Electronic Work Record – Laura Cairns
Project Notes – Term 1, Week 3

17/10/2020

- Uploaded weekly record of Weeks 1 and 2, and preterm work, to lmcairns fork of MPhysProject2021 repository
- Made template for weekly record in Word
- First attempt at using markdown on GitHub

Question

Where do you want me to put weekly record? How link you to it?

How does linking within repository work in GitHub markdown?

22/10/2020

Project Meeting

- Weekly record – can create mirror of project but shouldn't have code in separate repository. Work collaboratively in Rowan fork.
- Use labels to indicate weekly record. Create issues with that label. Tag Mika in issue. Close straight away.

- Last week, issues #2 to #4 to get used to ROOT.
- Close issues 2 to 4 are they have been sorted.

Issue #5

- Measurement suggestions are "just the very first steps".
- Not calculating a cross section from 1st principles – this is end of 1st year phd. Proton collisions are v complicated.
- Instead using tools written by theorists and generating collision events
- Pythia
  - Webpage with papers describing and instruction.
  - General tool – can do many types of collisions
  - Only at leading order accuracy, no quantum loop corrections.
  - Allows quarks to radiate gluons but in an approximate way
  - Prediction of Z crosssection should come out slightly wrong – no quantum loop corrections
    - "Tree level hypothesis is not enough"
  - May decide to run higher order tools with quantum loop corrections, but these are very computationally expensive. Possible future work
- Measurement
  - To understand the effect of the detector, have to run a simulation of the detector.
  - Simulation data in same data repository.
  - Generate collisions with pythia.
  - Program which simulates particle trajectories through various materials.

- - - Digitisation – make the data look like digital hits we would see in experimental data.
    - 1st step: make lots of histograms of different variables of the muons and the di-muon system, and compare the shapes of these distributions between the real data and the simulated data
    - Later step: Measurement for trigger efficiency.
    - What is the goal of comparing the two sets of data?
      - Need to correct the data for the imperfections of the detector. E.g. pattern recognition misses it, particle not detected, resolution can move measurements across bin boundaries.
      - 1st – do we think the simulation is really representative of the data.
      - Implicitly checking if the physics of the particle generator is correct.
      - Try to measure a lot of detector effects (eg efficiency) from the data themselves.
  - General comments
    - Latex!
    - Add some subdirectories named as given
    - Add latex templates needed to make a latex document.
    - Do analysis and reporting in these latex documents, for use in the final assessment documents.
    - Hope for complete analysis to become an actual LHCb publication.
    - Plan for top level script that produces tables and plots automatically, latex document that automatically adds figures.
      - Github repository is just code. Does not need to store data
      - Makes the study much easier to reproduce.
      - Reproducibility is more important than errors as we can redo and correct them.
- Top level script – document containing bash script to run things automatically but can be more powerful to write in python.
- Neither have preference, Rowan leaning towards the hypothesis.
- Hypothesis section requires a bit more understanding of others special environments and getting other people code to compile
- Measurement uses code already written
- Once split would be productive to go through code with individual. Debugging, setting up talking through.
- End session, Mika will be online all day today, can chat for the rest of the day. GitHub is the easiest method to discuss issues.
- Schedule a discussion on Monday. Read through issue and discuss how to divide up. Separate discussion to go through one on one.

Action
- Copy weekly record over into issues.
- Revise cross sections
- Read pythia link
- Read through issue and discuss how to divide up
- Separate discussion to go through one on one – organise for Monday.

23/10/20
- Made notes on cross section from PX395 and https://www.hep.phy.cam.ac.uk/~thomson/partIIIparticles/handouts/Handout_1_2011.pdf

- Made decision to divide work as:
  - Rowan: Hypothesis
  - Laura: Measurement

From Issue #5:

> **The measurement**
>
> - The next step is to try to compare our data with simulated Z -> mumu decays.
> - Essentially we need to make plots of various distributions of the muon (and di-muon) properties, overlaying the real data with simulation.
> - The simulation samples can be found in the same directory.
> - After that, the following step will be to try and correct our cross section measurement for the trigger efficiency. This will require trying to measure that efficiency directly from the data.

The simulated Z "data" events can be found in this path:
`/storage/epp2/phshgg/DVTuples__v23/13TeV_2016_28r1_Down_Z_Sim09h.root`.

The events should look just like the data events but you may notice that there are additional branches/leaves in the `TTree`, related to "true" information about the generated decay. Obviously this "truth" information wouldn't be available in the "real" data.

Workbook Notes

PAGE	DATE	TOPIC
22	23/10/2020	Cross Section Notes PX395

Link to Issues #5