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Changes in the PRL draft: Search for Supersymmetry with Gauge-Mediated Breaking in Diphoton Events with Missing Transverse Energy at CDF II

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This document is to show what has been changed in the PRL draft during the first collaboration reading. Most comments are minor and on style. The main change is to the bottom plot of the PRL Figure 1.

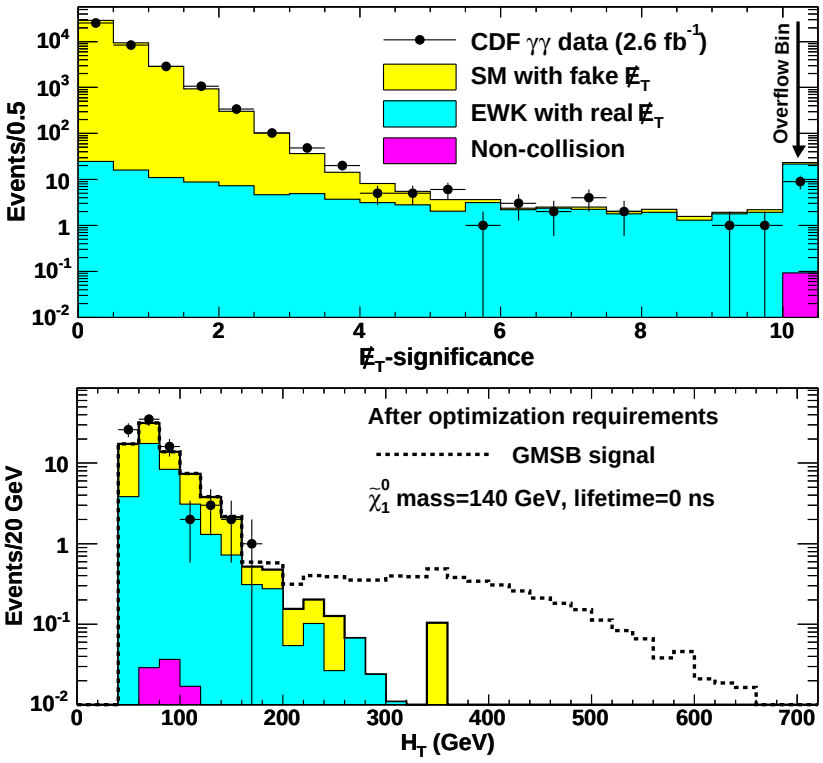


Figure 1: The Figure 1 in PRL draft version 1.0.

The Spokespersons Paper Reading Group (SPRG) raises a question as follows:

"*For the bottom plot of Figure 1 the number of background events of 1.4, quoted in the text, is inconsistent with what this plot shows (bottom part), where above 200 GeV of H_T one can only account for at most 0.7 events. Where is the rest? Is this an error of normalization? Furthermore, if one looks at the bins above 200 GeV of H_T, one sees that SM with fake $\not\!\!E_T$ appear to have a larger normalization than the EWK with real $\not\!\!E_T$ ones. So not only does the whole normalization*

of the region above 200 GeV look incorrect. It is also appears that the two processes have wrong relative fractions there."

Here we would like to answer this question in this document. We agree that the bottom part of Figure 1 was plotted in a misleading fashion and been fixed.

A quick explanation is that the analysis using a global electroweak (EWK) scale factor where we integrate all events above an H_T cut since there are small statistics around the cut region. This is why there is a larger error on the scale factor.

Using a single scale factor is fine for the overall analysis, but is not fine for the plot since the scale factor can vary significantly (again, taken into account in the analysis and optimization as well as in the uncertainty). A better estimate of the bin-by-bin background estimate for the H_T plot in the bottom of Figure 1 is to use a bin-by-bin correction to the EWK background. We have changed the plot to this format. In the old plot the scale factor for all events was smaller than the scale factor for $H_T > 200$ GeV. Thus, the plot contained a smaller scale factor which made the estimate above 200 GeV appear smaller than it should have. Now that we plot bin-by-bin the plot and the analysis are more consistently displayed.

Too see why the scale factor is a function of H_T see Figure 2 which shows the $e\gamma$ data and MC comparison. The bin-by-bin ratio is shown in Figure 3-(a). The scale factor (the ratio of the integrated number of events above the H_T cut) as a function of cut can be found at Figure 3-(b). As can be seen, with no cut the scale factor would be 0.78±0.02, and above our cut is 1.41±0.47. The plot in the PRL was with a constant scale factor 0.78, as shown in Figure 4-(a). A version with a constant scale factor of 1.41 is shown in Figure 4-(b). With this constant global scale factor, 1.41, EWK background prediction above H_T=200 GeV is 0.92±0.21 (stat. only). The new bin-by-bin corrected version is shown in Figure 5 and EWK background estimate with this bin-by-bin scale correction is 0.91±0.21 (stat. only), which is consistent with the prediction from a constant scale facotr. This is the version that is now in the PRL, as shown in Figure 6.

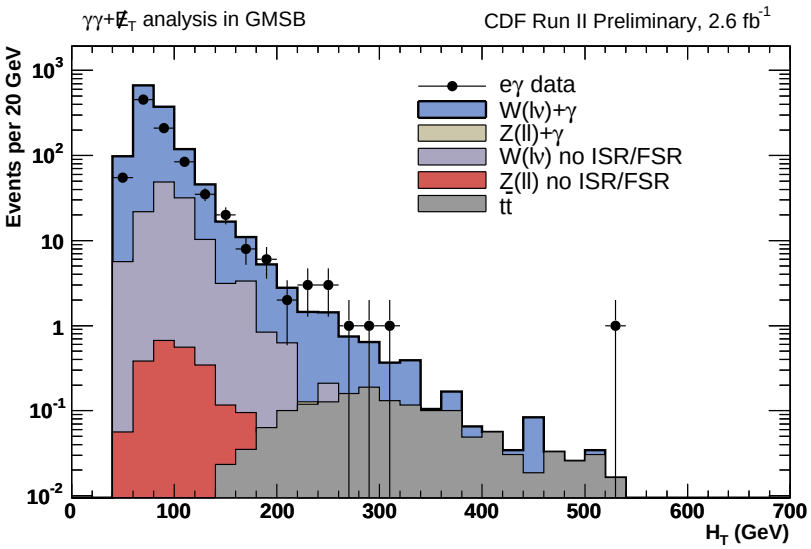
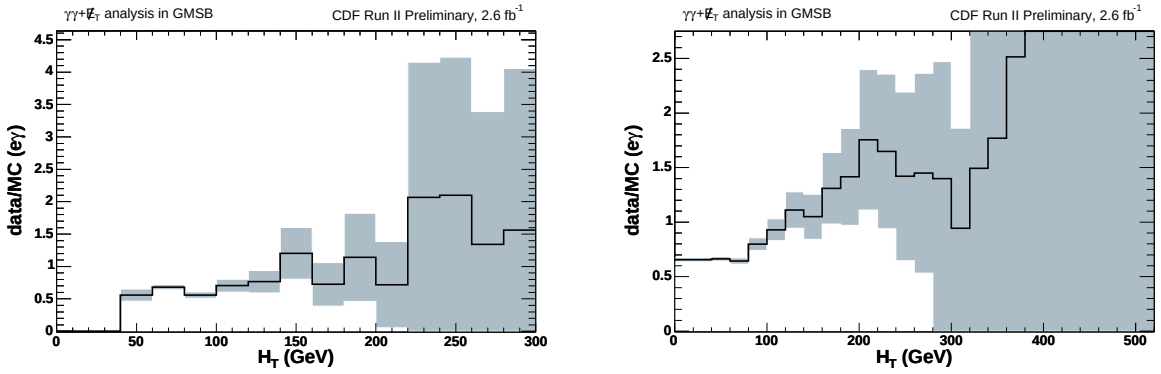
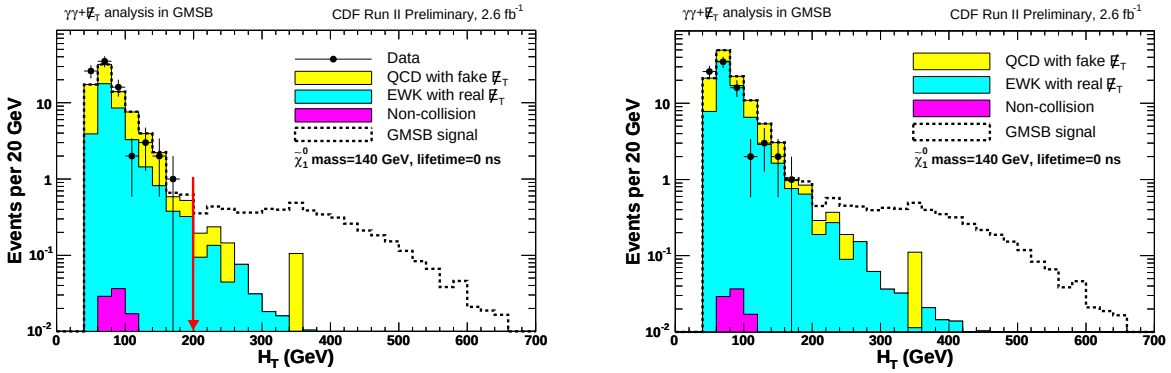


Figure 2: The H_T plot for $e\gamma$ data and MC.



(a) (b)

Figure 3: (a) shows the bin-by-bin ratio, $e\gamma$-data/MC. (b) is the scale factor, the ratio of the integrated number of events above the H_T cut.



(a) (b)

Figure 4: (a) shows the old H_T plot with a constant scale factor of 0.78. (b) is the plot with a constant scale factor of 1.41.

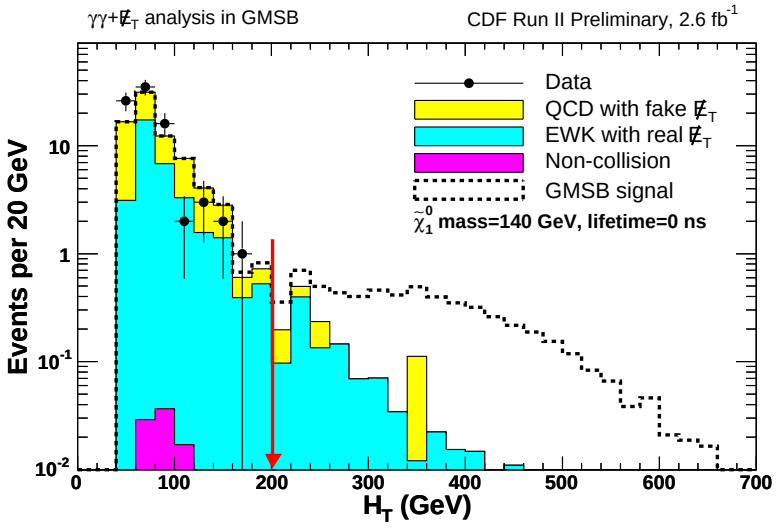


Figure 5: The new H_T plot with the bin-by-bin correction.

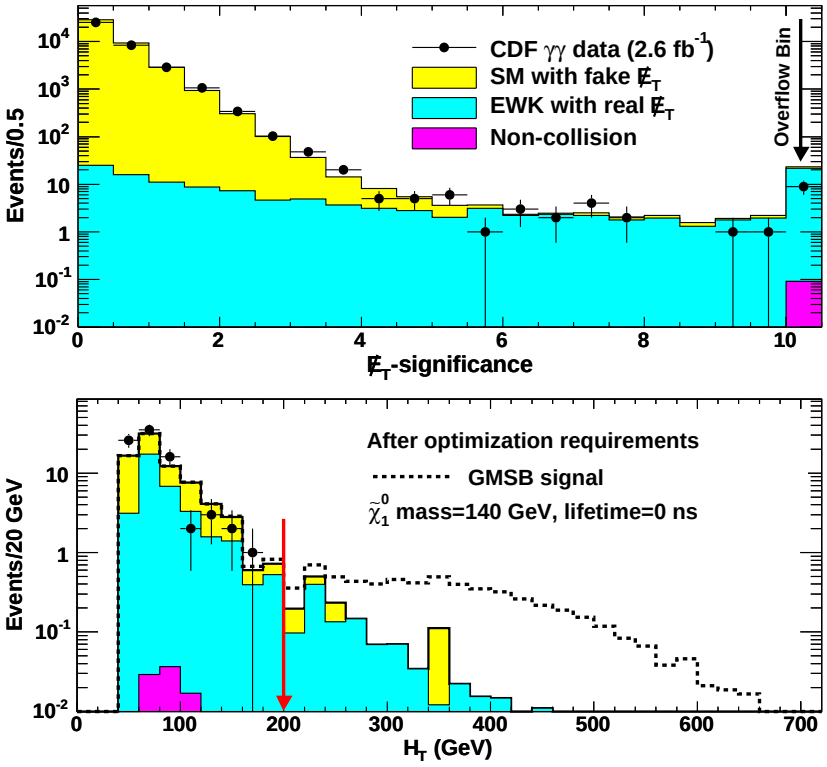


Figure 6: The H_T plot (bottom) with the bin-by-bin correction in PRL version.

Additional minor changes are:

- We added that the Branching Ratio of $\tilde{\chi}_1^0 \to \gamma\tilde{G}$ is greater than 96%.
- We fixed some typos in the references.
- We also added two additional references. One is Eunsin's thesis (Ref. [12]), which referred by line 39 in page 1. The other is about the GMSB simulation with full SUSY channels in line 94 in page 2 to refer to [21], explaining why we include all SUSY production.
- We rephrased a number of sentences to make them more explicit, and better grammatically.