Referee report on the $\tau\tau$ benchmark (by Keita Yumino and Daniel Jeans)

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The $\tau\tau$ benchmark

- Analysis of $e^+e^- \rightarrow \tau\tau$
- Physics outputs:
  - Measure polarised cross-sections, A_{LR}
  - τ polarisation
- Optimisation aspects:
  - τ identification, efficiency and purity
  - τ decay modes, efficiency and purity
  - "Polarimeter" determination
  - $\Rightarrow$ photon reconstruction and separation in a channel with potentially several very close photons from highly boosted π^0(:s).
- Several presentations, by both Keita and Daniel (Arlington, SwAna phone-meeting, here on Saturday).
- Very preliminary draft of the note sent to me Feb 5.

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Jenny's checklist: 1 - Important questions

"The most important questions raised and how they were addressed"
Points from reading the note:

- Go through the spread-sheet, to identify what is missing:
  - ~~Cross-section level analysis not so relevant for a high-cross-section SM-channel~~
  - Generator level analysis in the note (and in previous presentations). Just need plots in ILD-style.
  - Reco level: My remarks-suggestions has already been addressed in Daniel's talks since:
    - Cut-flow grouping backgrounds after the numbers of τ:s (2+X, some τ:s ($\neq 2$), no τ:s)
    - Plots of signal and backgrounds of (some of) the cut-variables (needs ILD style)
    - Eff/purity matrix for decay-modes (large/small)

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Jenny's checklist: 1 - Important questions, cont'd

- More from the spread-sheet
  - What "cheating" might be useful?
    - τ Cheating: use MC instead of cone to select seen objects from the τ
    - Cheat photons: replace photons seen in the cone by true values
    - Cheat decay-modes: Use seen values of true π, ρ or a_1 decay-products
  - We've discussed these points over coffee.
- Other comments
  - Neutral hadronic clusters: Do you check if the E_{calo}/p_{track} gets better if you add such neutral clusters to the closest charged cluster?
  - For the τ-decay mode, in the $\pi + \gamma$(:s) case, do you check if the mass matches the ρ? Or maybe rather the a_1 ? (Done in Daniel's talk Saturday)
  - What is distilledPFOs actually used for ? (Nothing, really. Probably just use PandoraPFOs)

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Jenny's checklist: 2 - Status of analysis

"Your general assessment of the status of the analysis"

- well advanced, but need to identify and focus on the aspects for the IDR.
- A number of questions has come up where a more detailed check of why we see what we see.
  - Why do we not see as many photons as we should?
  - why do we see neutral hadrons, when there should be none?
  - what are the extra true photons?
  - why does the π^0 reconstruction not better than it is?
- I had fruitful discussions with Daniel the last days in how to attack these issues
- On the π^0:s: Noted that the "DistiledPFOs" doesn't really do the trick in this topology, and conclude to use normal PFOs instead, and drop this issue as a bench-marking output. It is a full topics of it's own, and there isn't enough time/manpower for it

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- But newer plots and tables already shown in presentations.
- Please update the note with this! (and in ILD style)

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Jenny's checklist: 5 - Remaining Issues

"Remaining points to be addressed before material can be included in the ID"

Was mostly discussed along this talk:

- Figure out the "why:s", mainly by cheating aspects and/or checking true information.
- Not only number of photons, but also photon energy.
- Some more work needed to extract the polarimeters in the best way. (We had some interesting exchanges on this the last days)