Dear Joey, Bruce, Ulla,

Thanks for the updated draft. Karl and I have read it, and this mail summarises our comments. Overall, we think that the note can make it, if we further stretch the deadlines a bit more and we can get a new draft soon. Time is tight, and we appreciate everyone is very busy preparing for data.

The main comment is simple: please beef up section 4.4 and be clear about what is being tested: comparison of different MCs; comparison of MCs with MCFM; comparison of corrected data with MC input distributions; comparison of expected statistical and systematic uncertainties from data with theoretical/model uncertainties. These are all distinct points that merit being separately explained, with more than one figure (3) to explain them.

Best wishes,

Dave (& Karl)

*We have tried to edit the document to reflect the global comments above as well as to act on the specific requests below. Some of the sections have been shifted around in order to do so.*

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Going through section by section (caution that these comments are not in priority order):
Abstract:
- we suggest to shorten it a little; also delete the second "in this note", and make "PDF" abbreviation consistent with the text

Done

Introduction:
- delete "shortage of space" (it may feel like this, but this is irrelevant to the outside world that this note is aimed at).

Done
- use present tense to describe what is described in the note

Done
- you compare only to hadron–level information, don't you?

Yes
- you have inconsistent hyphenation of cross–section (which is hyphenated in British English, and I think not in US English).

We have switched to the hyphenated version.

Section 2.1:
- this subsection is too brief. For example:
  + How is the Z+nj weighting done in detail? Do you merge the ALPGEN datasets using the relative ALPGEN cross–sections for different n, and normalise the overall cross–section with MCFM, rather than doing some n–dependent normalisation? It's not stated.
You should spell out here how the MCFM normalisation information is used, in more detail.

Karl is dubious that your normalisation scheme is rather arbitrary: how is the MLM matching cut used?

(For a non-expert like me: what is the relevance/importance of the MLM matching cut – to what is it applied – both ALPGEN and MCFM or just one?)

More detail has been added which hopefully provides the needed explanations. MLM matching applies only to LO matrix element and parton shower matching. The purpose is to prevent double/under-counting of parton shower contributions since both can easily populate the same phase space if you're not careful. That is not applied (nor needed) to the fixed order matrix elements in MCFM.

+ Explain the "exclusive"/"inclusive" notation, for non-experts.
Done

+ The description of the non-ALPGEN samples is too brief: the cuts etc are written in a shorthand that is hard to follow
We have tried to add more detail

+ Some of the bkgd MC samples (eg ttbar) are not mentioned. Makes sure they are, and say what MC is used.
Done

+ For the tau tau case, you need to say what the "dilepton mass" means; is this the taутau mass or the invariant mass of the decay leptons?
Done

– overall Section 2.1 needs to be longer (O(twice as long)?)

We have added more detail
Section 2.2
- When you mention "jets with radius 0.4" you haven't yet said you use cone jets – do it here

**We have added the definition earlier.**

Section 3.0
- "As adopt as far as possible" (first line)
- "the other notes" – "other analyses"
- "W/Z note" – "W/Z study"

**Done**

Section 3.1:
- Delta R is used: define on first use.

**Done**

Section 3.2 last sentence:
- "The Z selection requires that there be two muon candidates with an invariant mass of..."

**Done**

Section 3.3:
- replace footnote 4 with a reference (another CSC note from jet/etmiss chapter?)

**Done**

Section 3.4:
- Trigger Paths isn't common ATLAS jargon at least; suggest "Trigger Selection" (or Conditions or Requirements)

**Changed to trigger selection**
Presumably the highest threshold non-isolated electron trigger was not used? (For the future, it should always be ORed with the highest threshold isolated electron trigger)

That is correct. It would have added to the complexity of the analysis with probably not an appreciable gain in the number of events.

- "with respect to that for the offline cuts" – "for events which pass the final selection cuts" (if that's what it means)

Done

Section 3.5:
- Please avoid "pseudo-data". Use "simulated data".

  This raises the whole question of what one is using corrected simulated data for (below).

We have switched to using the word simulated.

- You use "to validate" a couple of times here; suggest at least one should be "test the performance of"; I dislike "validate" in papers – we use it as jargon to mean an independent check of software performance in ATLAS, but its English meaning isn't really right... (too definite: validated means "definitely OK").

We have tried to qualify our use of validation

- On this part (second para) you don't really justify this validation "in high jet multiplicity events" anyway: at some level all this seems to mean is that you check the selection works in a high multiplicity environment; this is done in lots of other places too. Downplay this part?
We have.

Although we have to stress that in our opinion a systematic uncertainty introduced by an efficiency bias for a precision cross section measurement is much more serious than, say, for a background evaluation for searches.

Tables 1 & 2:

- Please remove "xsec", suggest to replace with "$\sigma$" and to define sigma in the table caption "accepted cross-sections $\sigma$"

Done

- Be explicit what a "corresponding surviving fraction" is. From the numbers in the table, it seems to be the fraction of the selected sample? (I read "surviving fraction" as meaning "efficiency").

We have tried to clarify the wording. It is not an efficiency but rather the fraction of the remaining sample from signal or specific background.

- Table 1 does not say which MC is used; Table 2 uses both PYTHIA & ALPGEN, though apparently just for the signal and ttbar. Please do this consistently, either use PY & AG in both, or use just one choice for both. You should probably merge the two tables. If you have important extra info only in one channel (why?), you could add one line to the table with "Z- mumu (PYTHIA)" and/or "ttbar (PYTHIA)" or similar. At the moment it looks like we think Z- mumu physics differs from Z- ee.

In the text (Section 4.2) we specifically stated that, in Table 1, the signal distributions are derived from ALPGEN Z + jets and the backgrounds from PYTHIA.

We have now restricted the muon analysis to the Pythia MC set to make the electron and the muon channel as similar as possible (In internal results we have compared to ttbar with MC@NLO and the
Section 4.2.1:
- Final sentence, suggest "The Z- ee selection efficiency, including the trigger requirements, varies little with both the jet..."
  (if that is what it is supposed to say)
HOWEVER: looking at the table it actually varies from 92% to 80% with jet multiplicity. This is not a small variation?!
I can't see any easy way to judge that the efficiency doesn't vary with jet Et: is this small or also at 10–20% level?

Hopefully, the clarification of the table helps with this question. The selection efficiency does vary little with jet multiplicity/kinematics.

The signal fraction in the final selection decreases for large jet multiplicities not because the efficiency decreases but because the background fraction increases.

The efficiency for the reconstruction of Z-\to ll in the acceptance region is stable and at 55% for the electron channel and 80% for the muon channel.

Section 4.2.2:
- MCs shown in Figure 1 should be mentioned somewhere (S2.1)

Done
- suggest to avoid "QCD" to mean "QCD multijet sample" (in S2.1 this is called "QCD dijet", should be consistent).

We have tried to be consistent with referring to QCD multi-jet (or di-jet when referring to the generation).
- remove brackets (replace with leading comma) for the last sentence in the first paragraph.

Reworded
- Fig 1 caption: please avoid "$ \geq $" in text (here write
"at least N jets"; put a space between "1 jet" – "1 jet".

Reworded
- Fig 1: do not write "1 fb–1" inside the figure panes if it's already in the y axis label (as it is)

Done
Section 4.2.3:
- This section is longer than needed; isn't all that is needed here to say that an unfolding technique (energy scale correction plus bin–by–bin correction) is used, and recovers the input distribution? (i.e. it does not have bugs).

It has been shortened. However, we feel that the information presented here is important for the note.

We have to prove more than that the unfolding has no bugs. For this study we do not simply do a bin–by–bin comparison of two PT shapes but we isolate the relevant effects and correct for them independently. (partly by correcting calibrations, partly by applying cross section weights.) Hence we think that we have to prove that this technique works.

- I repeat my earlier comment that "bin–by–bin unfolding" is an oxymoron: if it's bin–by–bin it can be called correction but it's not unfolding.

- In this section you introduce an "event weight"; fine, but you need to be more specific what this is and how it is used, if you want to introduce it (I am not sure you do).

The wording has been changed. We now talk about corrections to the cross section.

- See previous comment on "validating" (last line) – suggest "provided a consistency check of"

Reworded
Section 4.2.4:
- First sentence: "The Z- tau tau, ttbar and W- ev backgrounds are subtracted using Monte Carlo predictions." (the final clause is unnecessary). 2nd: "Special care will be needed in validating against data the differential..."

Reworded
- Remove "calculated as 1–QCD–fraction (as in Table 1)" (or if you leave it, rewrite so as not to have a formula with words and do not abbreviate Table).

This subsection begs question about what the uncertainties are on the background predictions: what are they roughly expected to be, and how does this propagate into the systematics discussed in S4.4?

Reworded. Assumptions of the uncertainties for real data have been made and propagated to the error measured cross section. We are currently also studying the data-driven extraction of ttbar background.

Section 4.3.0
- Delete "case of the"

Done

Section 4.3.1
- "It can be assumed" that the dominating dijet contribution of highly energetic muons is from bbbar – I think you need to say "isolated high energetic..."? Otherwise won't ccbar have a similar or higher contribution?

Done

Section 4.4
- See comments at the start about restructuring and clarifying
this section. This is the real "meat" of the note, and it is very hard to read at the moment.

We have re–written it.

We hope we have clarified the main reasons why we develop and perform the complete analysis with fully–simulated data: we want to extract the uncertainties expected on the measurement of the Z+jets cross section with 1fb⁻¹.

Since this is a study based on fully–simulated data we restrict to this goal.

This study is not intended to be a generator validation (any generator validation in our opinion should be done with sufficiently large amounts of Atlfast data sets instead of fully–simulated data and should go into a generator chapter instead of an analysis chapter)

We use the MC Truth level comparison of MCFM, Pythia and Alpgen predictions only to get an impression of how much the various predictions differ from each other, in order to get a first rough benchmark for our required precision. In other words: if the precision of the measurement was that low that we couldn't even distinguish LO from NLO predictions then there would be no point in doing the measurement at all.

– There is a sentence about PY/AG normalisation at the end of S4.4 para 1: this was discussed previously in S2.1. Please discuss fully in one place (2.1) and here refer back to that discussion.

– Spaces between number and "jet" in \ge 1jet" etc (many times in first para).

Done

– Delete "shortage of space" in footnote 5, if you keep it.

Done

Figure 2:
The last sentence of the caption is unclear: rephrase;
was this special for the muon channel? (It isn't mentioned in Fig 1 caption).

It was done only for the muon channel. Hopefully the meaning is now clear.

– Remove "# events with" for the top two panes: the x axis is the lower bound on Njet

Done

Section 5:
– Please check that the items mentioned in the conclusion are actually spelt out clearly as such in the text – not obvious at the moment in the text are:
  + that the lepton analysis effects from jets are in opposite directions and roughly cancel (maybe I missed this)
  + "a scheme to determine background from the real data is discussed" – is it?
  + again partly cancelling effects, this time from UE and jet fragmentation – again be sure this is discussed clearly in the text
– The "relative contribution of backgrounds" increase with jet multiplicity (not the backgrounds)
– Delete "while maintaining reasonable efficiency"

We have re-written the conclusion to try to address the above points.
We have made sure that all results summarized in the conclusion are presented in the previous chapters.

References:
Ref 12 is not going to appear in the CSC volume. Find an alternative?

This slipped through. Will look for an alternative.

Generally throughout:

- Write Standard Model (caps)

Done

- avoid abbreviations where not standard outside ATLAS, eg write out inner detector, jet energy scale.
- also write out "identification" – don't use "ID"
- define even common abbreviations on first use in the main body of the text (eg LO, NLO)
- You define UE to mean underlying event, but don't use it; don't define it (and avoid using "UE")
- always use the \ell symbol for a generic lepton (e or mu). You should define it on first use (as meaning e or mu) if you don't already.
- Reference style: suggest in the text use "described in Ref. [2]" not "described in [2]", preferably; "MCFM [4]" is OK of course.
- don't use "/c" in GeV/c (usually avoided, but not always)
- Please either merge footnotes into the text, or leave them out; I would suggest putting footnotes 1,3 and 5 in the text and removing 2 and 4 (references suffice for the latter two?).
- Use a symbol for eg $ \Delta R$ and always use it (at the moment sometimes it is italic, sometimes not: it should be
in italics.

We’ve tried to adopt the above conventions in the text.