

# High Mass $e\mu$ Search Z' Blessing

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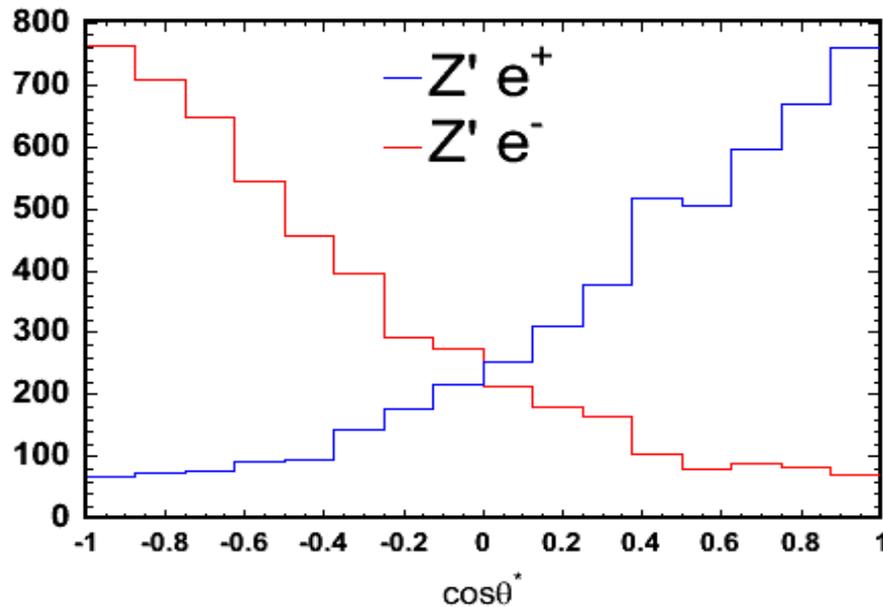
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# Overview

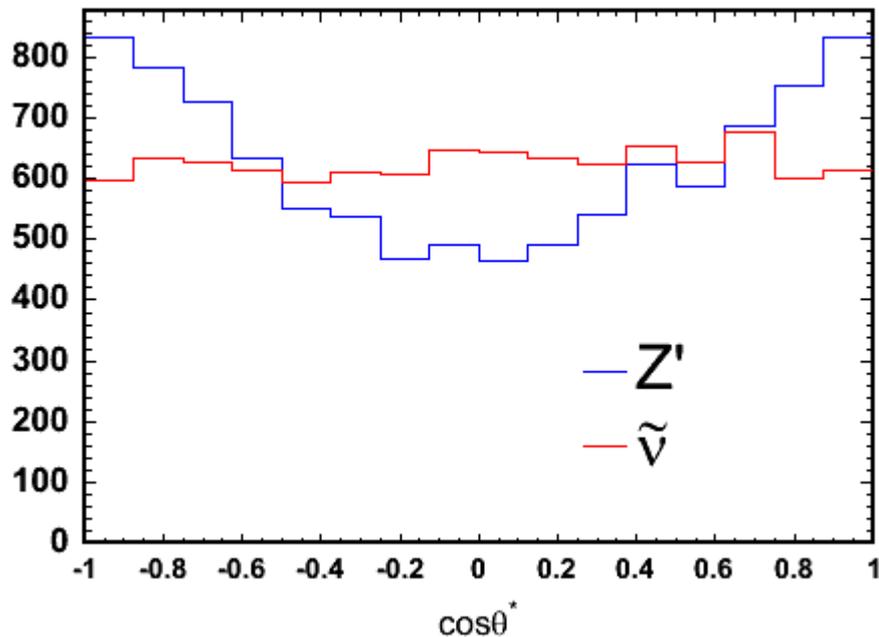
- Added a  $Z'$  interpretation to the high mass  $e\mu$  analysis.
  - Required new acceptance curves
    - Smaller acceptance relative to sneutrino
  - NLO  $Z'$  cross section w/ help from P. Langacker and B. Dobrescu
  - Results
    - exclusion in the  $M_{Z'}-Q_{12}^I$  for different E6 models
    - exclusion in the “model-dependent”  $c_u-c_d$  plane

# Z'/snu Helicity - Angular Distributions

generator  $e^\pm \cos\theta^*$ ,  $M_{Z'}=200\text{GeV}/c^2$ , 10K evts total



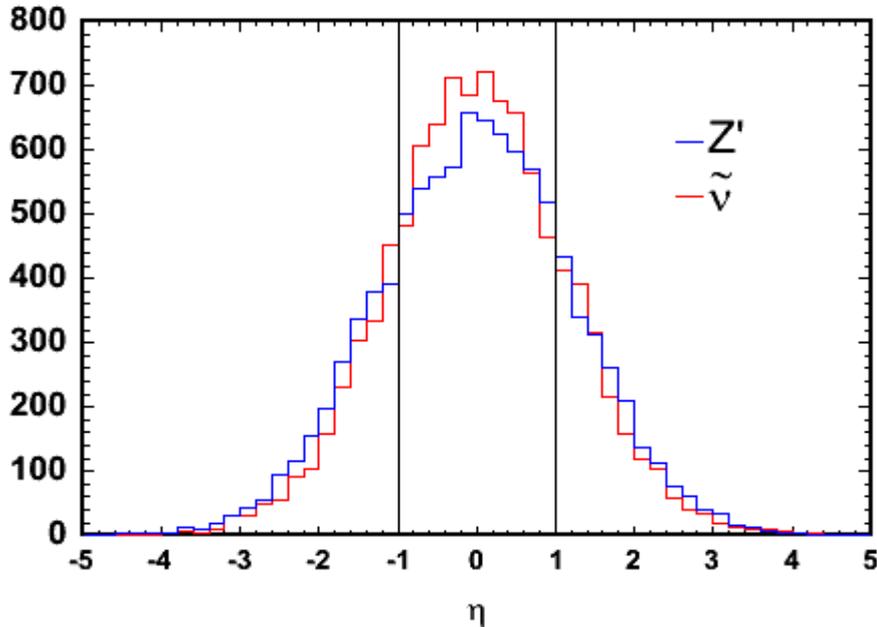
generator  $e^\pm \cos\theta^*$ ,  $M_{Z',\tilde{\nu}}=200\text{GeV}/c^2$ , 10K evts each



- We choose pure LH  $Z'$  couplings, favored in E6 theories with LFV.
- This gives asymmetric  $\cos\theta^*$  distributions similar to  $W$  decay.
- $\theta^*$  - angle of lepton in  $Z'$  rest frame w.r.t. beam axis
- **Snu**  $\theta^*$  distribution is isotropic,  **$Z'$**  peaks at  $\cos^2\theta^* = \pm 1$
- Both  **$Z'$** /**Snu** are produced with large longitudinal momentum. Expect leptons from  **$Z'$**  to be more forward.

# Z' vs. Snu Acceptance

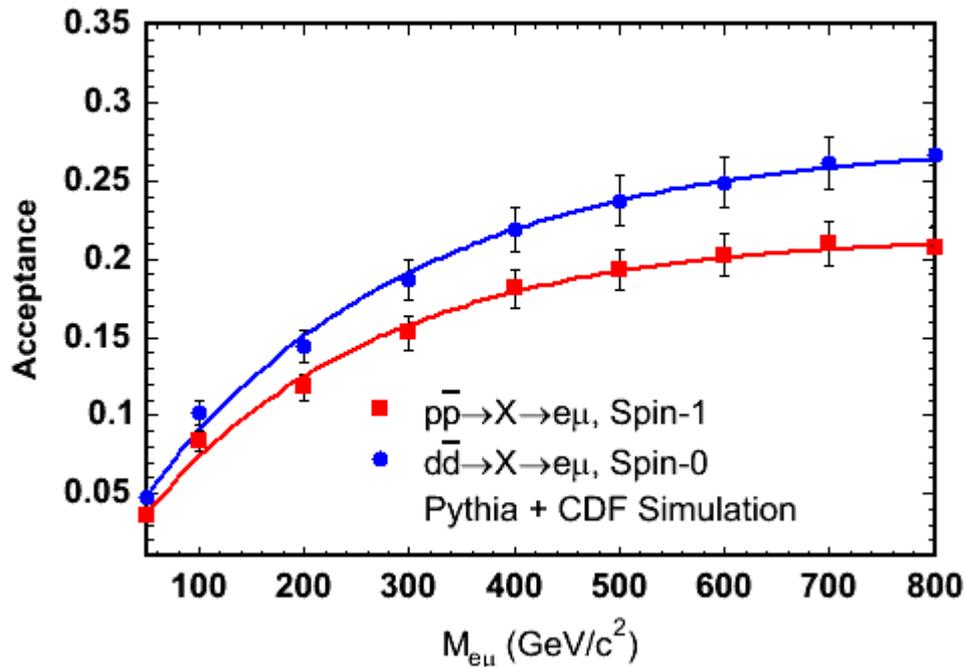
generator  $e^\pm$   $-\eta$ , 10K evts.



←  $e^\pm$   $\eta$  for 200GeV  $Z'/Snu$   
We select  $\eta < \text{abs}(1)$   
leptons

← Gen-level  $\Delta\alpha_{\text{rel}}$  after  $\eta$   
cuts : 15%

CDF Run 2 Preliminary, 344  $\text{pb}^{-1}$

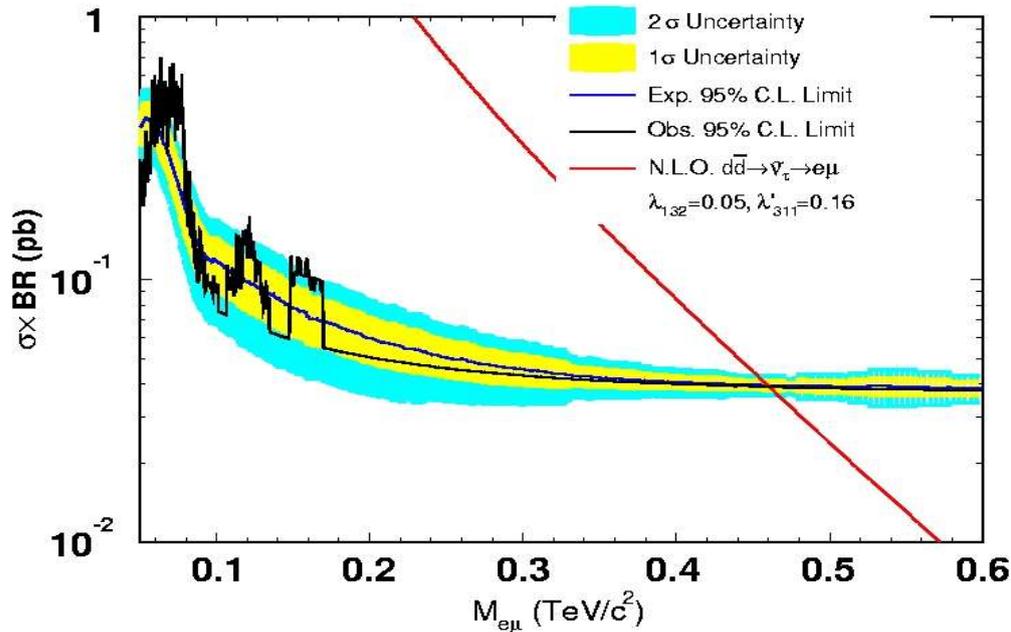


←  $Z'$  vs sneutrino  
acceptance

←  $\Delta\alpha_{\text{rel}}$  @ 200GeV after  
full sim : 18%

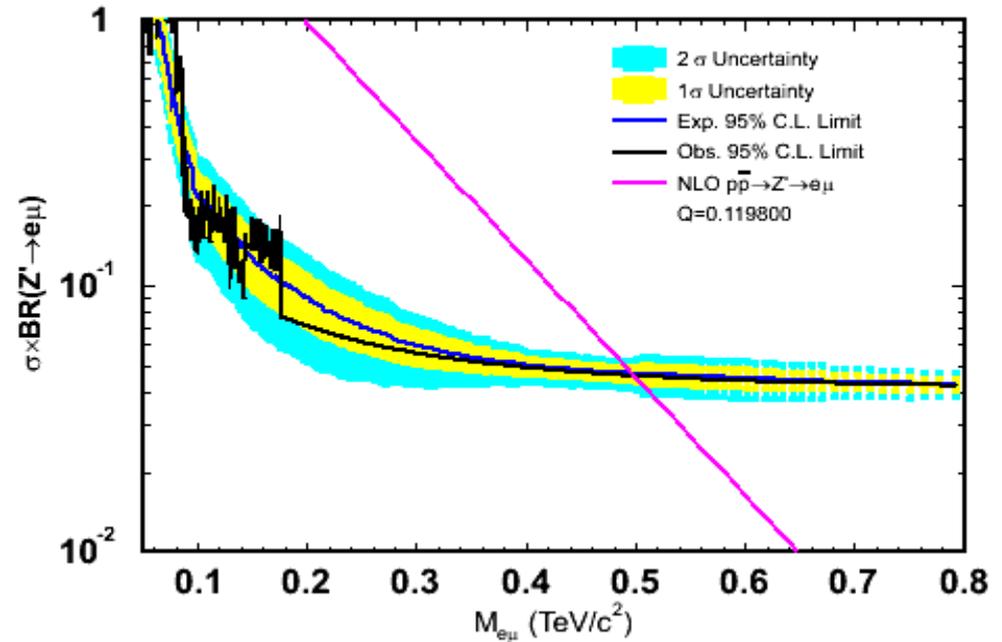
# Z' Cross Section

CDF Run 2 Preliminary, 344 pb<sup>-1</sup>



snu

CDF Run 2 Preliminary, 344 pb<sup>-1</sup>



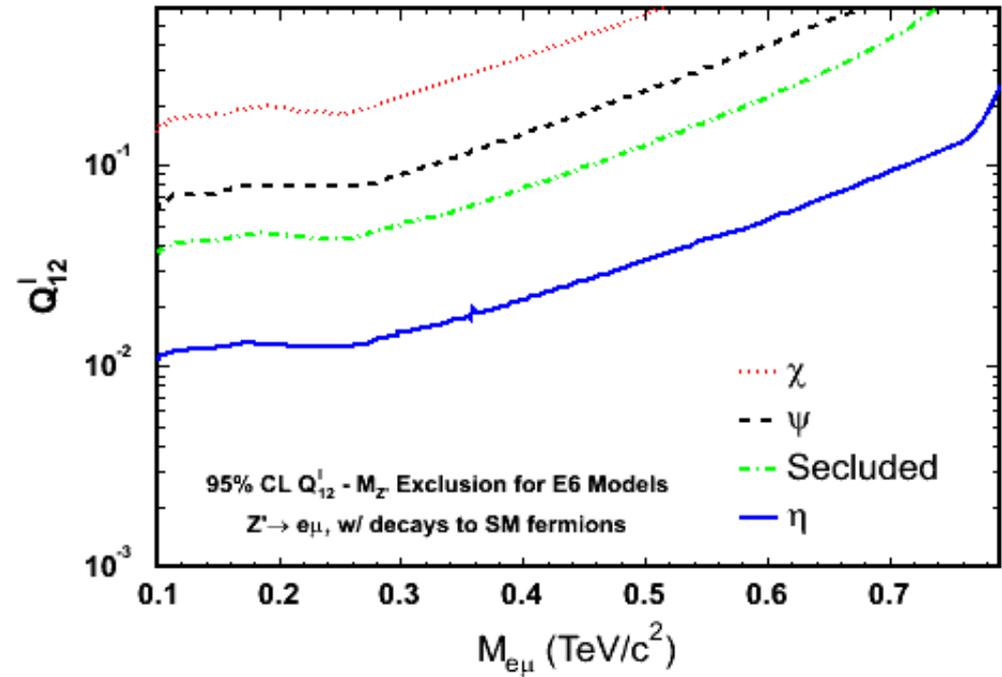
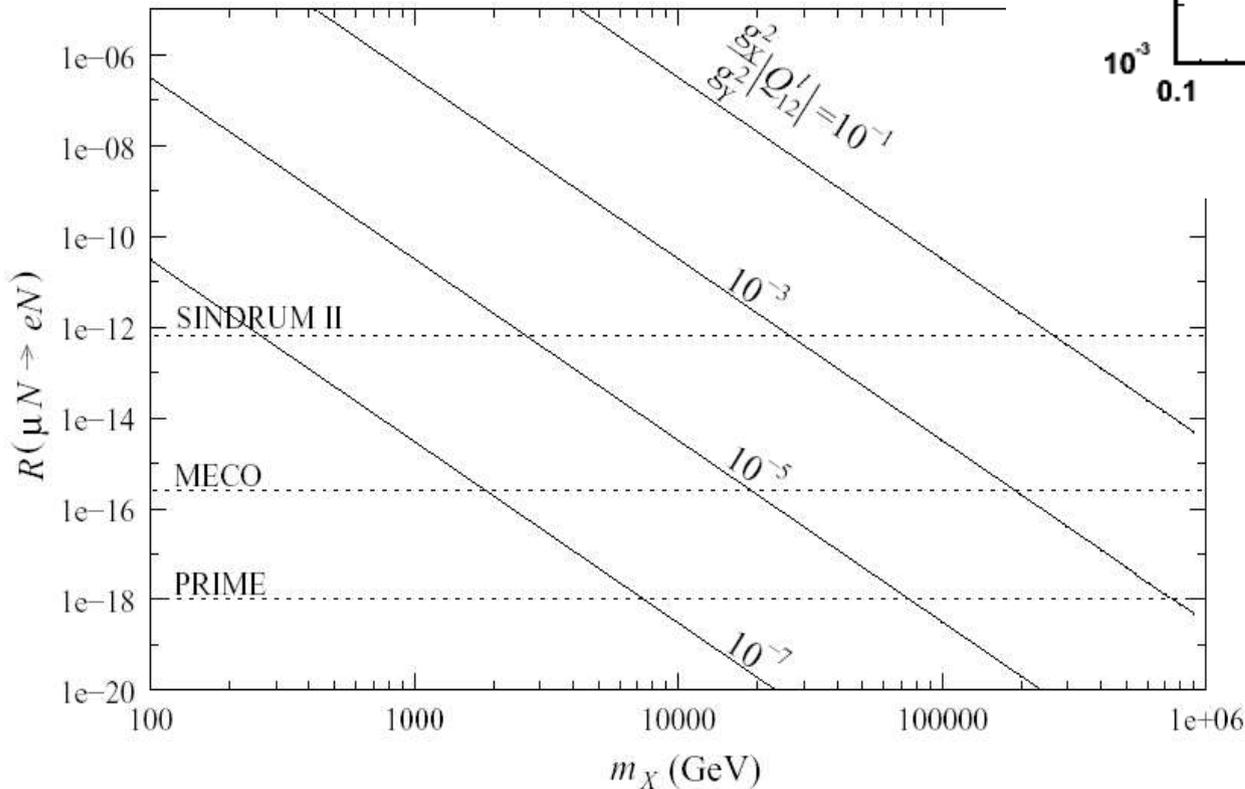
Z'

- Use acceptances in Bayesian routine for an observed upper-limit  $\sigma\text{BR}$
- Lower Z' acceptance seen as upward shift in the observed  $\sigma\text{BR}$
- NLO  $Z' \rightarrow e\mu$   $\sigma\text{BR}$  from Kang/Langacker code
  - Cross-checked with  $Z' \rightarrow ee$  plots in hep-ph/0412190
  - Add a LFV  $Q_{12}^l$  coupling to 4 different E6 models
- Intersection w/ NLO gives “mass limit” for choice of  $e\mu$  couplings. Z'-qqbar couplings specified by the models.

# Z' Limits

CDF Run 2 Preliminary, 344 pb<sup>-1</sup>

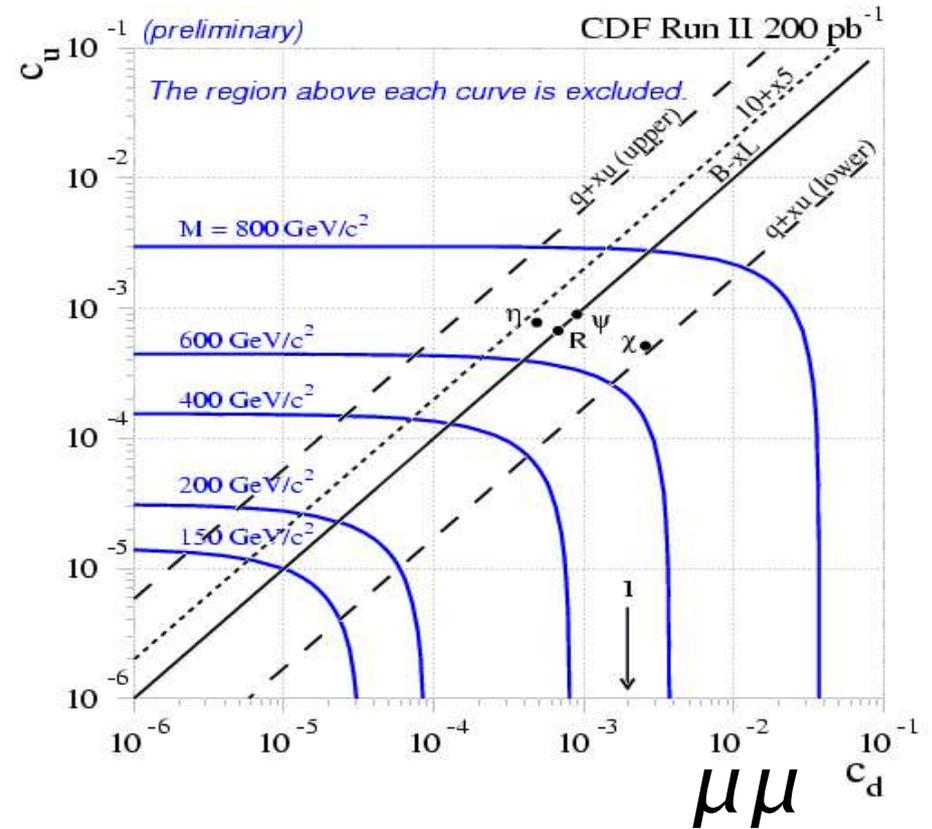
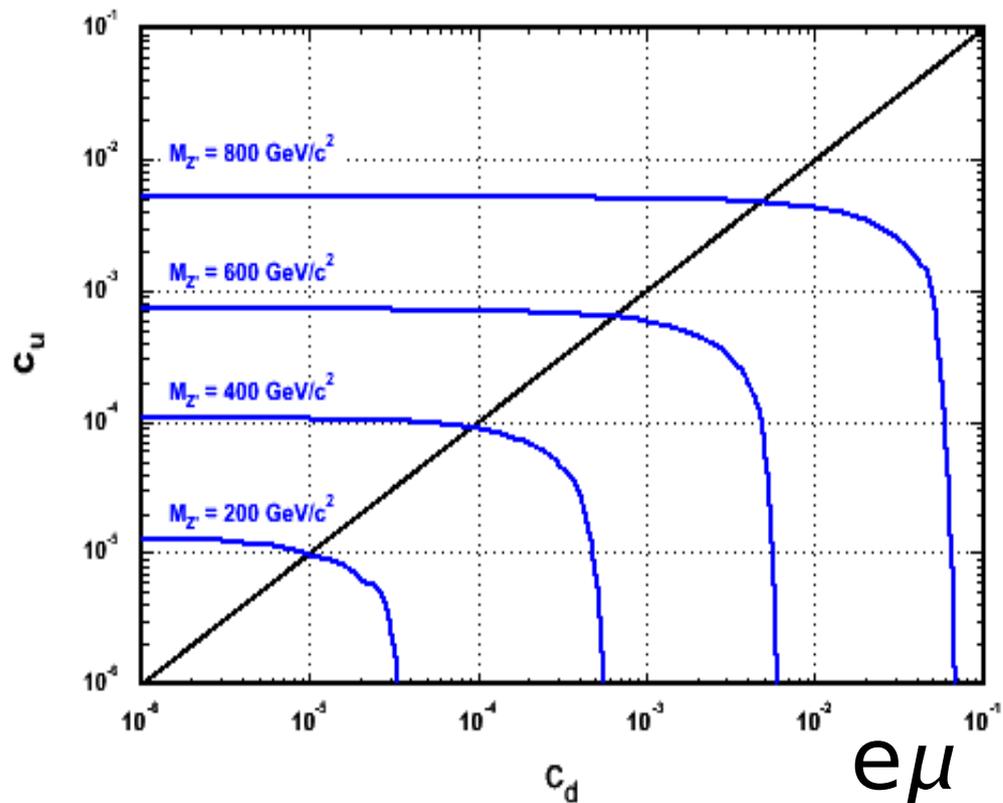
- Exclusion Regions →
  - Vary the couplings and plot the intersection points for each model



- Current best limits from indirect searches
  - $\mu$ -conversion &  $\mu \rightarrow eee$
  - hep-ph/0110095

# Z' Limits

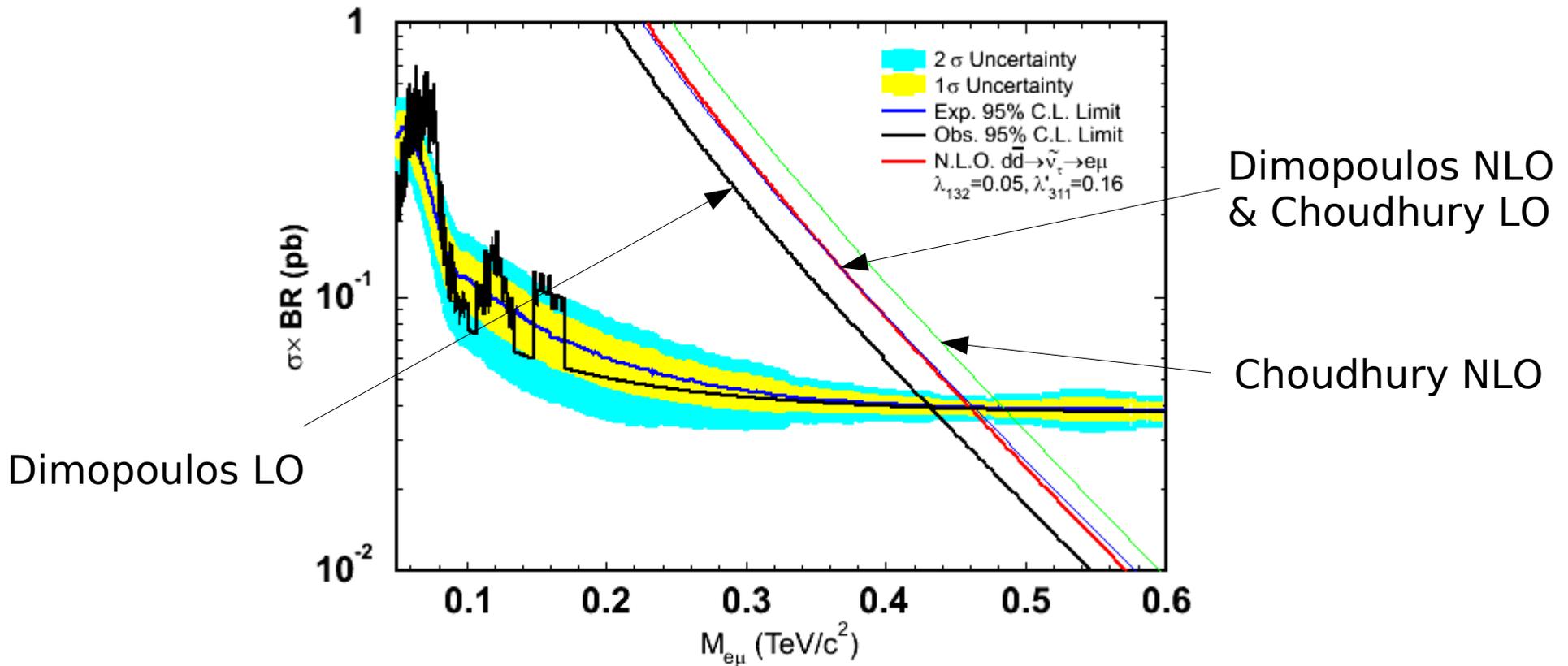
CDF Run 2 Preliminary, 344 pb<sup>-1</sup>



- Another representation of our limits ...
- Expression for Z'  $\sigma$ BR can be split into model dependent ( $c_u, c_d$ ) and model independent parts ( $w_u, w_d$ ).
  - See hep-ph/0408098
  - B. Dobrescu, et. al.'s  $w_u, w_d$  code from M. Schmitt

# Also, a snu cross-check ...

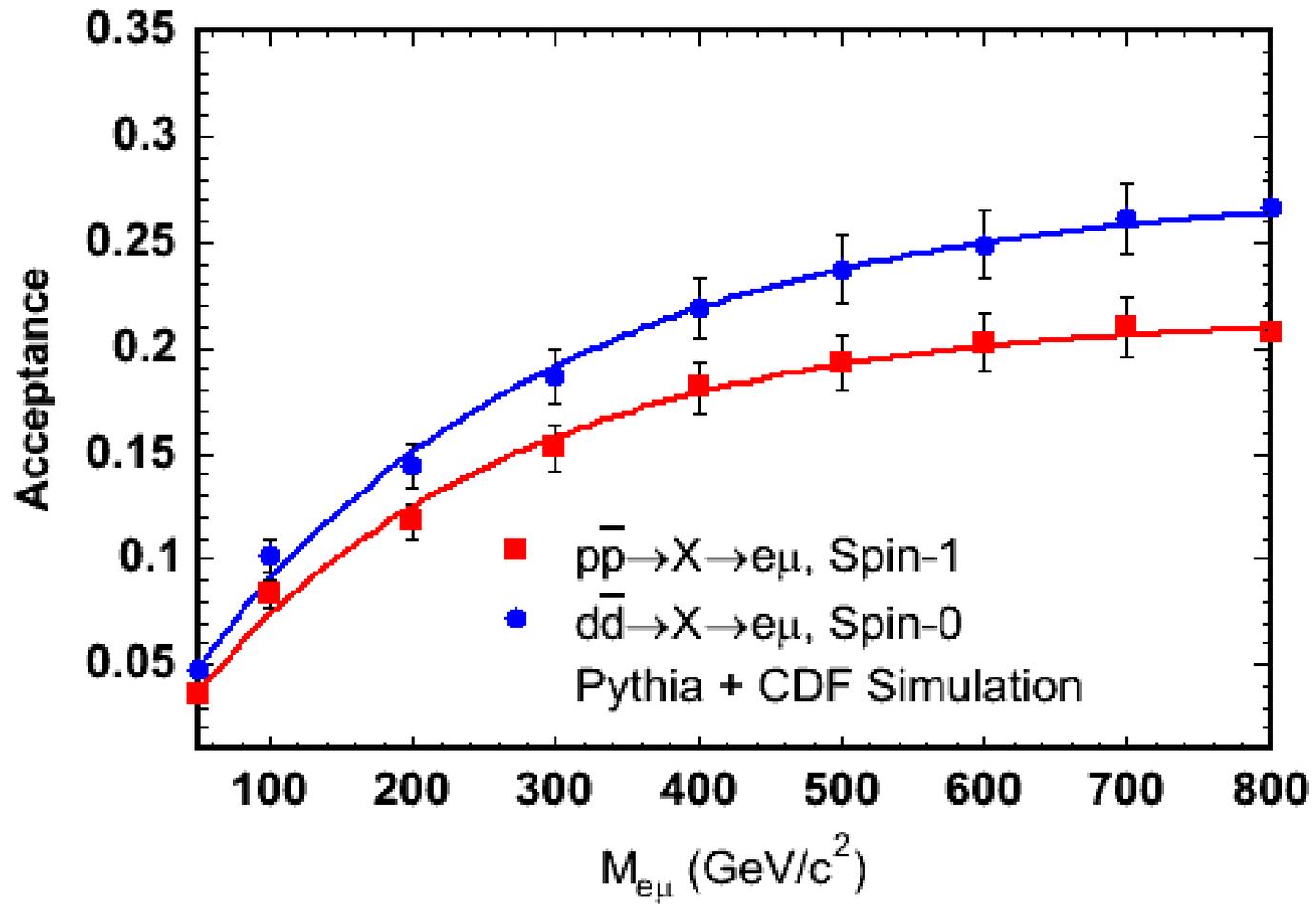
CDF Run 2 Preliminary, 344 pb<sup>-1</sup>



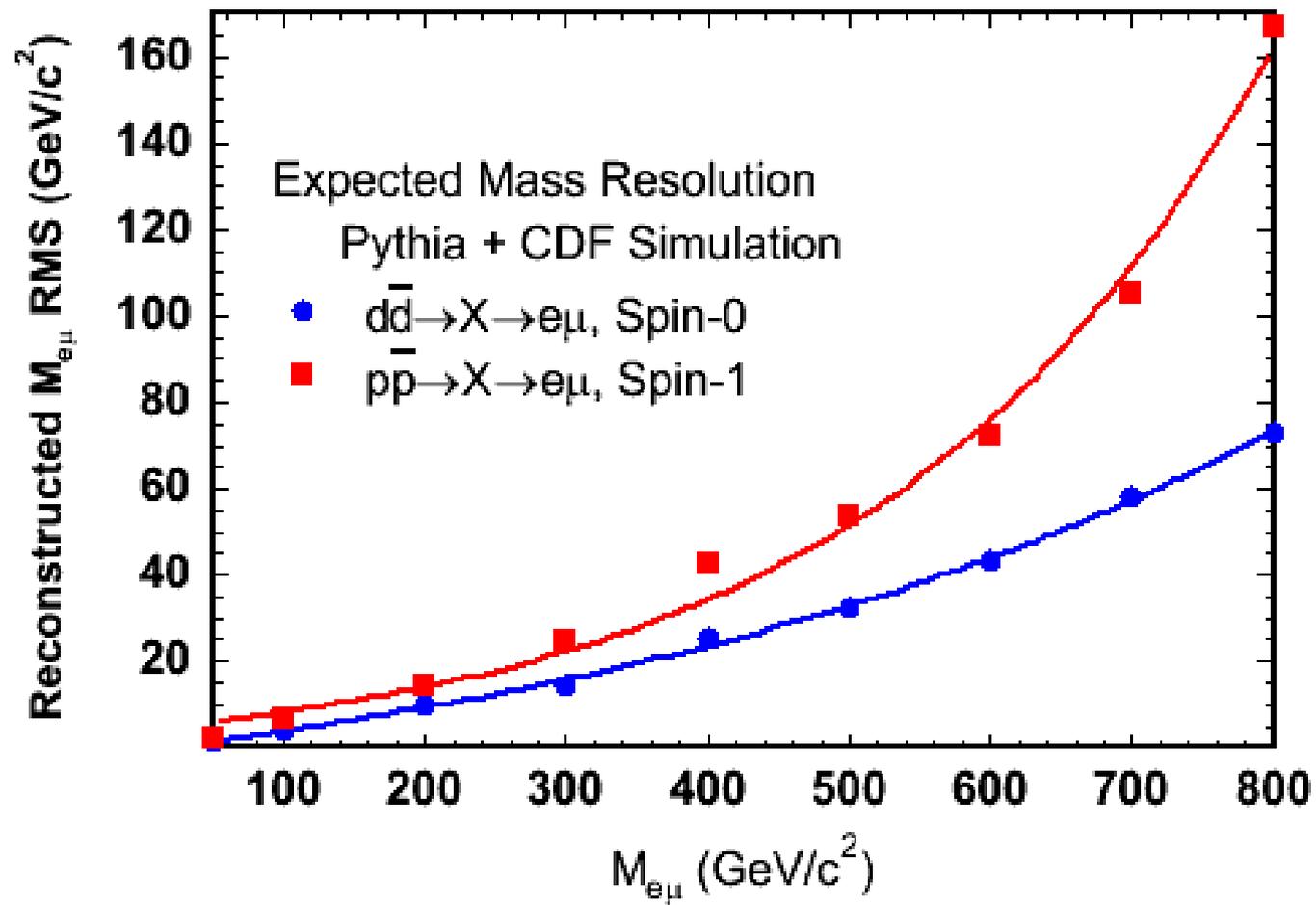
- Had integrated LO  $\sigma$ BR from Dimopoulos, K-factors from Choudhury et. al. (Muge)  $\rightarrow$  NLO  $\sigma$ BR
- Now have LO,NLO  $\sigma$ BR's from Choudhury et. al.
- Coincidence?  $\sigma$ BR's off by a K-factor ...
  - Check w/ them? Redo snu limits with new NLO  $\sigma$ BR?

Plots for blessing ...

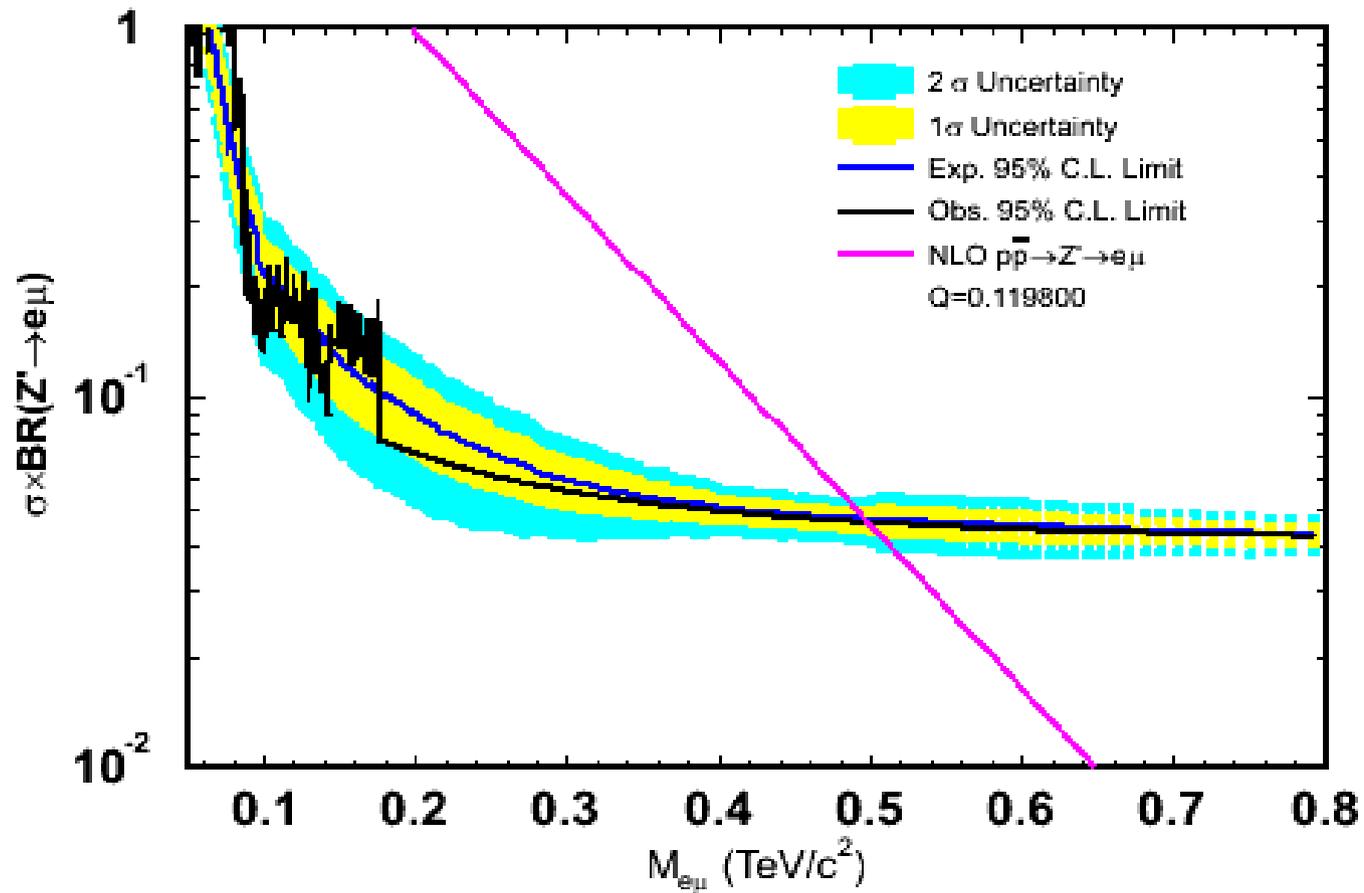
CDF Run 2 Preliminary, 344 pb<sup>-1</sup>



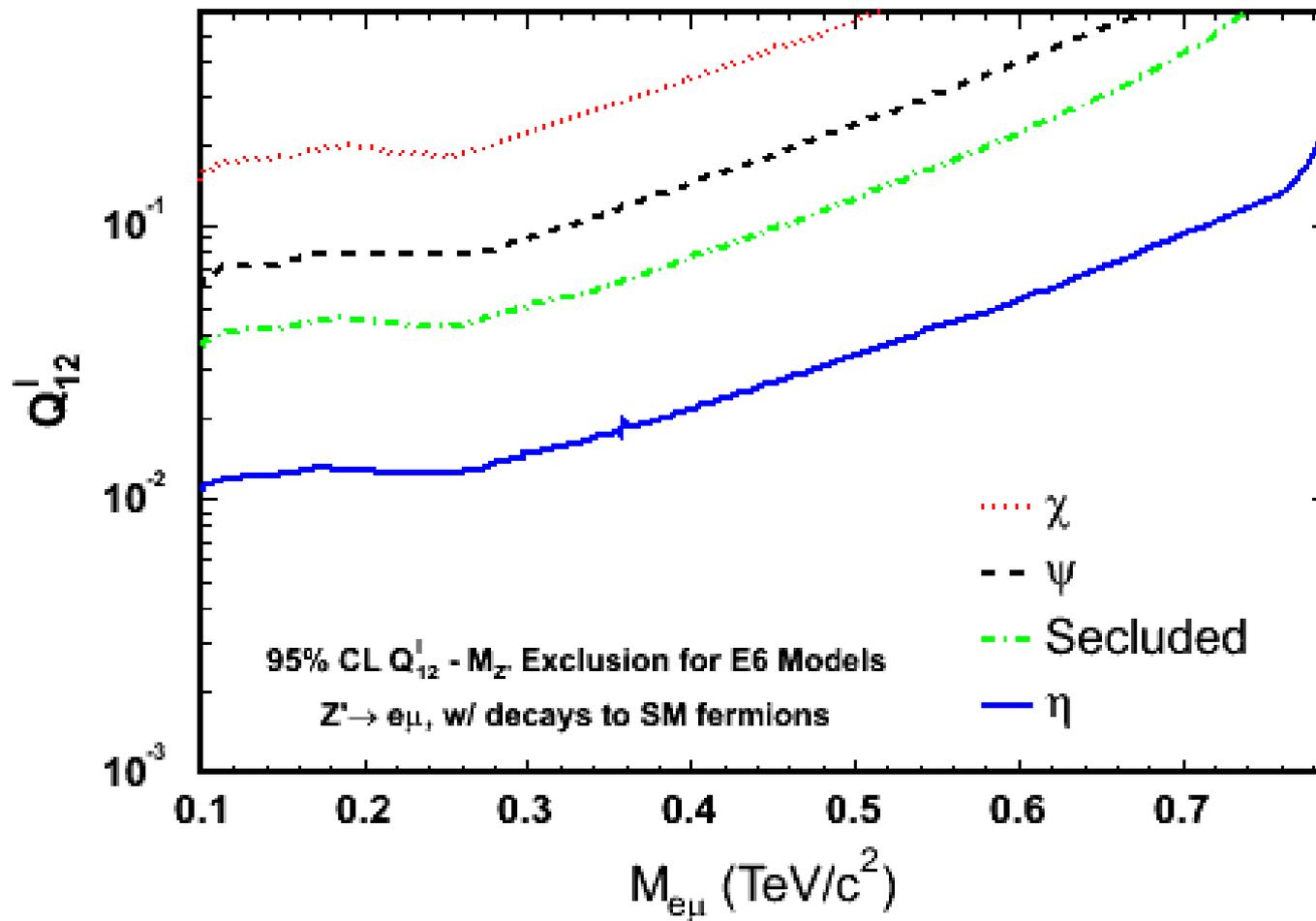
CDF Run 2 Preliminary, 344 pb<sup>-1</sup>



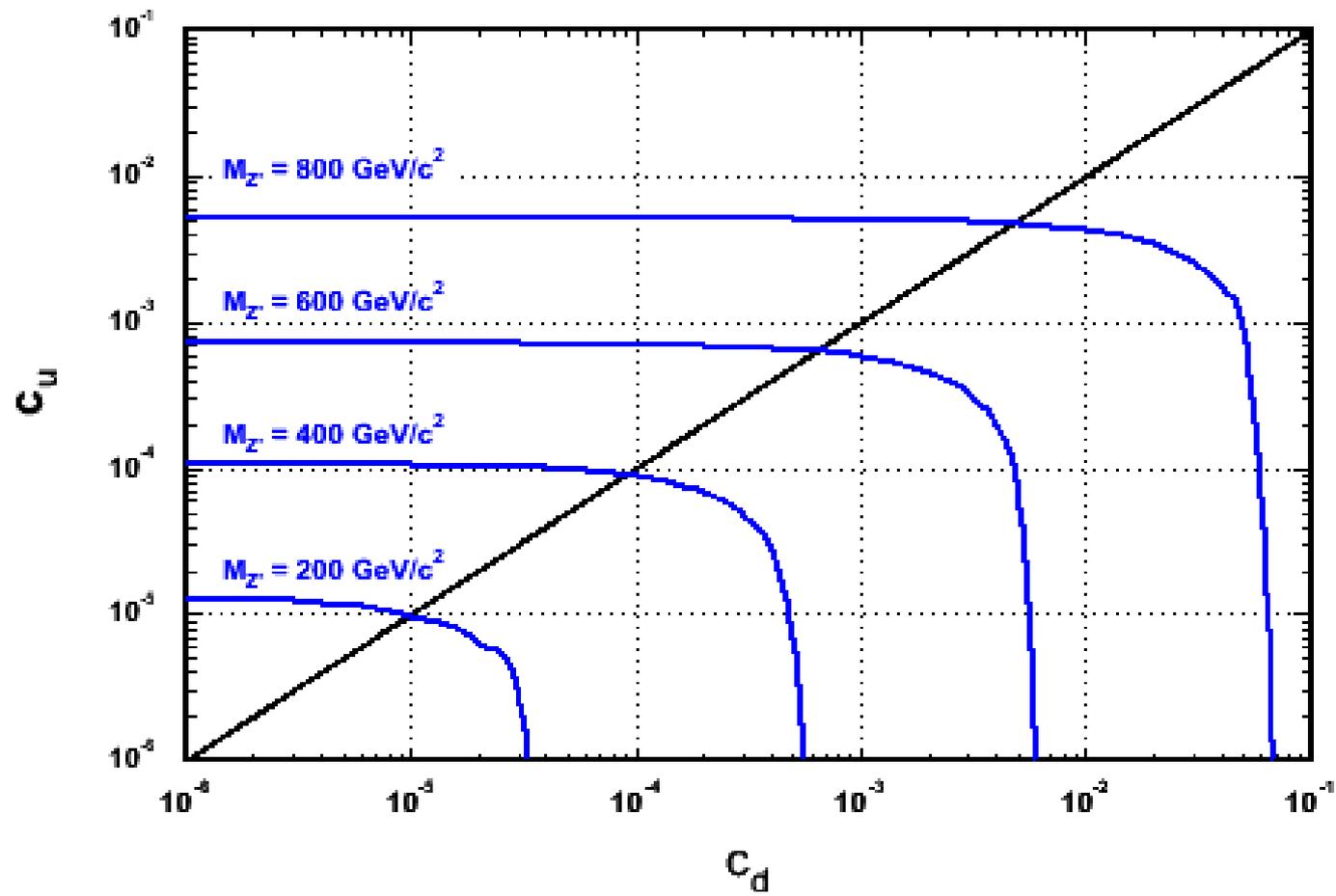
CDF Run 2 Preliminary, 344 pb<sup>-1</sup>



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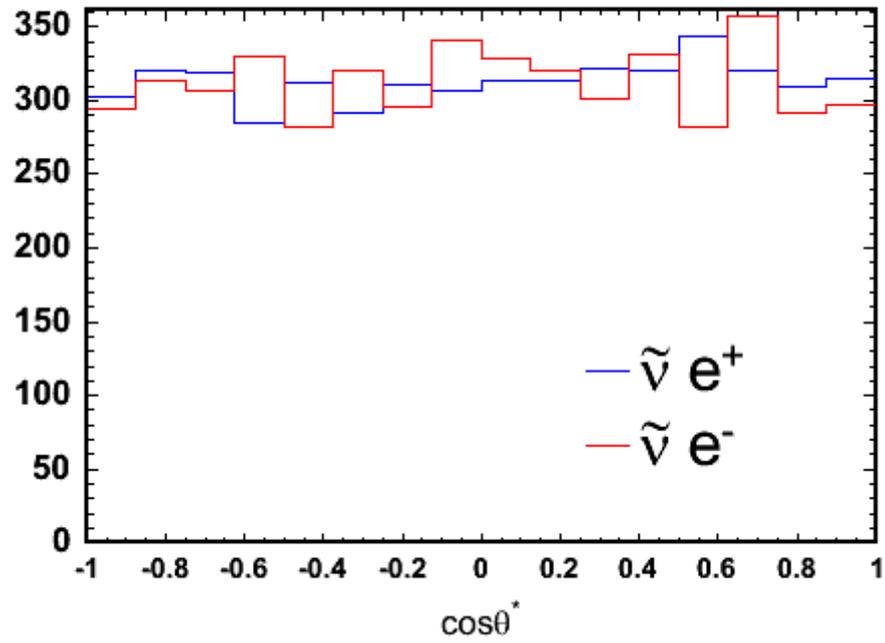


CDF Run 2 Preliminary, 344 pb<sup>-1</sup>

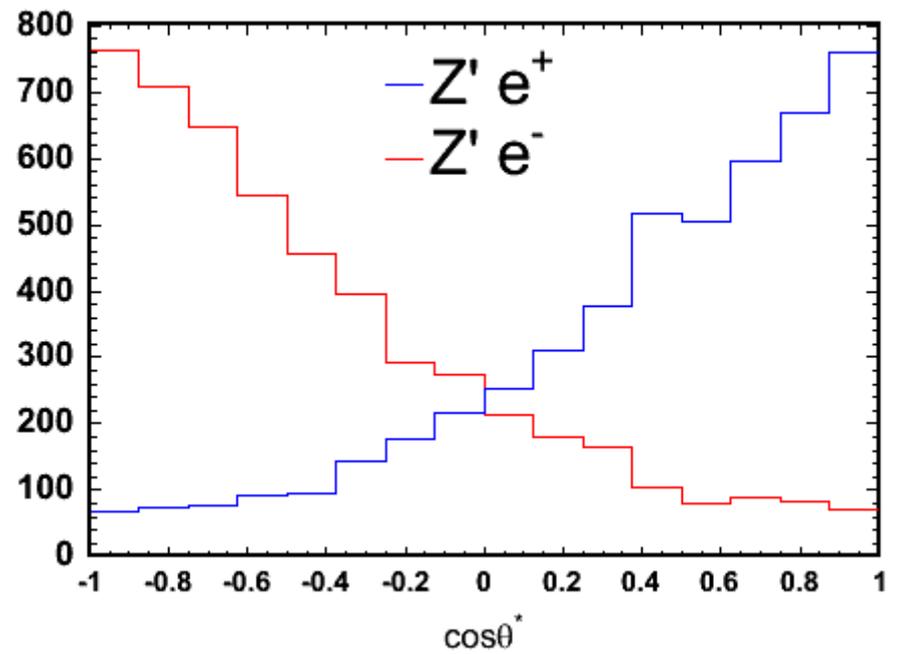


Backup

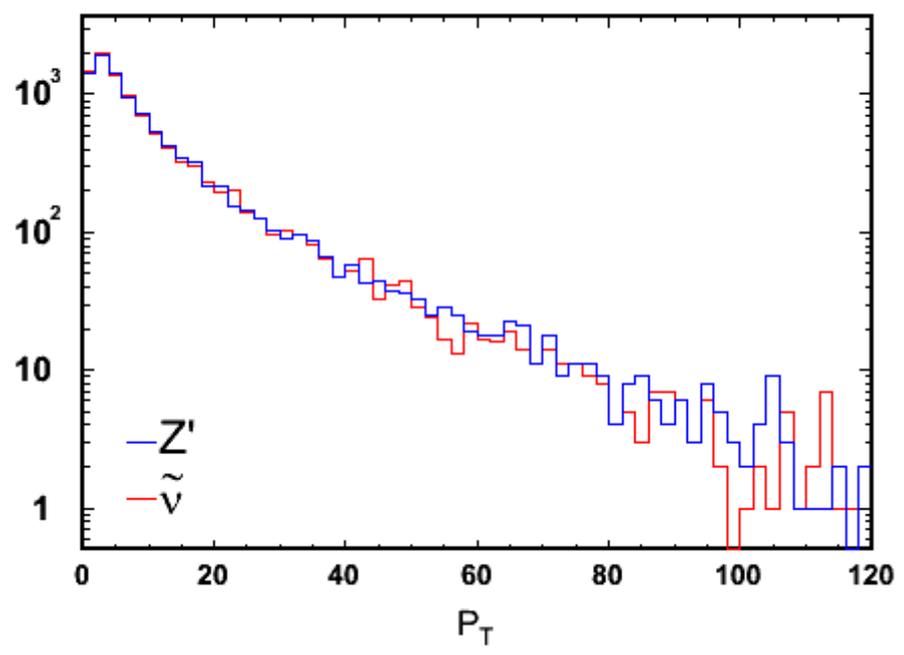
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generator  $e^\pm \cos\theta^*$ ,  $M_{Z'}=200\text{GeV}/c^2$ , 10K evts total



generator Z' &  $\tilde{\nu}$  P<sub>T</sub>, 10K evts.



generator Z' &  $\tilde{\nu}$  P, 10K evts.

