Meeting minutes

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July 3rd 2018 - Journal club meeting minutes
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dEdx Part 2: Greg chairs, Laura is expert.
Minutes do not claim to be coherent or complete.

Topics:

- Mass calculation formula and how we use it
- SUSY searches excluding more generic models with similar signatures
- MET thresholds
- How would we optimize this analysis for stable R-hadrons?
- Selection and background rejection

Details:

- Greg: Laptop broke with my notes for this paper on it. We will start with section 3. We looked at Bethe-Bloch and looked at dynamic ranges. It's worth looking at the PDG review again to refresh your memory on what those ranges looked like in the classic muon-Cu curve: http://pdg.lbl.gov/2016/reviews/rpp2016-rev-passage-particles-matter.pdf
- Rebecca: How do you convert from dE, using the ToT measurement, to the specific energy - which is per unit mass? Do you just divide by the mass of Silicon?
    - L: Something to that effect, yes.
- We move on to formula (1):
    - R: How do you know what the didx MPV is?
        - L: When we disregard the highest value of dEdx we assume it's in the tail. Then we take the mean of the remaining values. This truncated mean is equivalent to the MPV.
    - G: Why 5 parameters?
        - L: So, these come partially from Bethe-Bloch. And actually, in the next round of the analysis we only use 3 parmeters for this formula instead of 5. Some of the parameters come from experimental effects and see come from the Bethe-Bloch formulae.
        - Cesar: What changed?
        - L: Well, we use low momentum protons, kaons, and pions to tune this. Low momentum because…?
        - Mark: Because we need the high peak on the left of the distribution of the

dEdx curve.
        - L: Right! So, the tracking reconstruction assumes all particles are pions. As a result, for very low momentum there is a bias for protons and kaons. For most people this doest matter because its so low momentum but for us we do care. Once we introduced a momentum calibration we can use the reduced set of parameters.
- Laura: Where would our hypothetical R-hadron be on Fig. 2?
    - All: It would be further away from zero on either side: higher mass*charge.

<u>Section 4</u>

- G: How much of a concern is it that SUSY modeling would limit us for non-SUSY sensitivity?
    - L: Depends how it's used. For example we didn't cut off the MET at a higher value and tune it to the specific model we cared about because we don't want to overtune to the specific signal models we simulated.
    - R: Why is it so high?
    - L: Three things go into deciding a threshold for the off-line MET: background rejection, signal efficiency, and the interplay between trigger MET and offline MET. If you plot these then we have a turn-on and we want to be in the plateau of the turn-on, so - here, where the slope of the turn on is quite gradual - we go to a much higher threshold. Close-to-double from trigger-to-offline-selection is not uncommon with MET.
- R: phase-space approach in hadronisation?
    - L: The phase space is probably energy and momentum.

<u>Section 5</u>

- L: What's the most important property of the hadron for this search?
    - G: charge

- R: This sentence confused me: "the most stable R-hadron events are selected by trigger only when ISR boosts the R-hadron system" - why does the boost matter?
    - L: It's not actually that the R-hadron is boosted: it will still deposit very little energy in the calorimeter. We can trigger because we can check MET compared to the ISR which is realized as a jet.
    - L : Also, recall from last week: a SUSY particle decaying to all SM particles is only true when R-Partity is Violated. We are planning to look at making a dEdx trigger at HLT in HL-LHC.

- We talk about offline vs online MET trigger/selections and how the Z->mumu analysis is perfect for a MET trigger but then you need ISR to balance the MET.

- L: This analysis is optimized for meta-stable not stable particles. If we were *only* looking at the stable particles, what could we change?

    - All: Tracks in muon?
    - L: Maybe, you could imagine a stau that wouldn't have a charge flip and then you could trace it all the way through the detector.
    - Titus & Adrien: Timing?
    - L: Yes! You could imagine using timing to make a tof measurement to measure beta, or the mass. The timing in the calorimeter has resolution > 1 BCID and the MS also has timing resolution > 1ns. We don't think about it often, but it is there. Heavy things tend to be produced centrally so the new HGTD is not useful in this search.
- G: what about a double charge flip?
    - some stuff in exotics searches looks for a MS track but no corresponding ID track.

- R: About the electron and hadron background reduction...
    - L: So, with an electron you have the momentum of the track that was measured and a deposit in the calorimeter, a jet, which has a measured energy and you expect these to things…?
    - R: to match up?
    - L: Right. Now for an R-hadron, it is ionizing and has some momentum but deposits very little energy in the calorimeter so jet energy will be less than the track momentum. And for regular hadrons? We just talked about this with jets..
    - G: They will not be entirely made of charged particles.
    - L: Right, so the hadrons will have a larger energy deposit in the calorimeter than what we're necessarily getting from tracks.
- L: To further the point, in many analyses you reject a process, here since we're just looking for a track, we don't really care where its from so we try and reject combinations of scenarios. The W-cut is the only one where we target the thing decaying. That's partially because we have a hard time rejecting taus.
- A: Fragmentation is exremely hard?
    - frag. produce a strong thing (parton) and go to a jet with many hadrons. First part of that process is fragmentation. Hard frag: all of energy is carried by one f the hadron.