

Update of $h \rightarrow \mu^+ \mu^-$ Analysis

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ILD Analysis/Software Meeting



General Status

- DBD-paper: reactivated, working on v01 -> v02, analysis redo is started slowly due to unphysical cut
- benchmark analysis: start to check difference between IDR-L and IDR-S
- IDR note: submitted Filip/Ivanka/Jenny/Mikael, waiting/implementing comments
- IDR itself: nothing

Benchmark Analysis: Overview

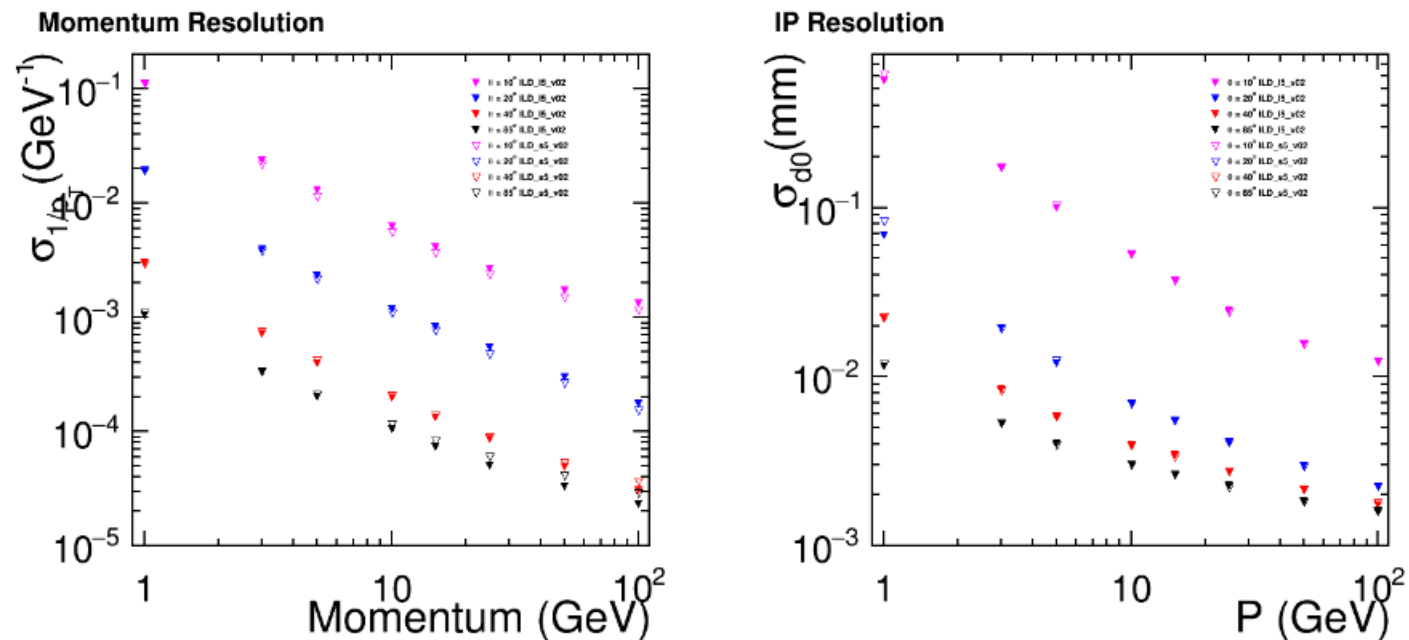
- IDR samples with v02-00-01, further analysis with v02-00-02
- Use IsolatedLeptonTagging (w/o impact parameter and yoke) and VertexInfo
- Cut-based analysis (preselection)
- TMVA (BDTG)
- Toy MC
 - Modeling
 - Pseudo-experiment

Momentum Resolution Difference

- We have some difference between IDR-L and IDR-S in momentum resolution.
- ...directly affect to $M_{\mu^+\mu^-}$ and $\sigma(M_{\mu^+\mu^-})$

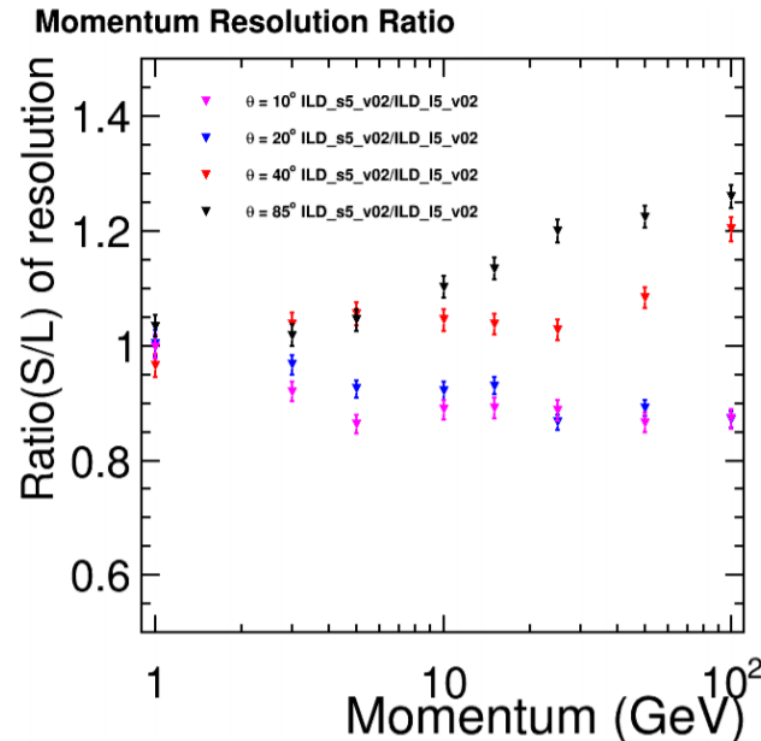
Figure I-8.1

Momentum (left) and impact parameter (right) resolution for the two ILD detector models, as a function of momentum of the single muon. Large detector: closed symbols - small detector: open symbols.

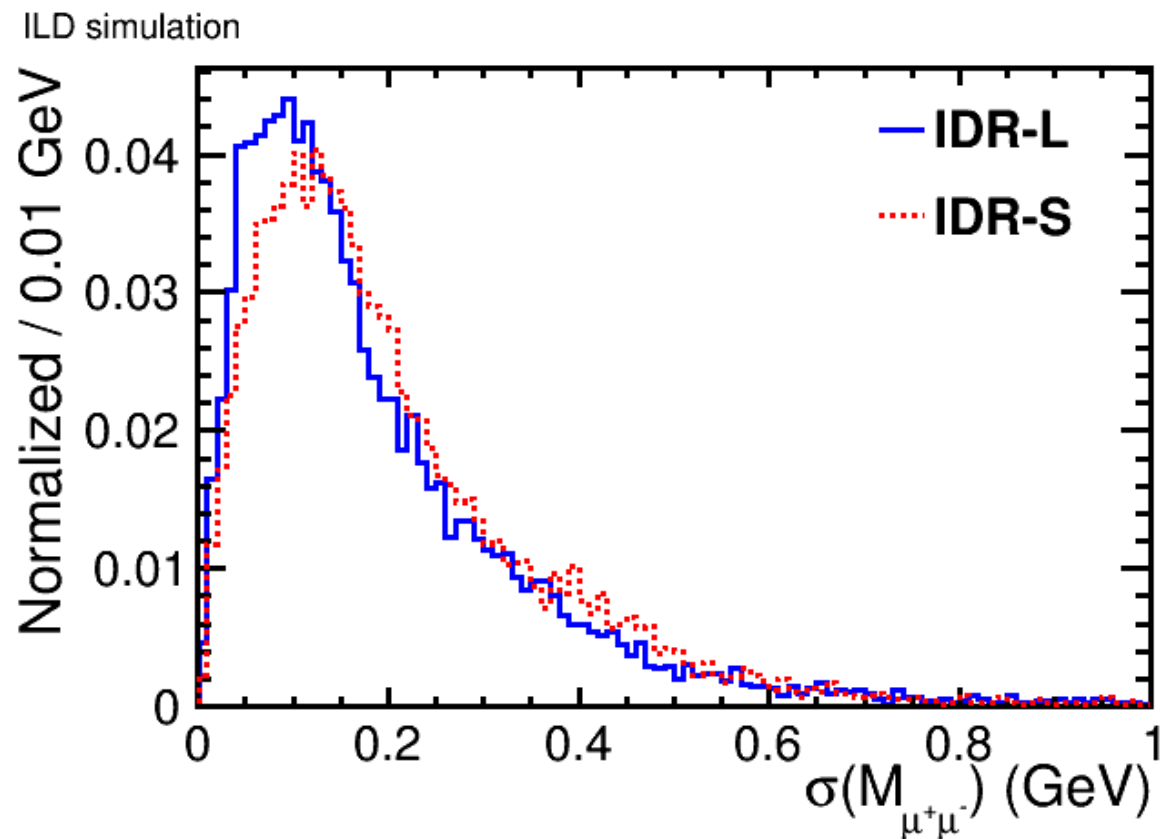
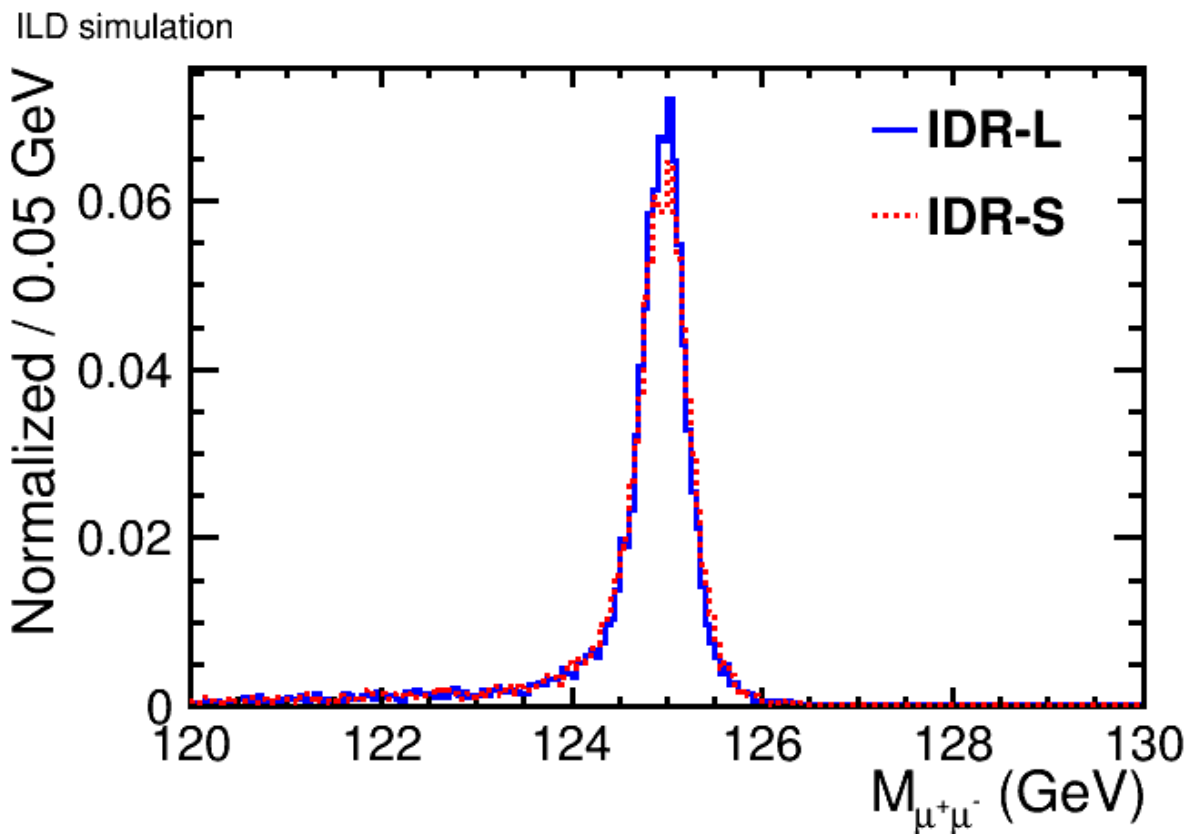


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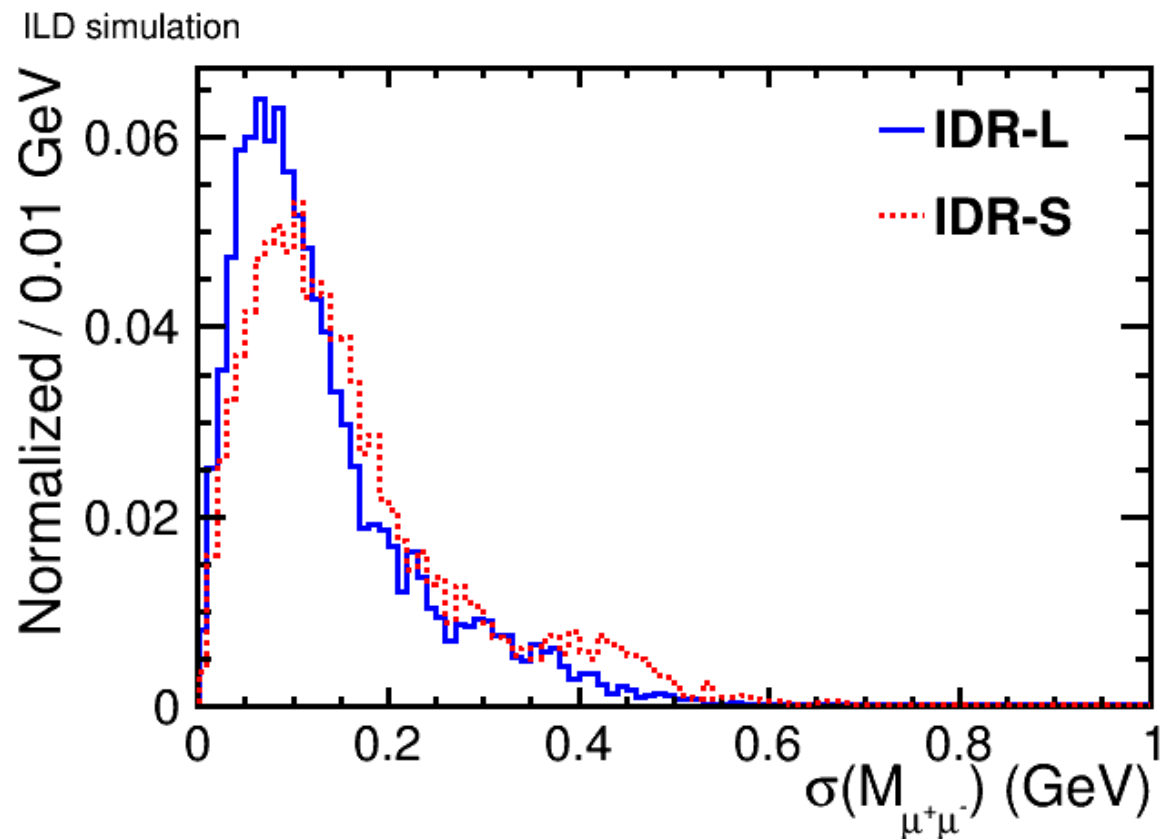
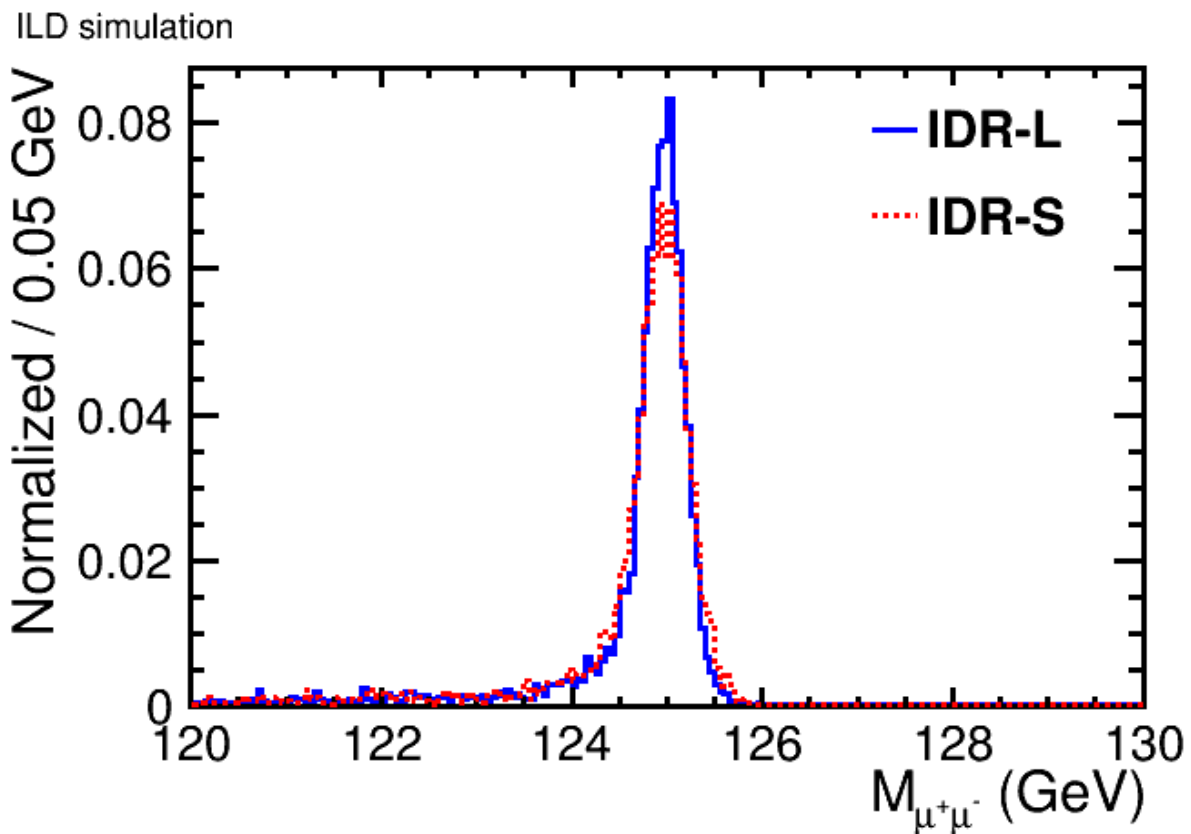


Overall (after preselection)



IDR-L is much better than IDR-S

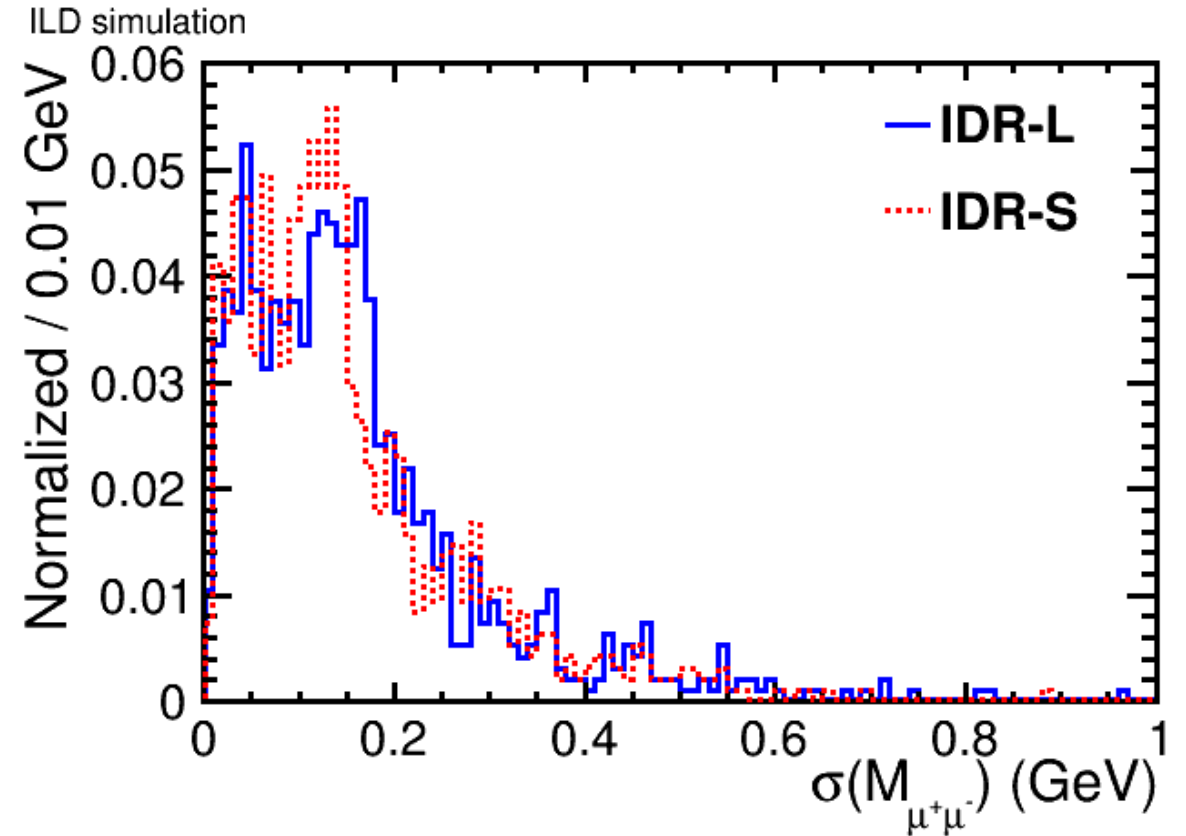
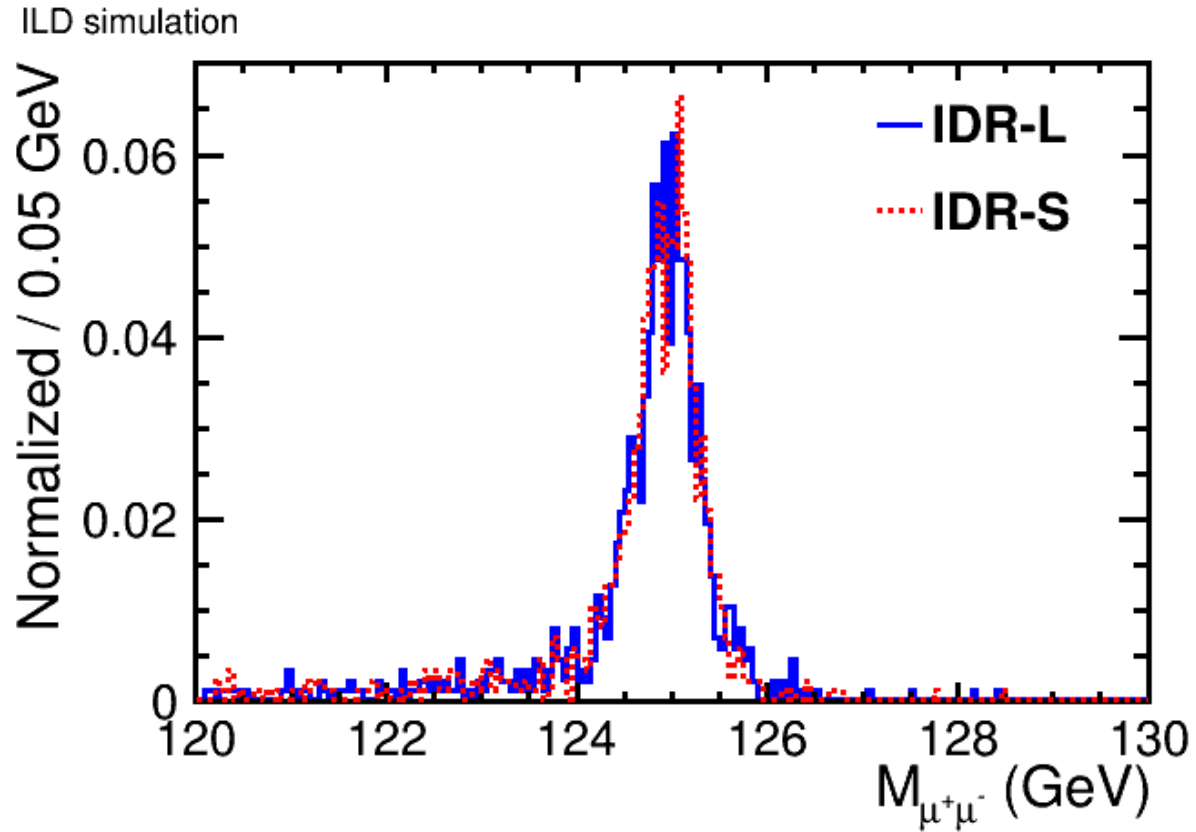
Barrel Region (after preselection)



Both muons are $|\cos \theta| < 0.7$

IDR-L is significantly better than IDR-S

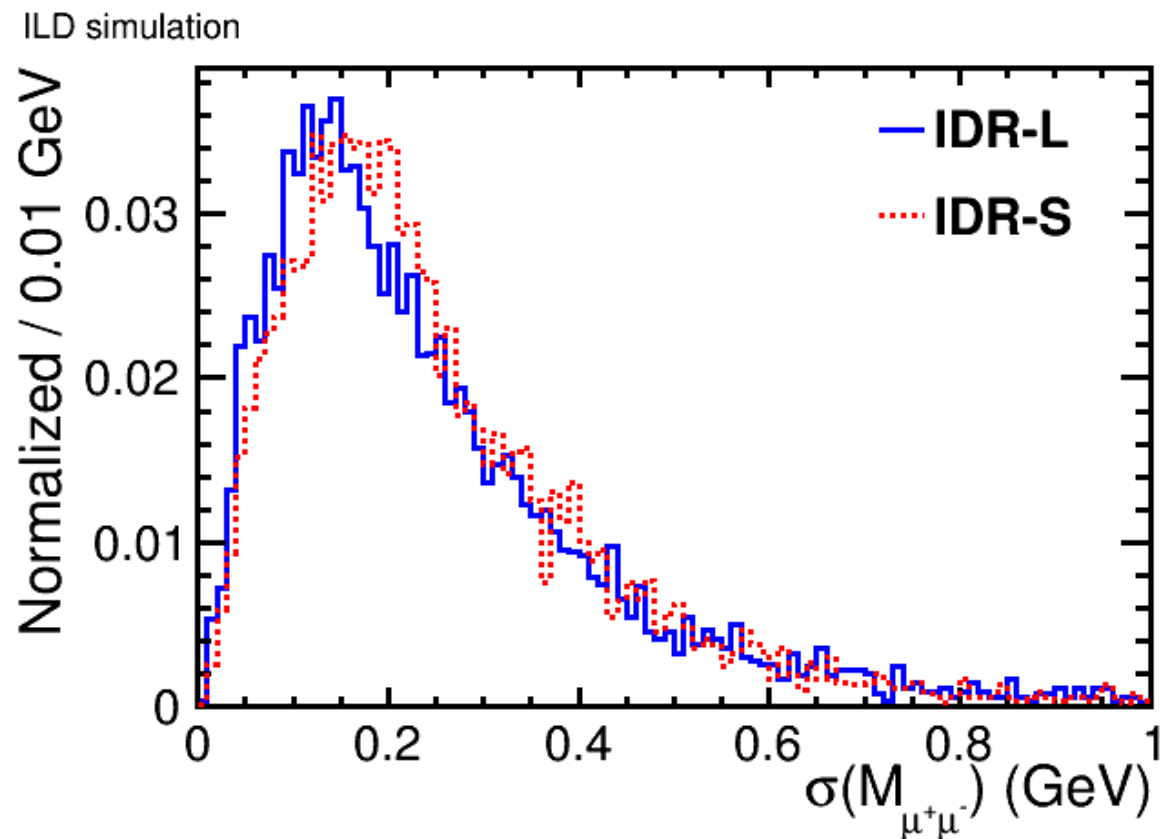
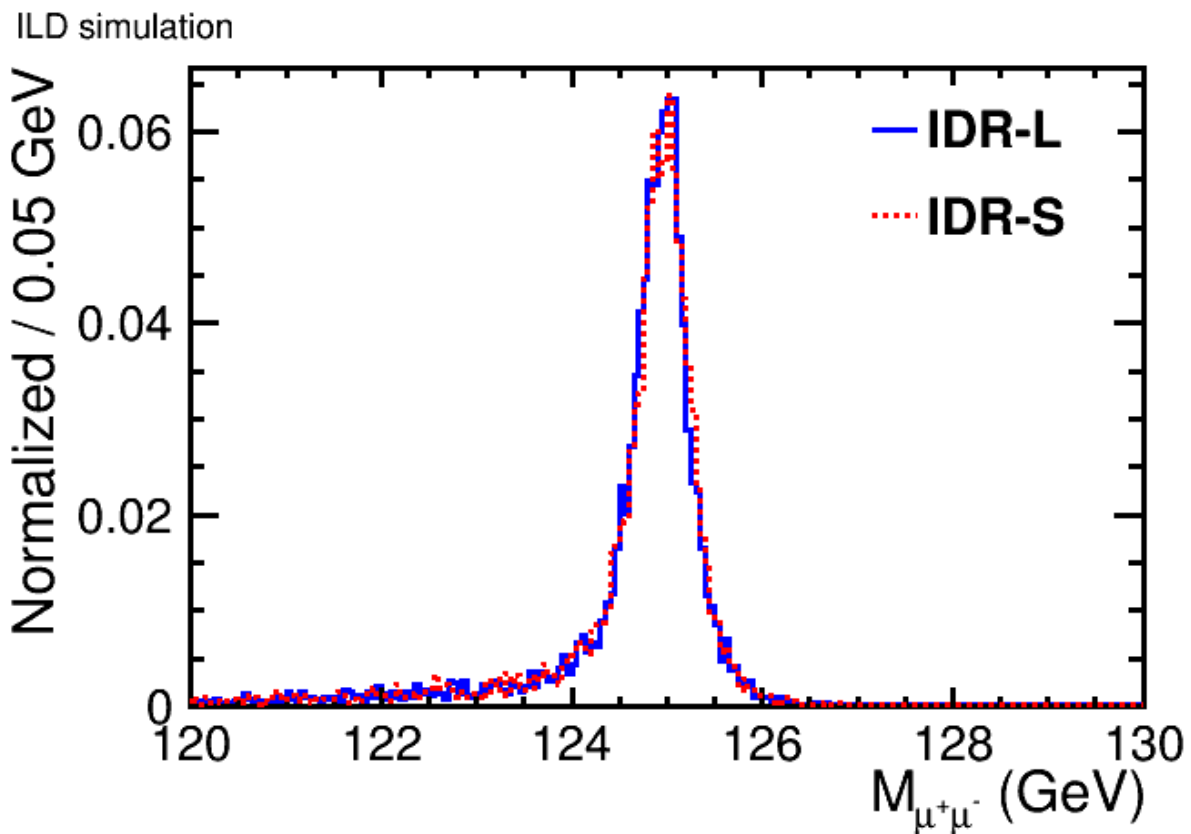
Endcap/Forward Region (after preselection)



Both muons are $|\cos \theta| > 0.7$

IDR-S looks a bit better than IDR-L? (MC statistics...)

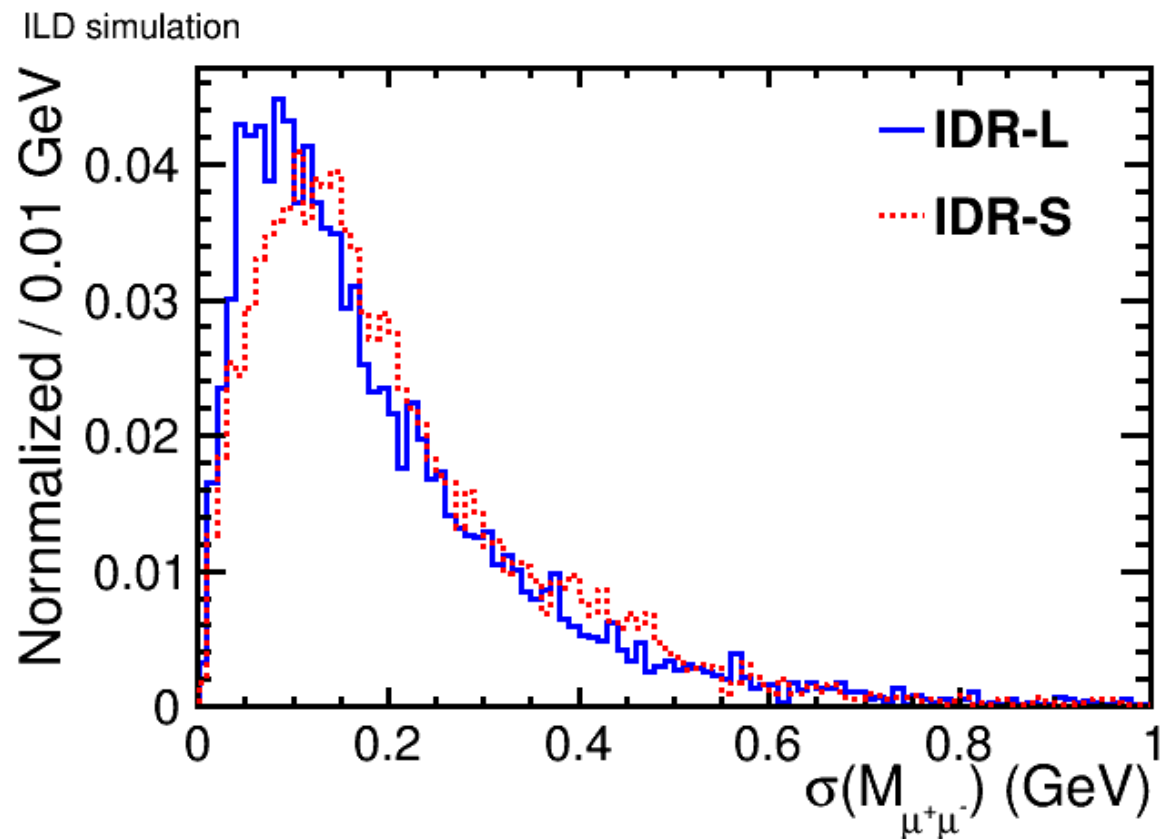
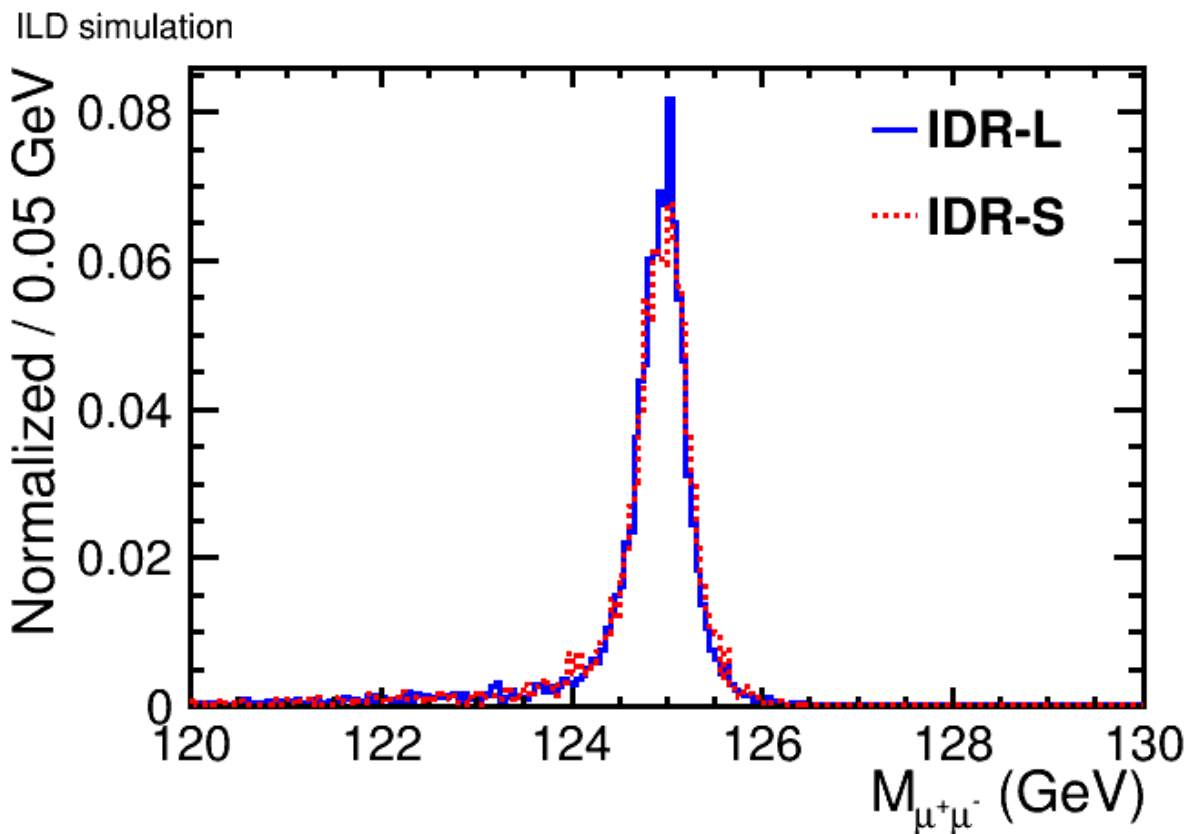
Mixed (after preselection)



Mixed case

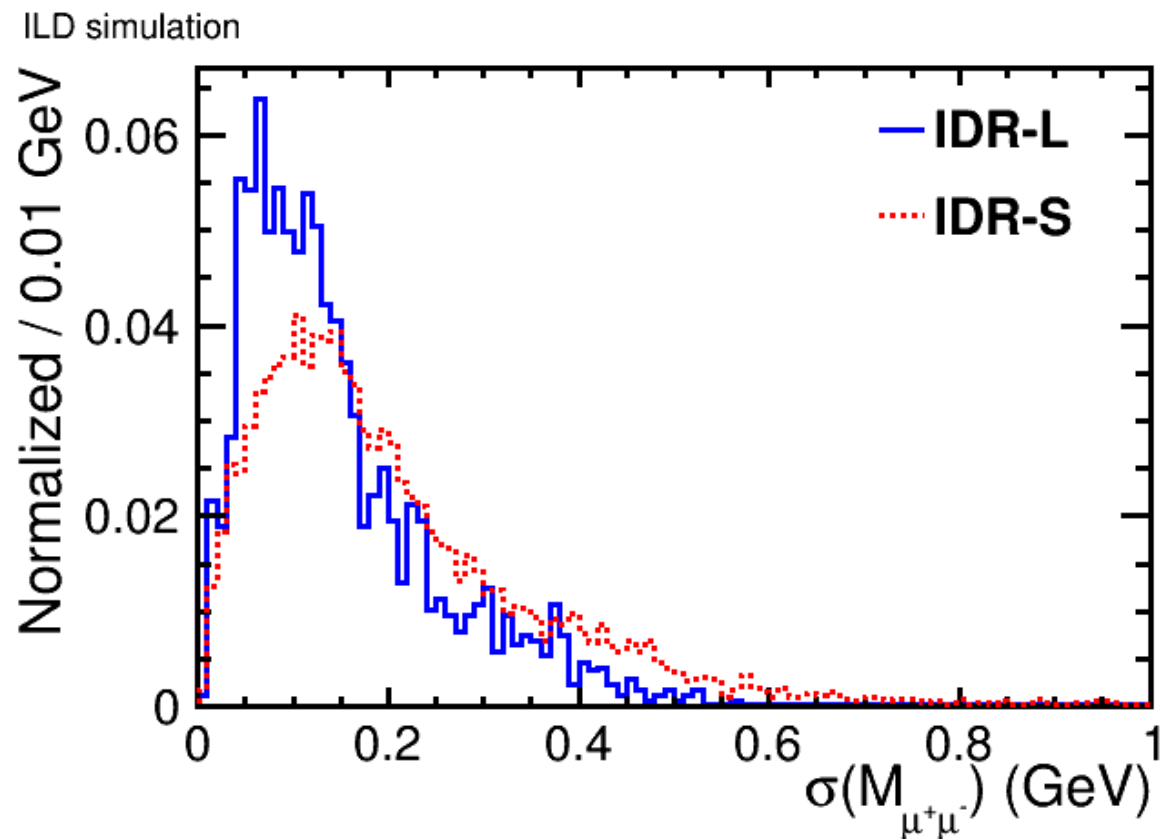
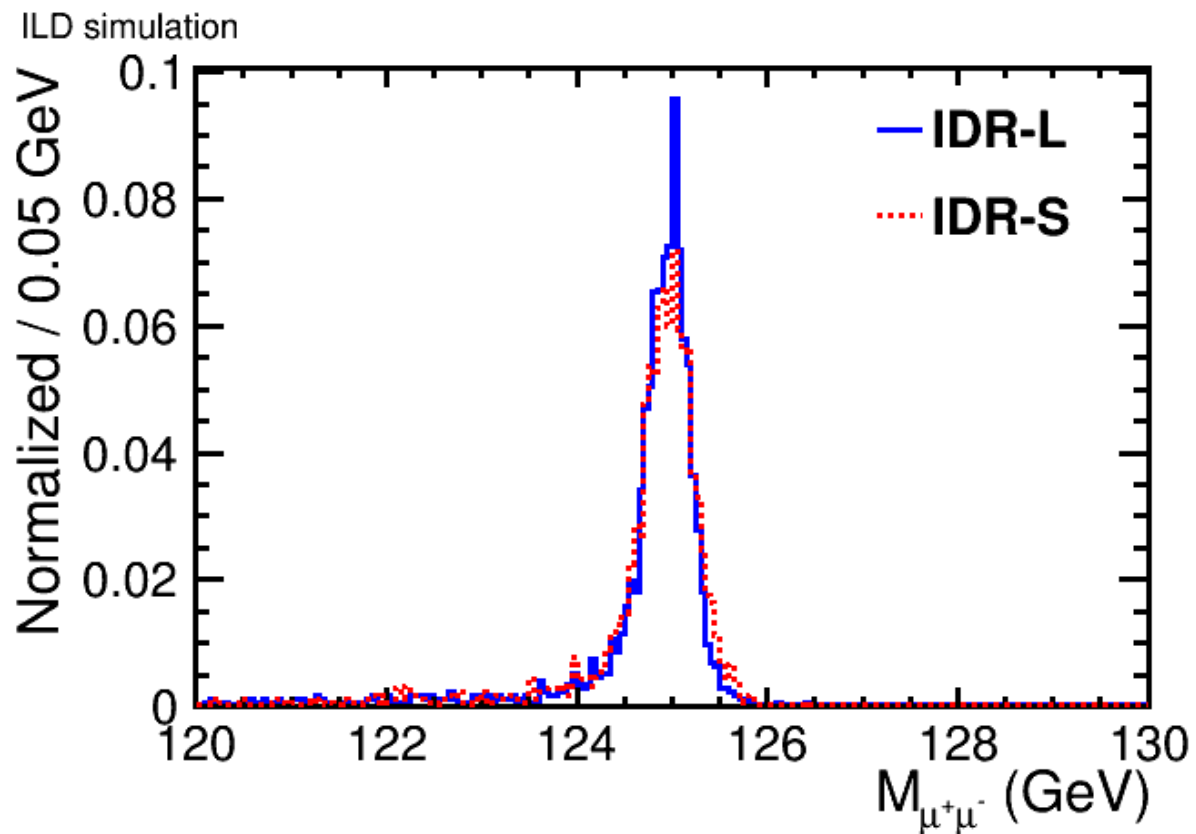
IDR-L looks better in $\sigma(M_{\mu^+\mu^-})$, but worse than barrel

Overall (after BDTG cut)



IDR-L is much better than IDR-S

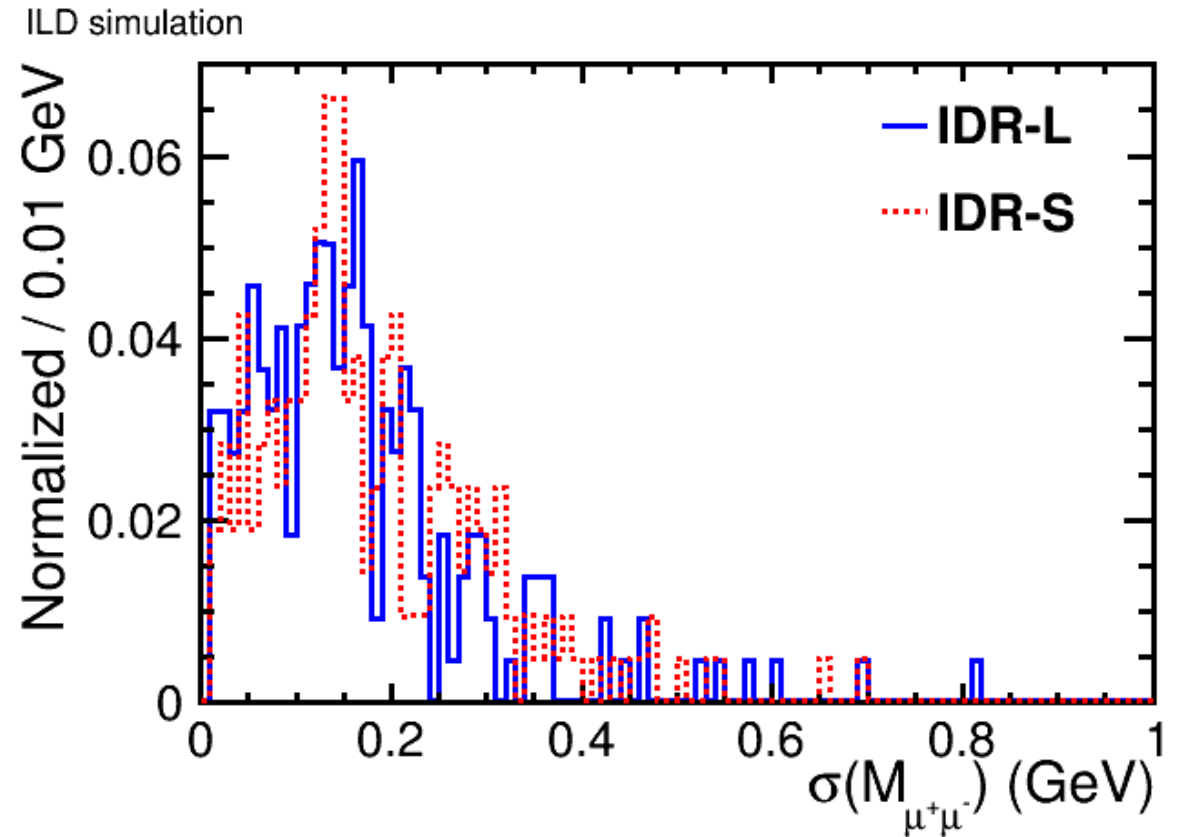
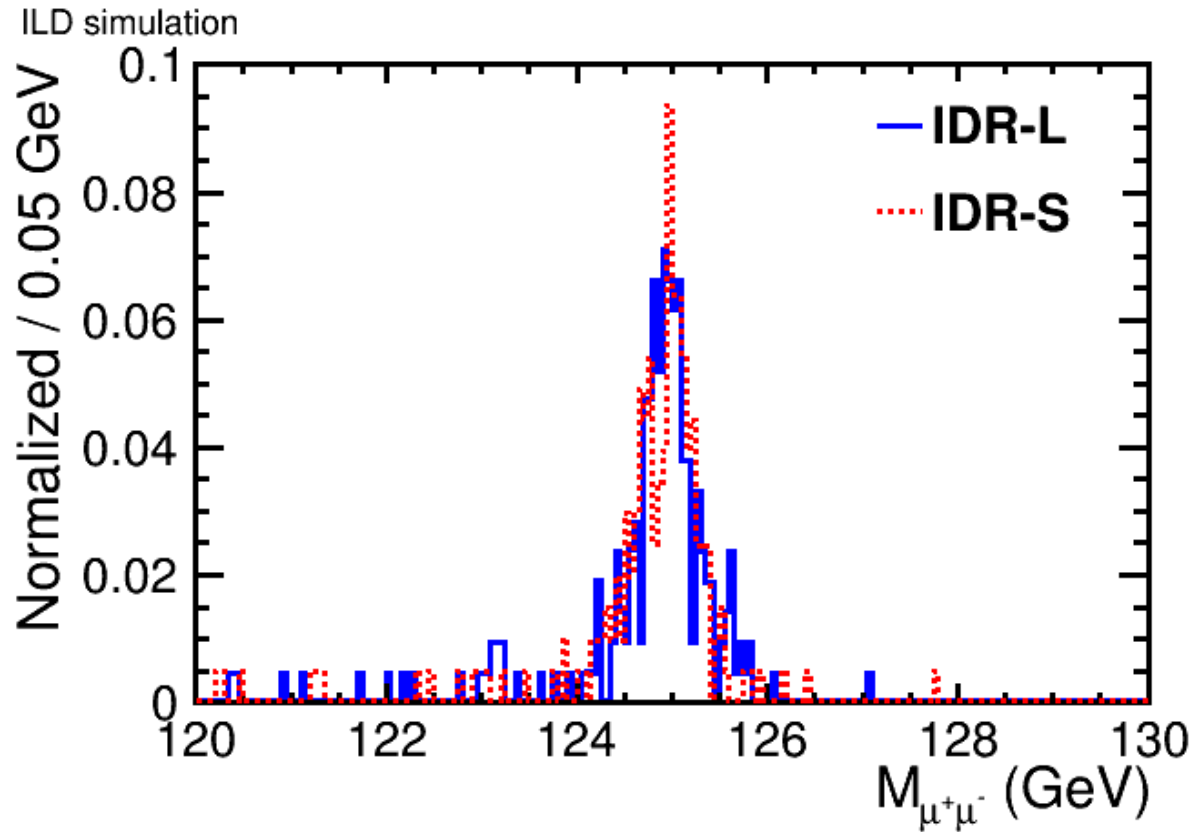
Barrel Region (after BDTG cut)



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IDR-L is significantly better than IDR-S

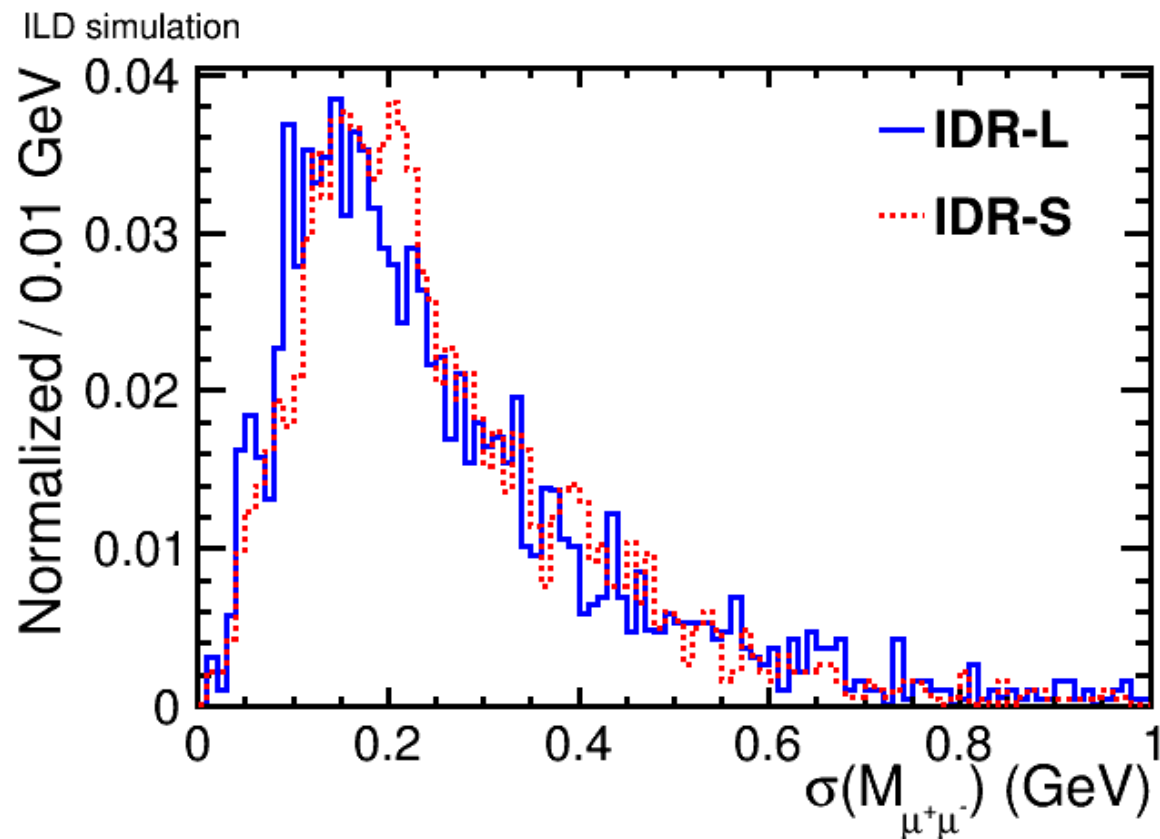
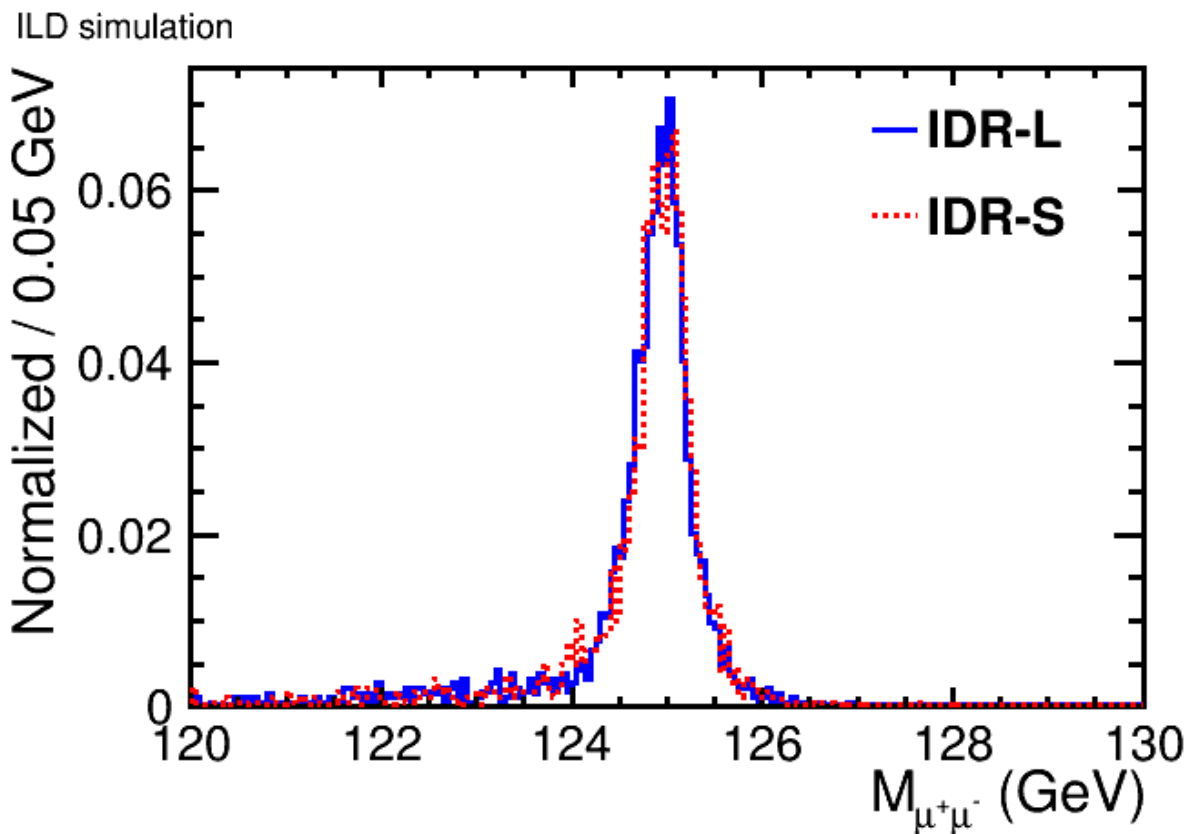
Endcap/Forward Region (after BDTG cut)



Both muons are $|\cos \theta| > 0.7$

IDR-S looks a bit better than IDR-L? (MC statistics...)

Mixed (after BDTG cut)



Mixed case

IDR-L looks better in $\sigma(M_{\mu^+\mu^-})$, but worse than barrel

Results

Table 12: Obtained precision on cross section times branching ratio $\sigma \times \text{BR}(h \rightarrow \mu^+ \mu^-)$ for each analysis channel. The theoretical limit precision is also summarized in the column of theory.

	IDR-L	IDR-S	theory
left	$40.15 \pm 0.15\%$	$41.11 \pm 0.15\%$	13.18%
right	$114.51 \pm 0.69\%$	$113.73 \pm 0.68\%$	35.51%

after 50000 times pseudo-experiments

right: too small number of signal

left: IDR-L is relatively $\sim 2.4\%$ better than IDR-S

theory: 100% signal eff., no bkg., no det. eff.

Discussion (after BDTG cut)

- ~5% of endcap/forward, ~47% of barrel and mixed
- IDR-L gives better performance than IDR-S because $M_{\mu^+\mu^-}$ is better in barrel, and similar in mixed.
- Probably IDR-S is better in endcap/forward, but ratio of event is small, resulting no influence to overall distribution.

Summary

- Performed analysis with IsolatedLeptonTagging, VertexInfo, cut-based analysis, TMVA(BDTG), and toy MC.
- IDR-L gives better result of precision on $\sigma \times \text{BR}(h \rightarrow \mu^+ \mu^-)$ than IDR-S by relatively $\sim 2.4\%$, because barrel is better in IDR-L.
- Probably IDR-S is better in endcap/forward.
- Next
 - IDR: more optimization? $\gamma\gamma \rightarrow 2f$? write note/IDR anyway
 - DBD: re-do analysis, write a paper