Karl Warburton – Questions, Corrections etc

Chapter 1

p. 9 Should there be a double summation in (1.18)?

p. 13 ~~Octant, rather than quadrant?~~

Chapter 2

~~p. 19-20 Confusion between neutrino beam power and proton beam power?~~

~~p. 20 Is "luminosity" really the right term?~~

~~p. 25 What are ellipses on fig 2.3?~~

~~p. 26 Luminosity (?) measured in MW?~~

~~p. 27 Looks as if "two beam designs" refer to neutrino and antineutrino. Also see figure captions.~~

p. 48 Fuller description of PMTrack and Pandora needed, either here or in chapter 4.
More explanation needed of Box and Birks models.

~~p. 49 Is it clear what "by the user" means?~~

Chapter 3

~~p. 51 Explain time resolution of 20 ns.~~
~~Is camera really triggered, or only recording? Clarify this.~~

~~p. 52 "elevated, though cryogenic" is vague.~~

Chapter 4

p. 61 Isn't the source a line, rather than a "3D position"?
~~Position of muons specified, but not direction.~~

~~p. 62 Perhaps some explanation of terms "predicted", "expected, "reconstructed" is needed?~~
~~"the metric" – which one?~~

~~p. 62-5 What does "calculated by the photon detectors" mean? "**measured** by the photon detectors"? "calculated **from** the photon detectors"?~~

p. 63 ~~Fig 4.3 – Why is the gradient ≠ 1? Which axis is which?~~

~~p. 64 Fig 4.4 – is ΔYZ defined anywhere? Strange caption – aren't both Monte Carlo?~~

~~p. 65 Does "each ADC" mean ADC bin (or count)?~~
Reference for 1.8 MeV/cm?

~~p.66 Why Gaussian, not Landau, or Landau convolved with Gaussian? Is this reasonable?~~
~~Muon direction again unspecified.~~

~~p. 67 MPV not actually indicated (figure caption).~~

~~p. 68 "no MC information" – not really, as these are entirely MC-generated tracks!~~

~~p. 74 30% of short tracks <1 cm even for muons? What energy?~~

~~p. 76 What is meant by "This relationship"? How does it depend on particle?~~
~~Is it an increase, or *decrease* in *dE*/*dx*? This could be explained more clearly.~~

~~p. 77 Units of *A* are not correct (see (4.4) and remember *b* is negative).~~

p. 81 Definitions of θxz, θyz not very clear.

p. 85 Understand why (most) points are below the lines in fig 4.17?

~~p. 86 Not true that PIDA ranges are "*centred* on the peaks"!~~

~~p. 92 Fig. caption has ratio given in cm.~~

~~p. 94 (Huge loss in muons, going from fig 4.21 to 4.22.)~~

Chapter 5

p. 97 What are the two lines on fig 5.1?

p. 98 I am not sure the sentence containing "in order to be separated … one drift window before and after" really says what you want to say!

Have channels been defined? Wires?

p. 101 Not sure what "centre them around their chosen conditions" means!

p. 108 (Not clear whether counter shadowing is used or not! What is MLESAC method?)

p. 111 Not clear why the *yz* plane, rather than *xz*. Aren't all EW counter centres (on one side) at fixed *y*? (Explained in viva, but could be clearer.)

p. 113 Is caption of table 5.1 consistent with fig 2.6?

p. 114 Axes: non-integer counter differences in fig 5.12. Are a) and b) consistent?

p. 118-9 Constant added to signal? Apparent increase in width is an artefact of (invalid) fit, not real.

p. 119 RMS in time (ticks)? So why *transverse* diffusion?

(How is RMS calculated? One value per track? But *charge* is per hit, not per track?)

Evidently not true that Gaussian gives most probable values – fig 5.16. Why should it be a Gaussian, especially for RMS/charge?

p. 121 Why is *width* of RMS significant, rather than mean?

Fig 5.17 Do you expect linear dependence, or square root?

p. 122 Confusion of "normalised plot of hit charge" and "plot of normalised hit charge", in multiple places.

(Explain *predicted* and *reconstructed*.) Why "centred about the interaction time" rather than about zero?

p. 125 and many other places: Surely what is called *accuracy* here is really an offset in the mean or peak?

p. 127 (Again, why fit *Gaussian* to these distributions?)

p. 130 Fig 5.24 Again why expect linear dependence, not square root?

Surely choosing drift distance = 0 cm eliminates diffusion. Width (RMS) is angle dependent, but why due to diffusion?

p. 135 ("accuracy" used in a more sensible way here, but not consistent with previous usage!)

p. 136 Define coefficient of longitudinal diffusion. Reference needed for value.

p. 147 (Would the 2-pass method have an effect on efficiency?)

Chapter 6

p. 149 Origin in *z* does not agree with fig 6.1.

p. 150 Does "muons are *initially sampled*" mean "generated"??

p. 151 "inelastic scattering" means CC?

p. 152 Contradictory definition of POCA?

Confusion between *point* and *distance* of closest approach?

Not clear what topology is being searched for. Explain lower limit on cut etc.

p. 153 Text refers to photon, figure 6.2 refers to electron.

p. 154 Sudden change from "photon" meaning gamma ray to meaning scintillation light!

p. 155 (Confusion between 2100 m, 1505 m and sea-level. Is 70% due to height?)

Is scaling adequate? Are the properties of lower energy the same?

p. 157 Is $\theta_{beam}(E)$ cut described somewhere? What are the errors on 1/10 and 1/140?
What about systematic errors? Only statistical errors quoted.
Explain "Ext→γ".

p. 158 "The same muons"? Hit or miss?? (Explained in viva, but could clarify.)
Where does 10700±300 come from? Richardson thesis?

p. 159 Why different order of cuts?

p. 162 (5.18×10^{-9} at what depth?)

p. 164 Define 2 cm fiducial cut. Vertex more than 2 cm from edge? No energy within 2 cm from edge?

p. 168 Safe to reject events without true K? How many π will fake K?
"external muon track length" means muon which *starts* externally? Is this defined somewhere?

p. 169 Does "as the kaon interacts" mean "*if* the kaon interacts"?

p. 170 "this *level* of reconstruction" is imprecise.

p. 173 Have the energy deposition cuts been defined? (Just existence cuts on K and e?)
Is there any information in fig 6.7 not also in fig 6.8? (Also for later pairs of plots.)
Vertical axis of fig 6.7 is a bit odd, as it is "number of events per bin" but the size of bin is not constant.
(Are double-sided errors appropriate for a limit like this?)

p. 177-8 (Are dotted lines really neutrons, not neutrinos?)

p. 180 Is it reasonable to assume K decays at rest?

p. 182 Can you conclude the cut is too strict without looking at background?

p. 185 Can't actually see <0.1 cm in fig 6.16!

p. 188 Errors in equations for momentum.
"This also takes into account the energy resolution" is an unjustified assertion!

p. 190 How is "the expected energy region" defined?
(Do the events include Fermi motion?)

p. 199 In conclusions, is it really reasonable to assume that background rejection with perfect particle ID is realistic? Couldn't there be a much bigger background due to misidentified pions (or other particles)?

Chapter 7

p. 201 (As in chapter 5, I am unconvinced by the use of the word "accuracy" here!)