Lessons in Computing and Physics from the Belle II Summer School

...

Paul Gebeline, University of Mississippi

Introduction

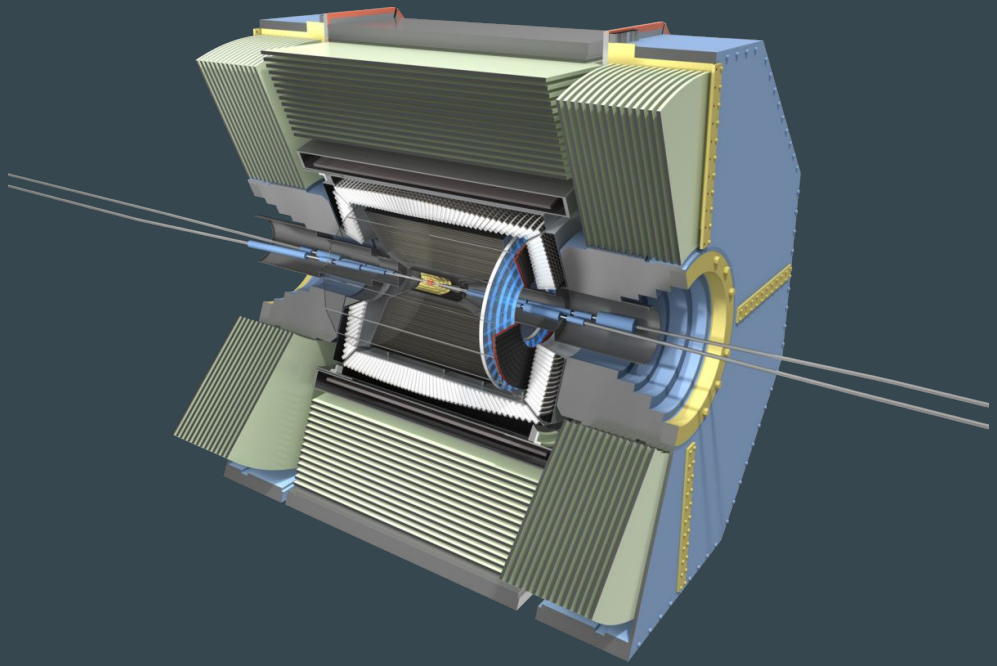
- Background
- Purpose of seminar
- Summer School Expectations
- Two parts of presentations: Physics and Computer Science

Physics

CP Violation

- Charge conjugate/parity
- CP Violation means some processes would not occur at the same rate as the charge conjugate mode
- Matter dominated universe

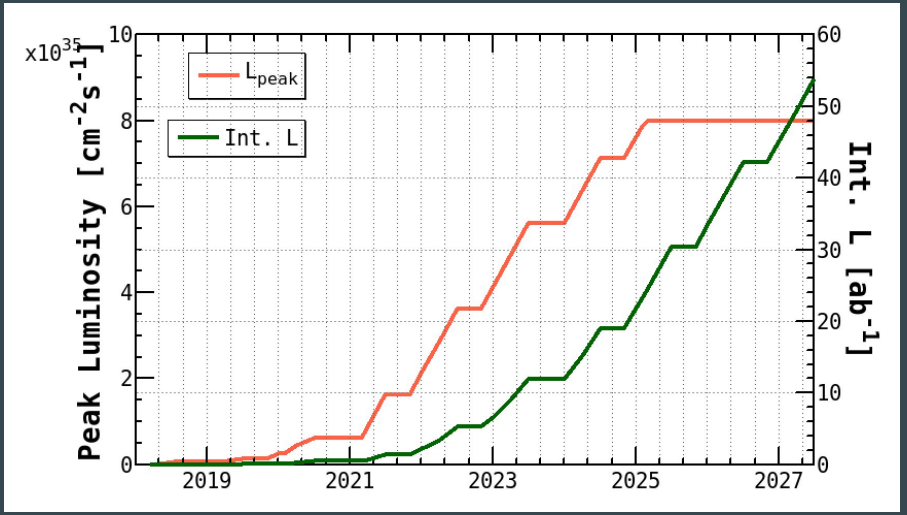
The Detector



- SuperKEKB uses nanobeams that are much smaller than the beams at Belle
- Since Belle II has such a high luminosity, we have to account for the higher background that this will produce
    - One solution is to use pipelined readouts

Reading Graphs/Data

- Integrated Luminosity
  - Basically the amount of data a detector collects (units of 1/barns)
  - The integrated luminosity, when multiplied with the cross section (barns), provides the number of events



Computer Science

Artificial Intelligence

- Machine learning is learning from data, but AI is making decisions and actions based on data
- AI is not a futuristic concept -- it's already in our lives (e.g Alexa & Self-Driving Cars).

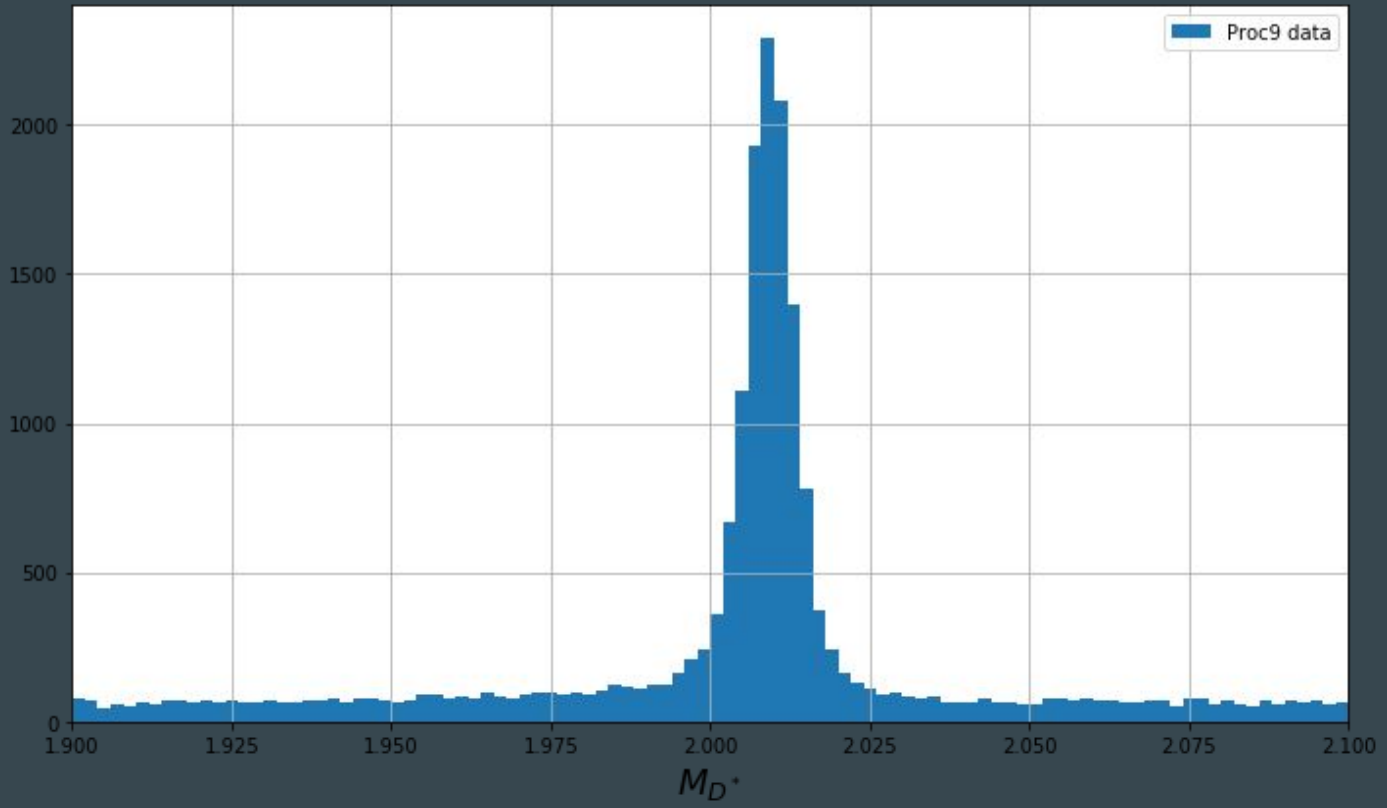
Basf2

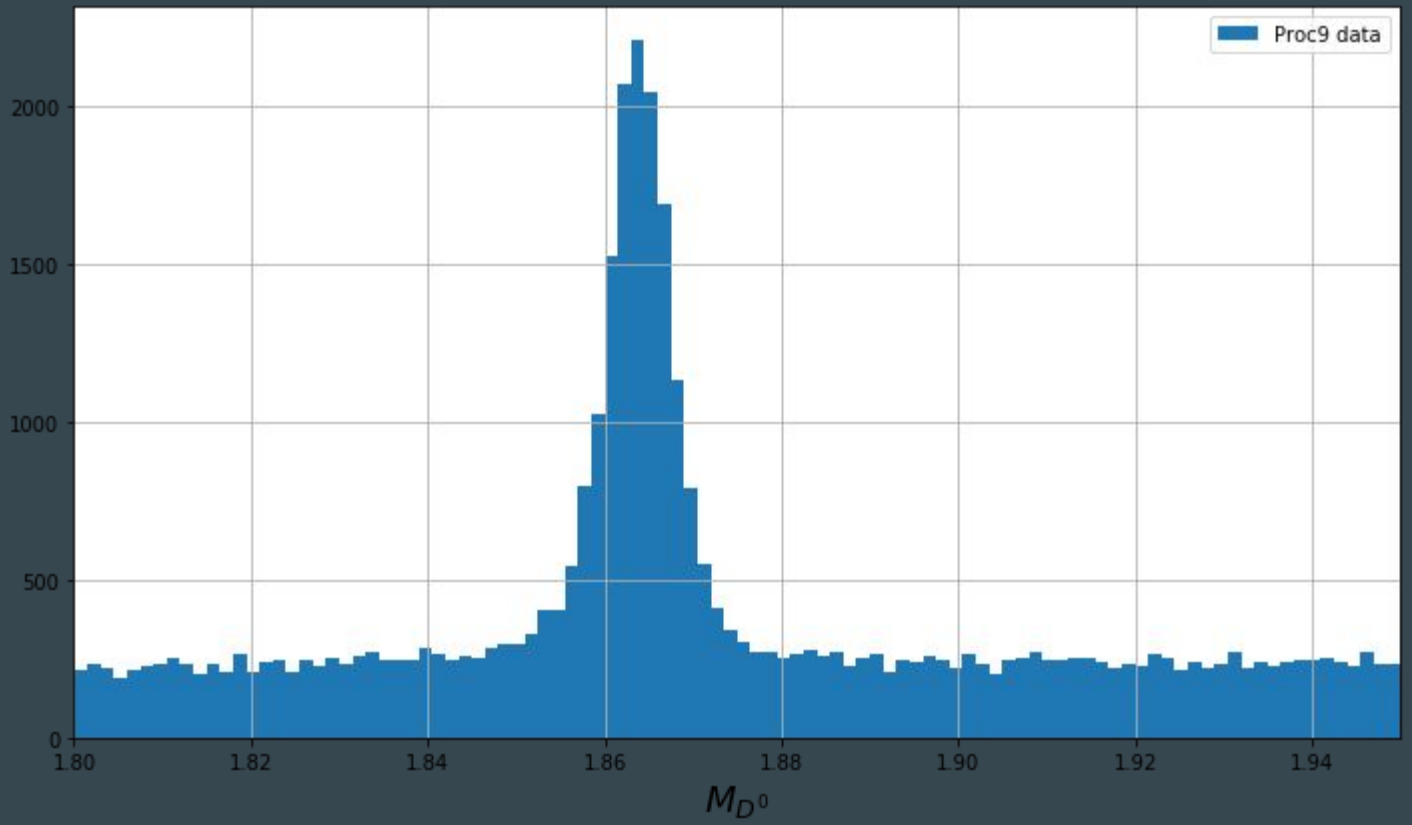
- Running MC analysis
  - Generation, simulation, reconstruction
  - Proper use of resources, such as stash
- Learning what the code actually **means**
- Large part of analysis is trimming down background to keep signal

Going through some of the code

- Applying cuts
  - goodTrack = ‘abs(dz) < 2.0 and abs(dr) < 0.5 and nCDCHits > 20’
    - This code applies some track quality cuts -- specifically, it tells the analysis to only run tracks that are within a certain range of the impact point and says the tracks must have at least 20 hits along the Central Drift Chamber (reduces background)
  - D0cuts = ‘1.7 < M < 2.1’
    - This code defines loose cuts for the D0 plot

Analysis of $D^{*+} \to [D^0 \to K^-\pi^+\pi^-\pi^+]\pi^+$




Proc9 data
2000
1500
1000
500
0
1.80
1.82
1.84
1.86
1.88
1.90
1.92
1.94
M_{D^0}

Conclusion

- While many of the things may have went over my head, the Belle II Summer School did a great job of teaching a few things to someone with very elementary experience in particle physics.
- Experimental particle physics is pretty cool.