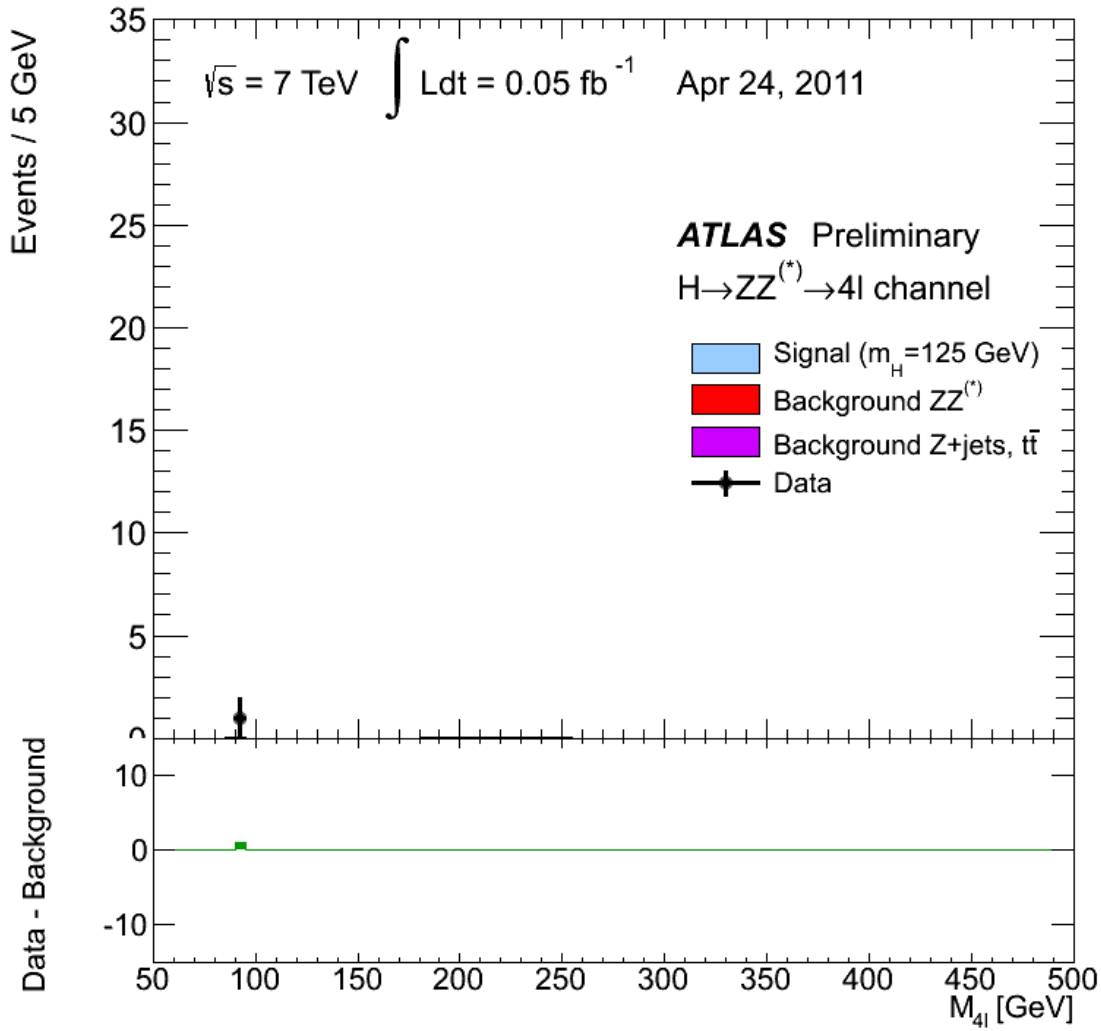
April 21st, 2011

A commenter on the previous posting has helpfully given us the abstract of an internal ATLAS note claiming observation of a resonance at 115 GeV. It’s the sort of thing you would expect to see if there were a Higgs at that mass, but the number of events seen is about 30 times more than the standard model would predict. Best guess seems to be that this is either a hoax, or something that will disappear on further analysis. But, since spreading well-sourced rumors is more or less in the mission statement of this blog, I think I’ll promote this to its own posting. Here it is:

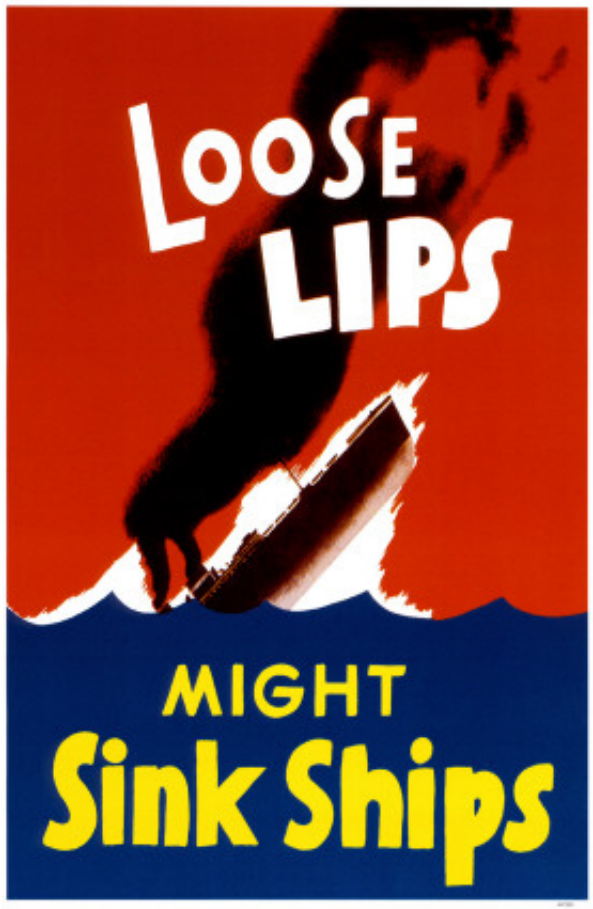
> Internal Note
> Report number ATL-COM-PHYS-2011-415
> Title Observation of a γγ resonance at a mass in the vicinity of 115 GeV/c2 at ATLAS and its Higgs interpretation

- http://www.math.columbia.edu/~woit/wordpress/

Where it actually was



When should you discuss data?



- It is important to present data when it has been fully understood
  - Internal notes
  - Grant applications
  - Seminars
  - Conferences
  - Arxiv
  - Publication
  - Review Articles