

# PHY215 Honors Project: Analyzing LHC Collisions in the ATLAS Detector

## Fall 2017

### Document 2, November 13, 2017

Due: December 5, 2017

## The Data Analysis

By this point, you've been through Exercises 1 and 2, and so you're beginning to get a feel for what events of particular kinds would be like in the ATLAS detector. We do not scan these things by eye – there are billions of them every month. Rather we train computers to do “pattern recognition” analyses and only look at the displays when things go wrong, or when things go very right. Science is much more the former, than the latter.

We're doing the “Z-Path analysis” from <http://atlas.physicsmasterclasses.org/en/zpath.htm> It involves calculations that the computer will do...just like for us...and identification of the kinds of events that you see. Note: these are real events, there is no correct answer in the back of the book. You make your best evaluation!

I hope you've read all of the information gotten by clicking on each of the side tabs from Introducing the Z Boson through Search and Discover Through Mass.


We're about to do the last one, Get to Work!

You'll find everything you need in,

<https://qstbb.pa.msu.edu/storage/PHY215/honors/>

so ignore any instructions to get something else from their web page. In my directory are:

- The “groupA-etc” directories are your data...see below.
- The tally2017 directory contains 11 tally sheets that you'll fill out by hand as you analyze. One for each of you...see below.
- The spreadsheet is the assignments, which are duplicated below.

In the tally sheets, count using whatever stick-marks you use to keep track of counting. To me, that means for “7” I'd have made the marks: . Get what I mean?

What you'll turn in is:

1. Your paper (see the first instructions)
2. Your tally sheets filled out
3. Your invariant mass plots (see below)
4. Your invariant mass export to Invariant\_Masses.txt

## Here are your measurements:

- 1. Count and categorize your events.** You'll have a total of 100 to analyze into Z, Z', Higgs (in gamma-gamma and/or eeee, eemumu, or mumumumu), or background. Follow the suggestions on the Analyzing Your Result page.
- 2. Invariant mass calculations.** HEPATIA does this for you.

## Your Data

Your data sets are found at:

<https://qstbb.pa.msu.edu/storage/PHY215/honors/>

Each of the group directories contain 50 real LHC events taken by our ATLAS detector. They're randomized. You're each assigned 100 events, from two of the directories according to the assignments in the spreadsheet (and the table below). The assignment is like this, alphabetically. Mr Chen, you get the 50 events in groupA and the 50 events in groupA-2. The rest of you get them in that same way.

I've made a 25 minute movie that shows you exactly what to do. You can find it as

<https://qstbb.pa.msu.edu/storage/PHY215/honors/Zpathintro.mp4Z>

I think I've done everything you need. So you don't have to follow the links on the Data samples and Tools page. Furthermore, the last line of the Do It! page...hold off on that.

## Your Workflow:

1. Fire up your HYPATIA tool.
2. Arrange your windows so you can see everything, as per the movie.
3. Download your two directories into local directories near your HYPATIA JAVA tool.
4. Choose the first directory and start analyzing.
5. You can save your work and go do something else and then come back. In File, you can save your HYPATIA project and then when you come back, open HYPATIA and load the saved file.
6. When you're done (or maybe before...just to play), save out the histograms that you made after you've done all 100 events. Remember some will be backgrounds (not interesting physics) and so your final results will probably be fewer than 100 events.
7. Export your histograms to the file that it does for you in File/Export Invariant Masses.
8. COPY your Invariant\_Masses.txt file to a second file called Invariant\_Masses-A.txt...or whatever is your letter. So you've got two.
9. Send them to me via email.

Do this by December 5, 2017.

There is a mechanism to combine your results, but with only 3 of you that's not so interesting. So I'll combine them with Spring Semester's ISP220 class and let you know the results. So you'll have to wait until late April to find out what you discovered!

Have fun! Here's the table:

<b>Student_Name</b>	<b>Datasets</b>	
Katie	A	A-2
Gabriel	B	B-2
Aalayah	C	C-2