Royal Holloway
University of London

Graviton→e^+e^- Update

Lepton+X Meeting

Tuesday 4th of May





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Contents

- Reminder of New 7 TeV MC09 Datasets.
- MC (Data) Analysis.
- Invariant Mass Window Definition.
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MC09 Datasets (7 TeV)

Signal

(Graviton)

mc09_7TeV.105298.Pythia_Gee_001_300.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105586.Pythia_Gee_001_500.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105299.Pythia_Gee_001_800.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105587.Pythia_Gee_001_1000.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105562.Pythia_Gee_003_500.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105563.Pythia_Gee_003_800.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105564.Pythia_Gee_003_1000.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105898.Pythia_Gee_005_700.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105982.Pythia_Gee_005_1000.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105983.Pythia_Gee_005_1250.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105984.Pythia_Gee_005_1500.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105937.Pythia_Gee_01_800.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105588.Pythia_Gee_010_1000.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105938.Pythia_Gee_01_1250.merge.AOD.e522_s765_s767_r1207_r1210/
mc09_7TeV.105939.Pythia_Gee_01_1500.merge.AOD.e522_s765_s767_r1207_r1210/

MC09 Datasets (7 TeV)

Background

(Drell-Yan)

mc09_7TeV.105417.Pythia_DYee_75M120.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105418.Pythia_DYee_120M250.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105419.Pythia_DYee_250M400.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105420.Pythia_DYee_400M600.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105421.Pythia_DYee_600M800.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105422.Pythia_DYee_800M1000.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105423.Pythia_DYee_1000M1250.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105424.Pythia_DYee_1250M1500.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105425.Pythia_DYee_1500M1750.merge.AOD.e526_s765_s767_r1207_r1210/
mc09_7TeV.105426.Pythia_DYee_1750M2000.merge.AOD.e526_s765_s767_r1207_r1210/

(TTbar)

mc09_7TeV.106201.TTbar_McAtNlo_Jimmy_170GeV.merge.AOD.e522_s765_s767_r1207_r1210/

(W+Jet)

mc09_7TeV.106043.PythiaWenu_no_filter.merge.AOD.e468_s765_s767_r1207_r1210/

MC09 Datasets (7 TeV)

Background

(Z+Jet)

mc09_7TeV.106046.PythiaZee_no_filter.merge.AOD.e468_s765_s767_r1207_r1210/

(Jet+Jet)

mc09_7TeV.105009.J0_pythia_jetjet.merge.AOD.e468_s766_s767_r1206_r1210/
mc09_7TeV.105010.J1_pythia_jetjet.merge.AOD.e468_s766_s767_r1206_r1210/
mc09_7TeV.105011.J2_pythia_jetjet.merge.AOD.e468_s766_s767_r1206_r1210/
mc09_7TeV.105012.J3_pythia_jetjet.merge.AOD.e468_s766_s767_r1206_r1210/
mc09_7TeV.105013.J4_pythia_jetjet.merge.AOD.e468_s766_s767_r1206_r1210/
mc09_7TeV.105014.J5_pythia_jetjet.merge.AOD.e468_s766_s767_r1206_r1210/
mc09_7TeV.105015.J6_pythia_jetjet.merge.AOD.e468_s766_s767_r1206_r1210/

MC (Data) Analysis

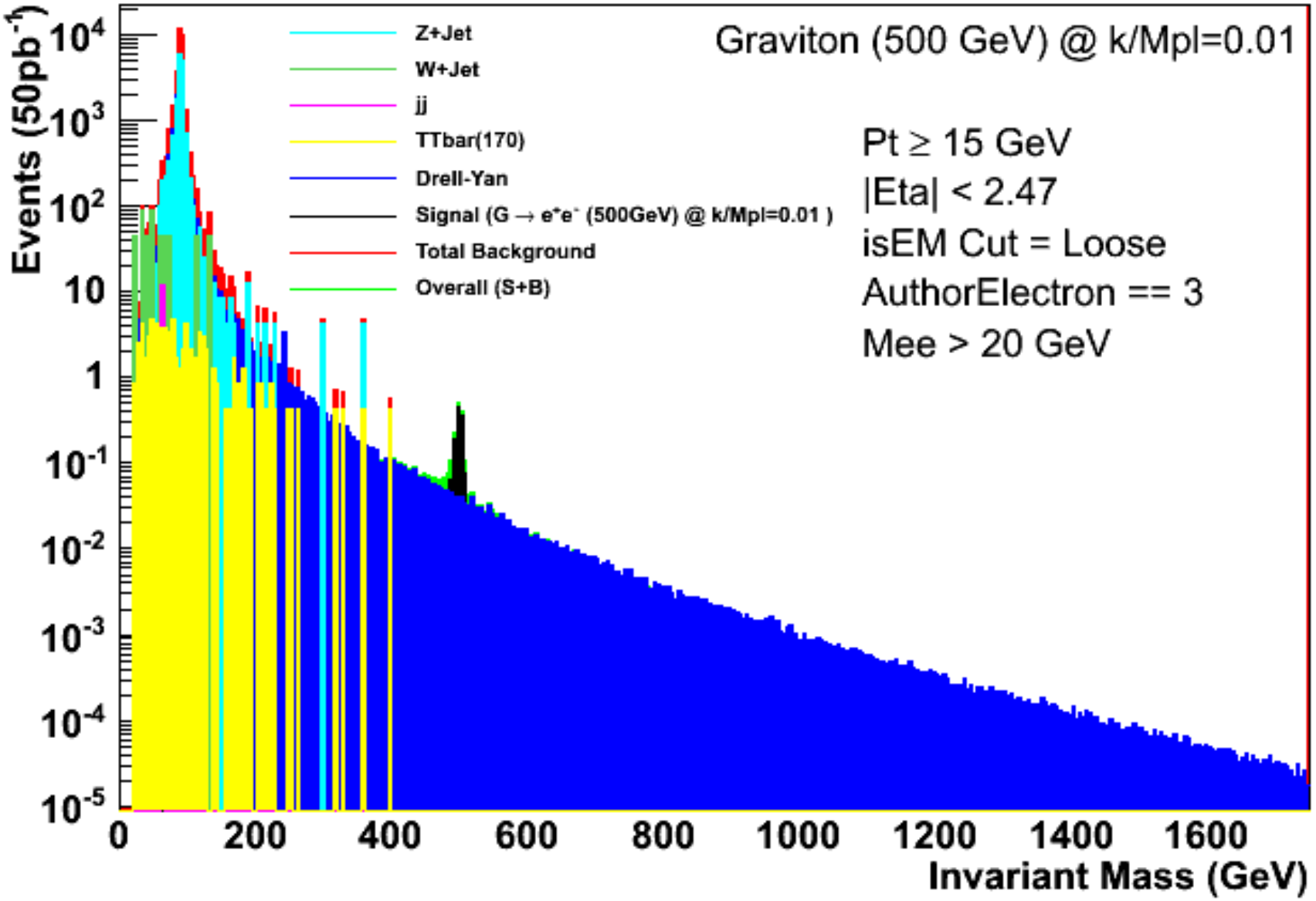
Now

- Run on MC, but as if it were Data.
- Take in to account All Backgrounds.
- Make simple counting based Significance Calculation.
- See how this varies with Integrated Luminosity for all Signal.

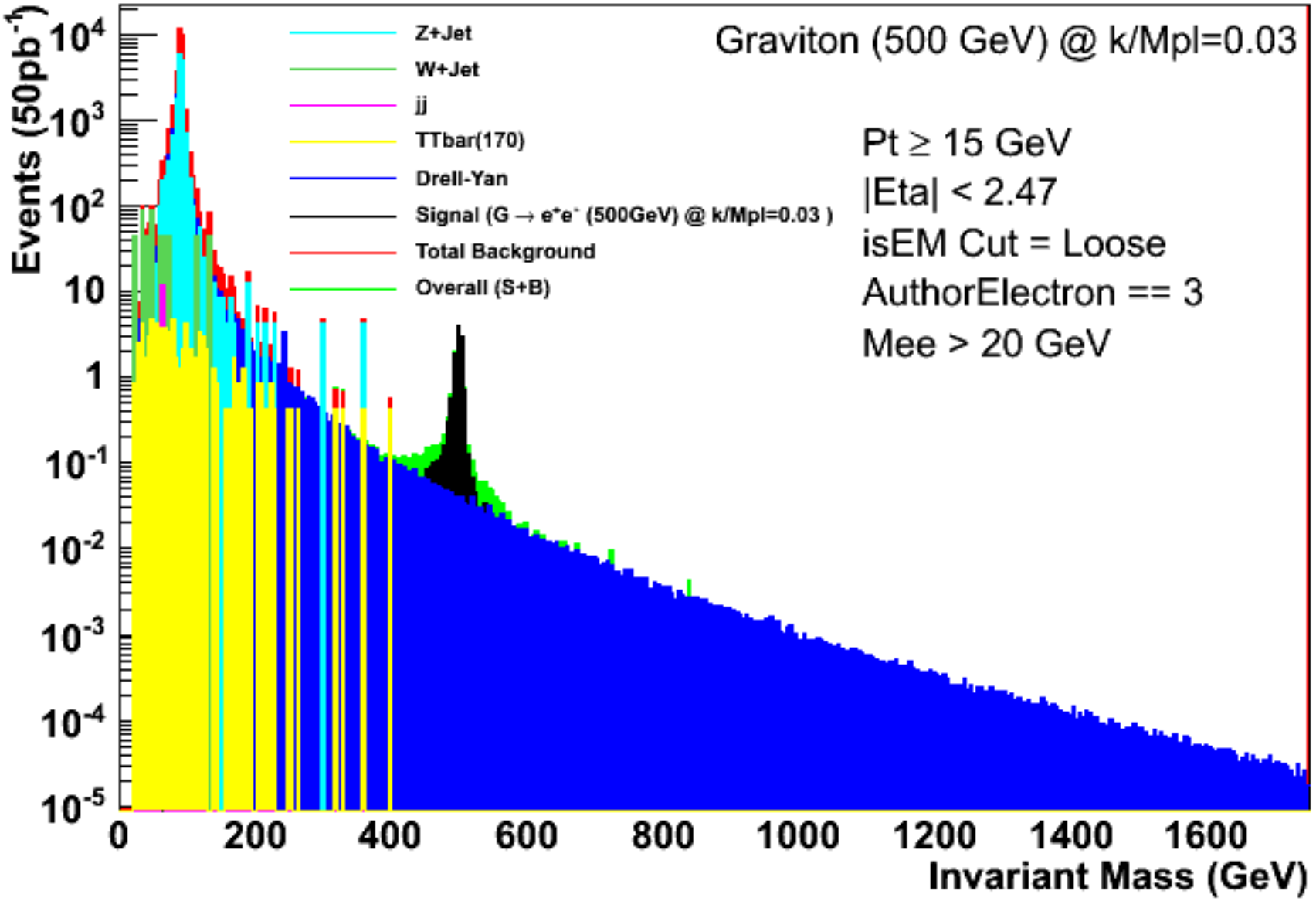
Coming Soon

- Do Data vs MC Comparisons.
- Use RooStats for Significance Calculation / Fitting.
- Improve Search Efficiency

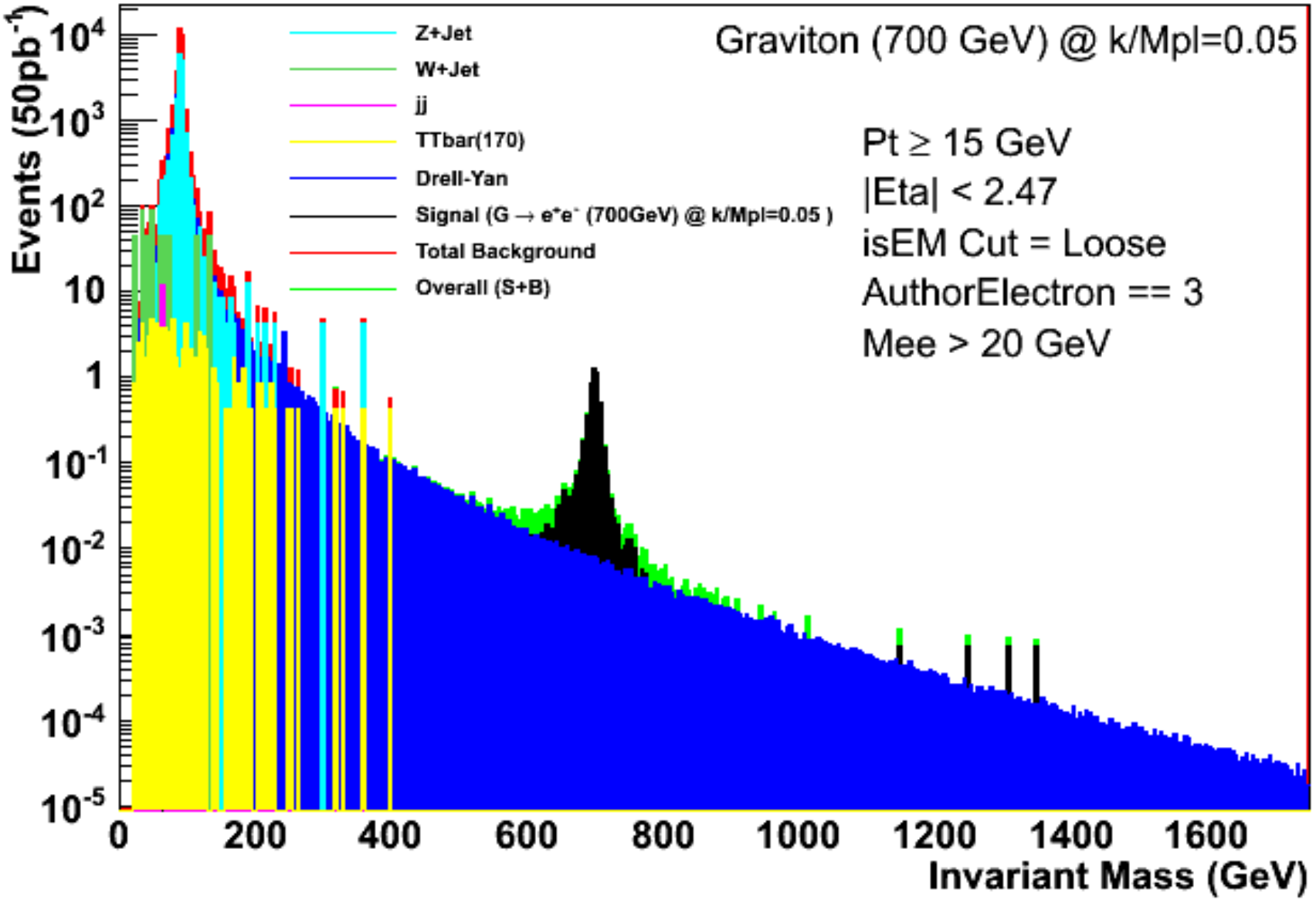
$G \rightarrow e^+e^-$ + Background @ $\sqrt{S}$ = 7 TeV



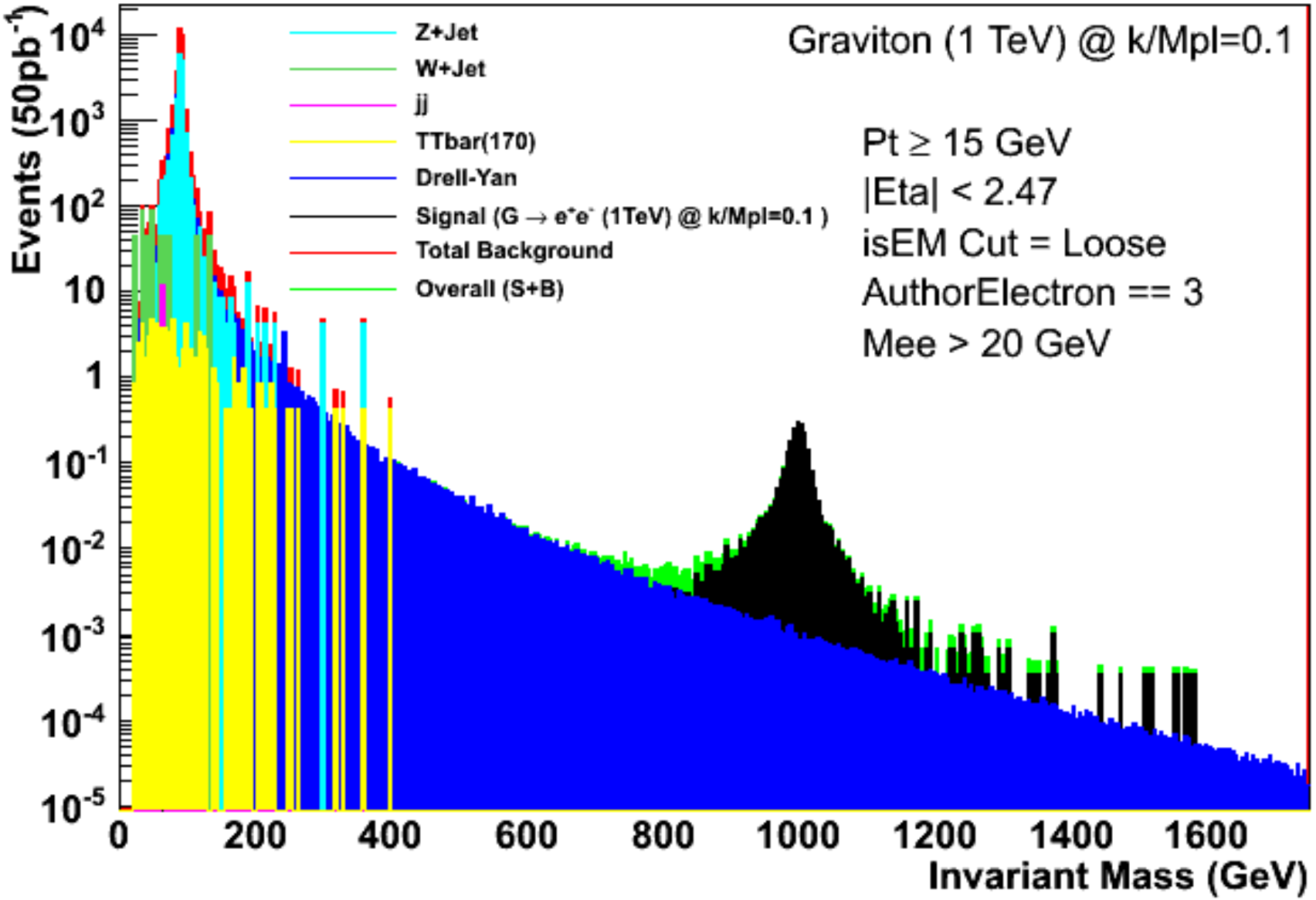
$G \rightarrow e^+e^-$ + Background @ $\sqrt{S}$ = 7 TeV



$G \rightarrow e^+e^-$ + Background @ $\sqrt{S}$ = 7 TeV

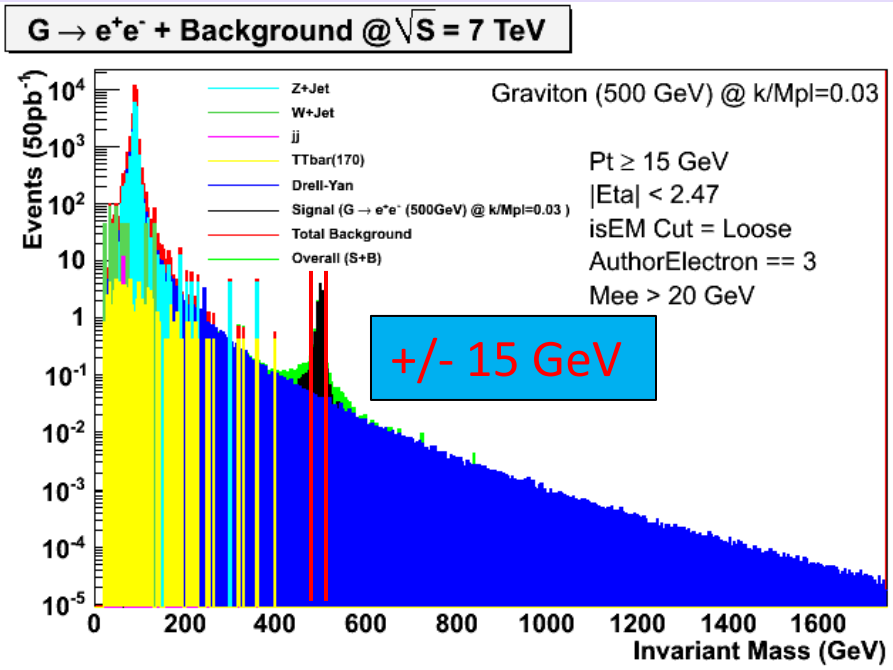


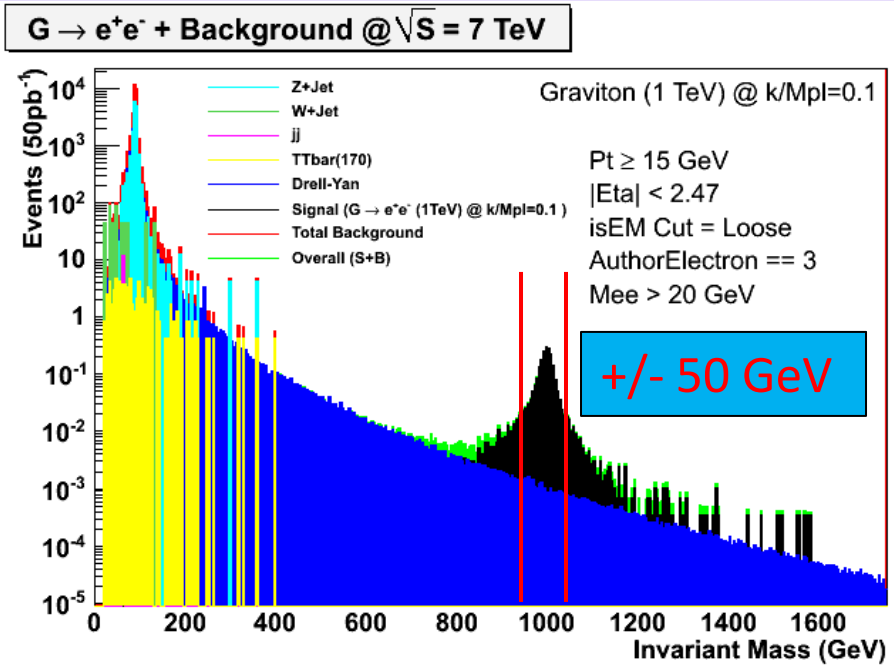
$G \rightarrow e^+e^-$ + Background @ $\sqrt{S}$ = 7 TeV



Invariant Mass Window

- Fit a Gaussian to the Resonance.
- Invariant Mass Window is then; GMass +/- (3 x GaussWidth).



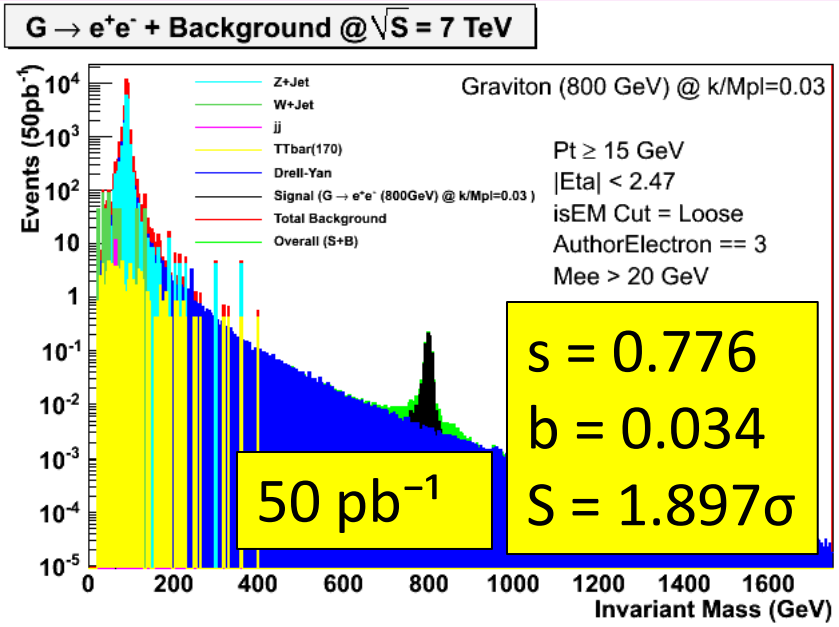


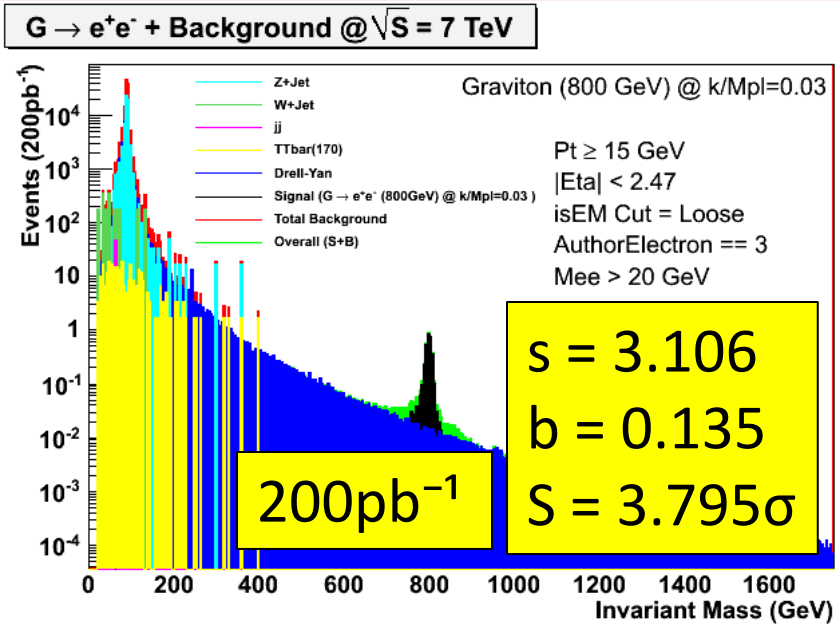
- Can improve further with ranged Gaussian Fit.

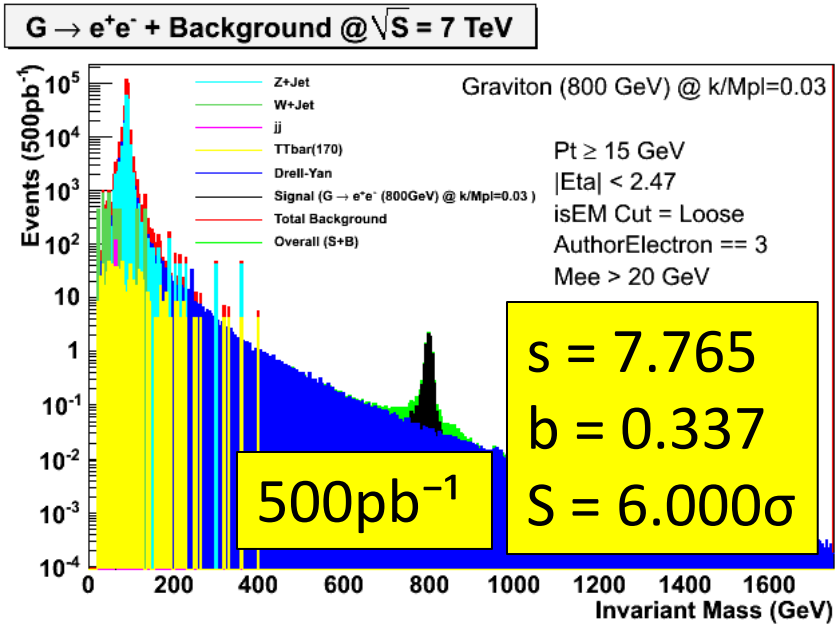
Signal Significance with increasing Integrated Luminosity

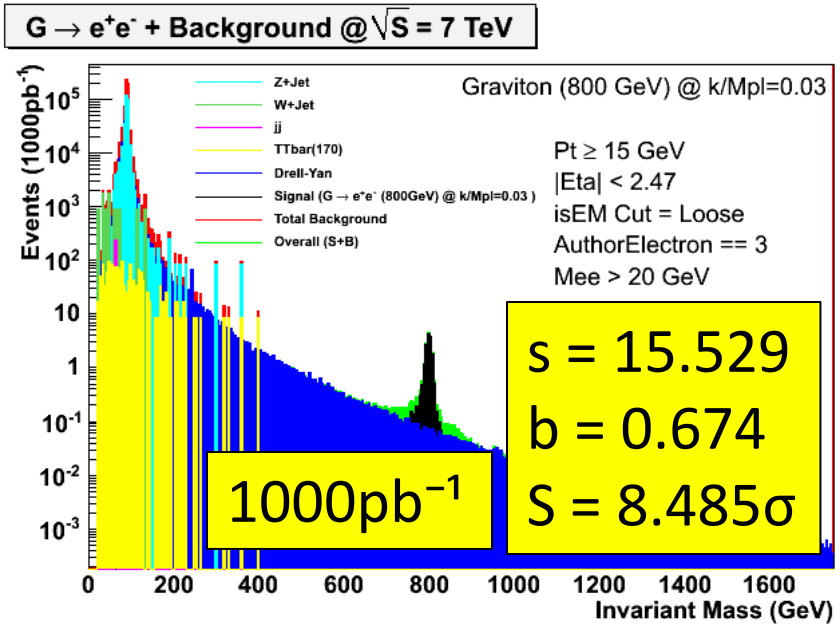
$$S = \sqrt{2[(s+b)\ln(1+\frac{s}{b}) - s]}$$

Graviton (800 GeV) @ k/Mpl = 0.03

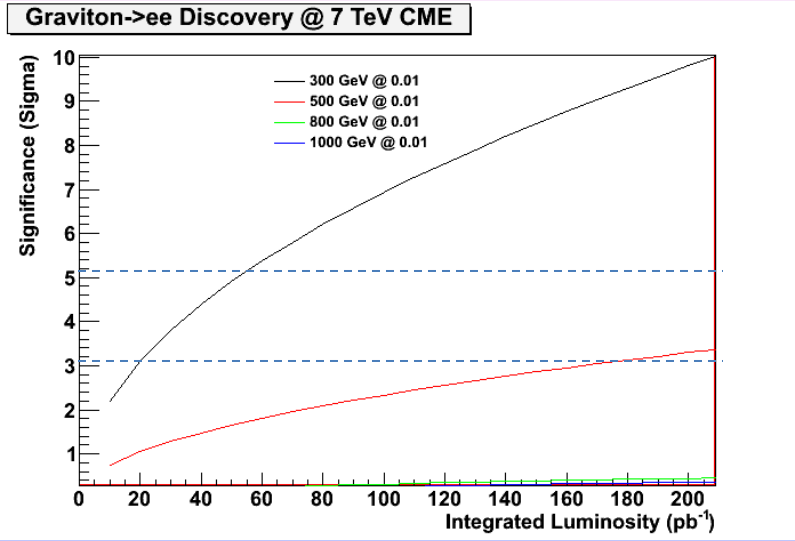


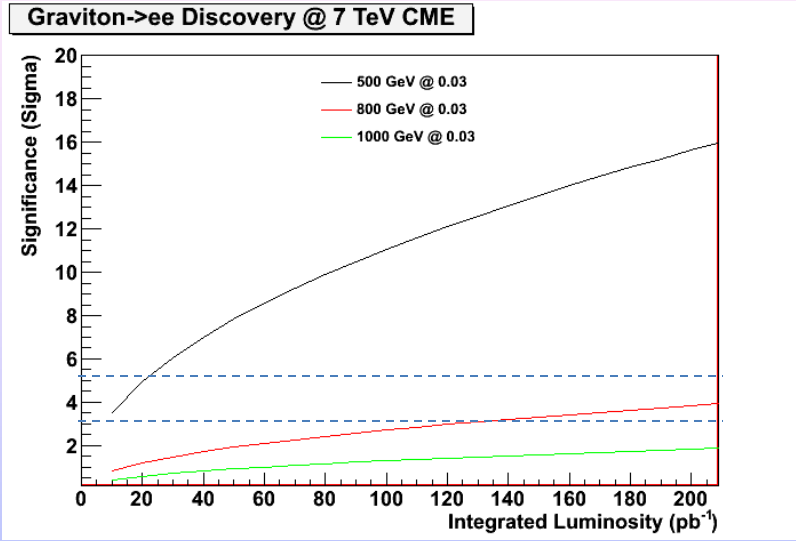


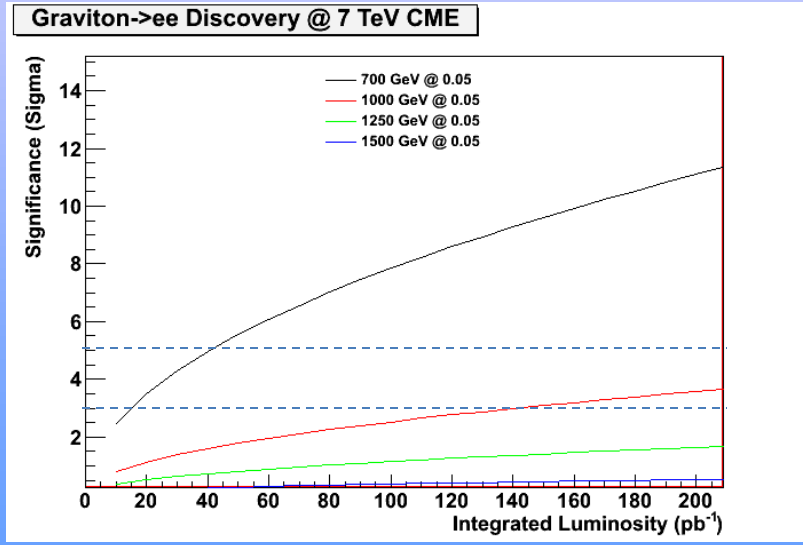


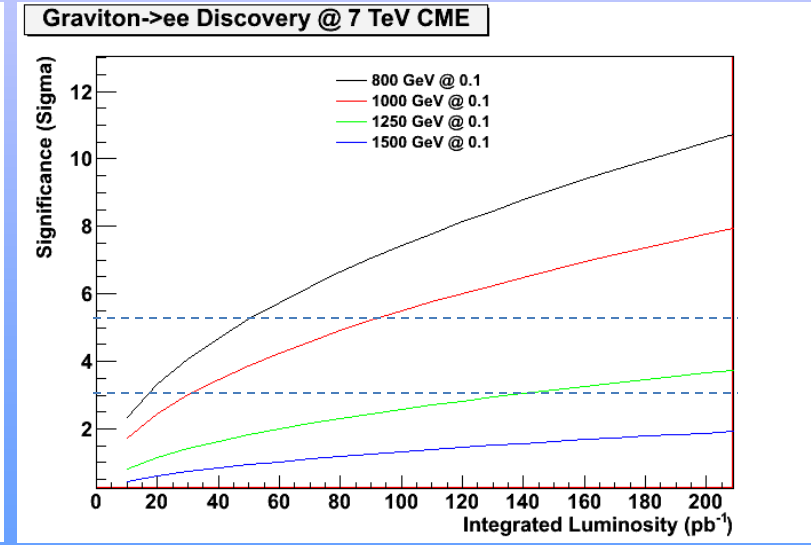


Early Data ($\rightarrow 200 pb^{-1}$)

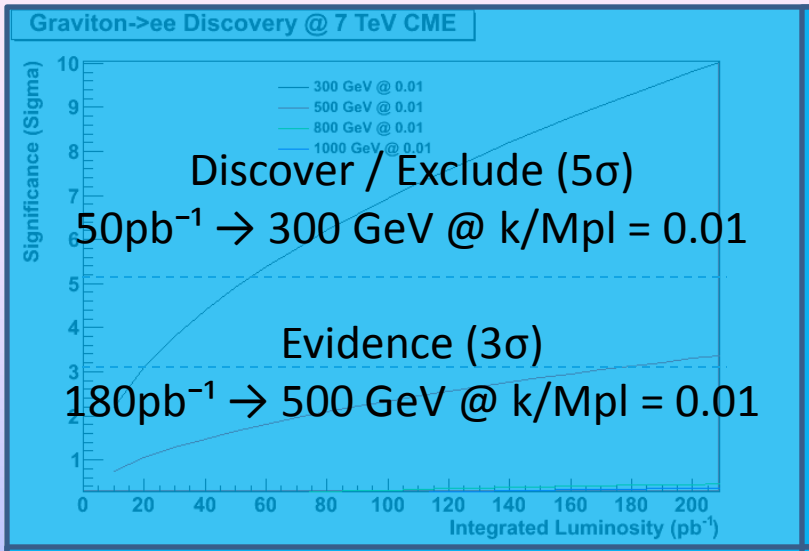


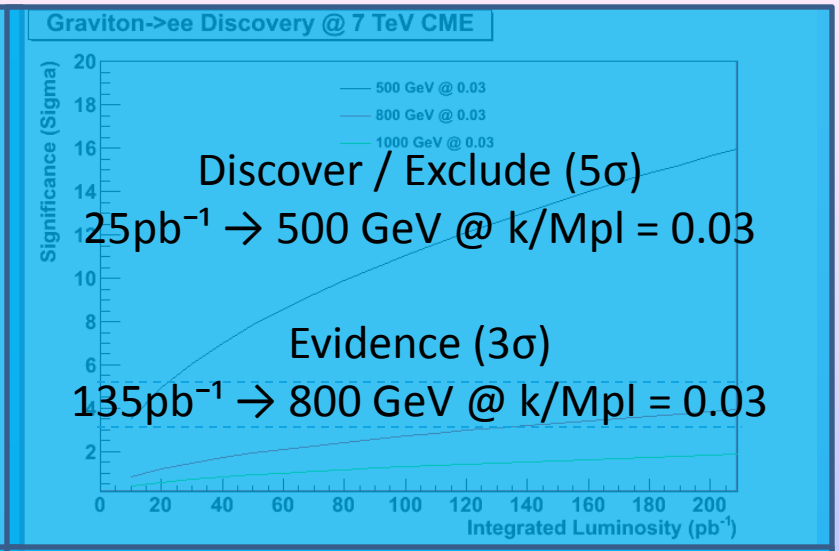


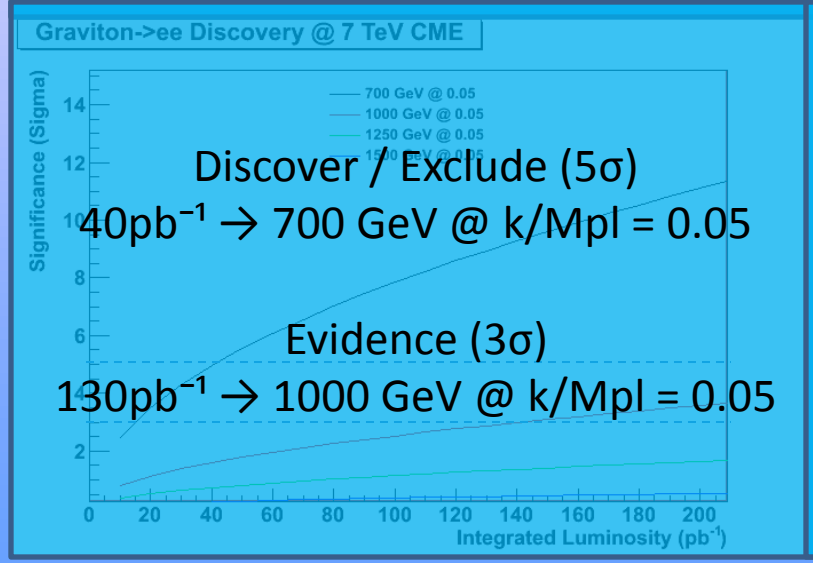


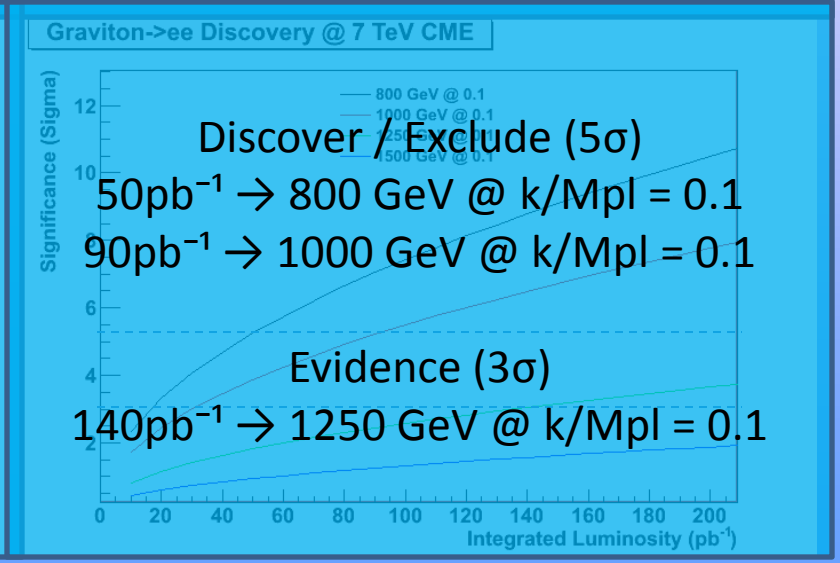


Early Data (→200pb^{-1})

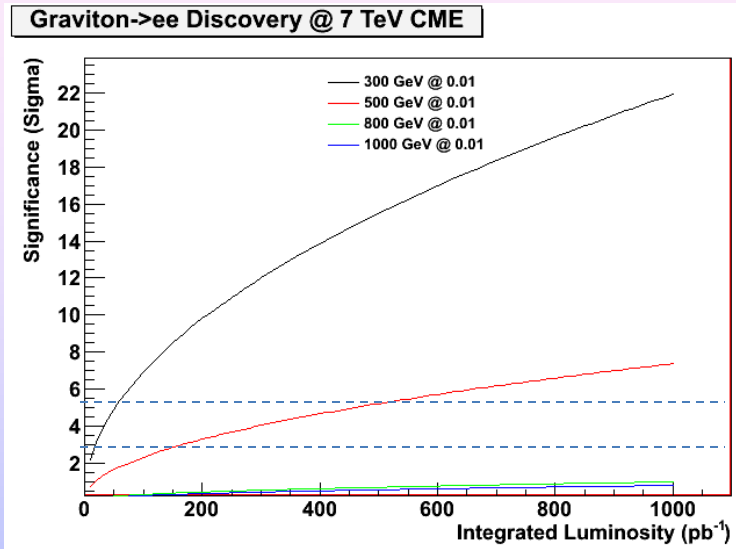


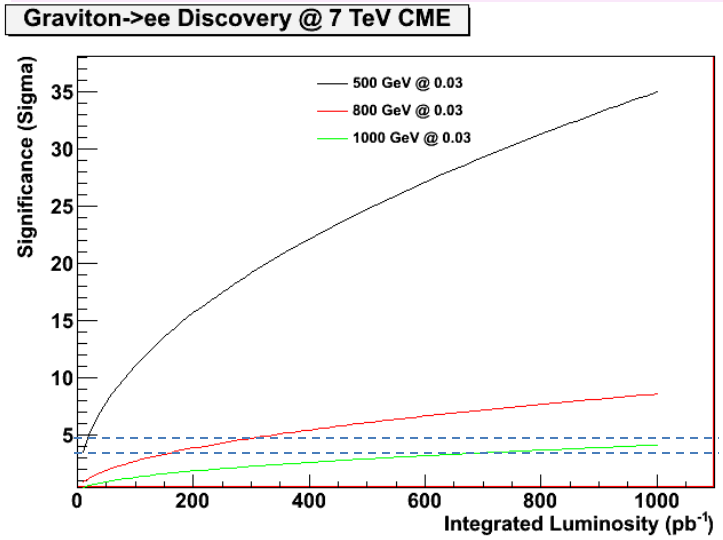


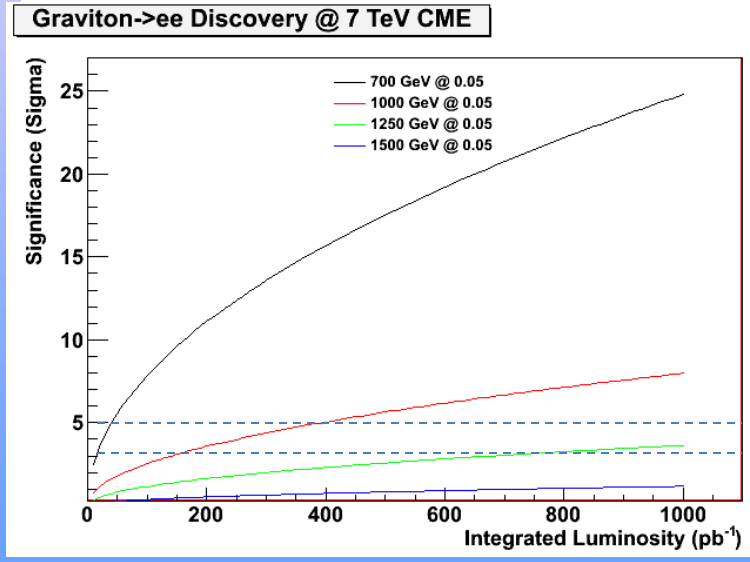


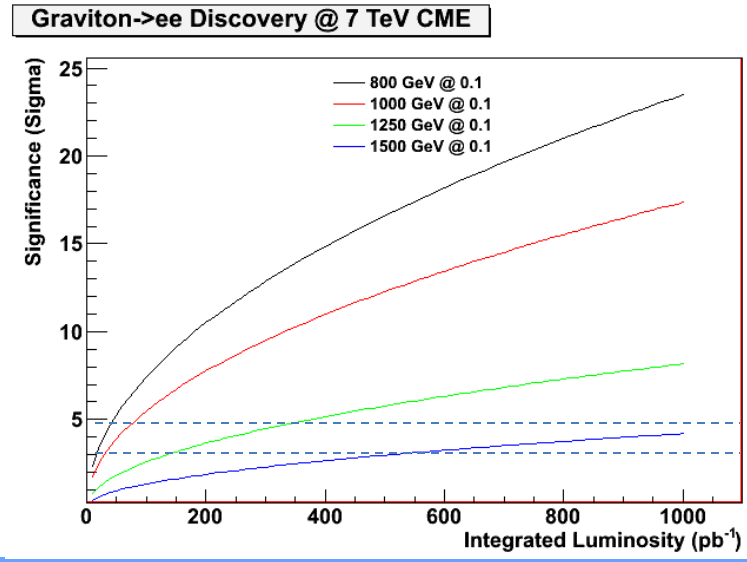


(Not so) Early Data ($\rightarrow 1fb^{-1}$)

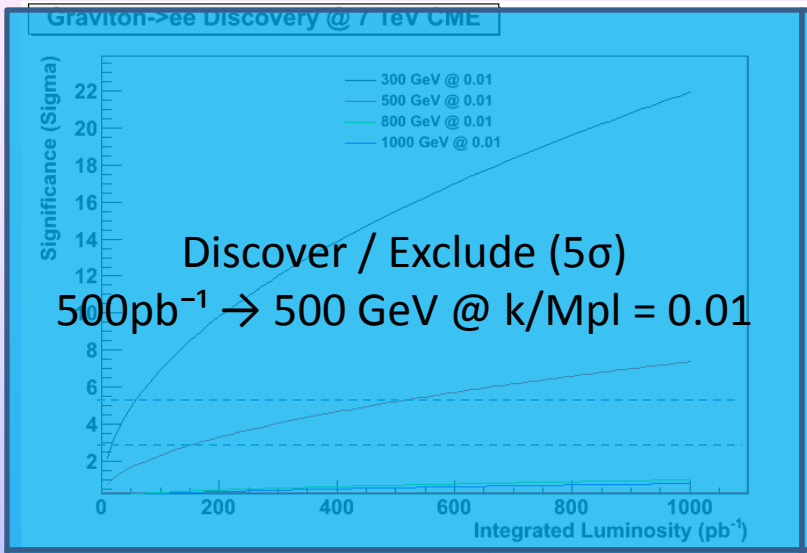






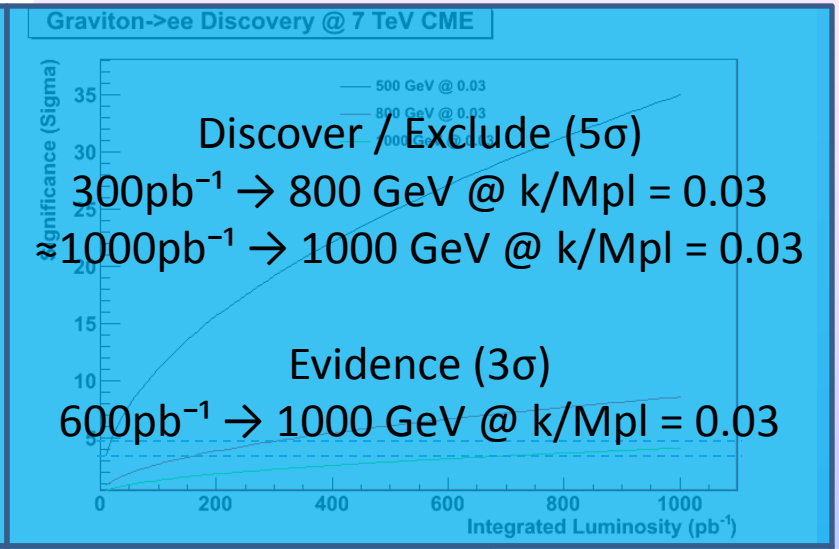


(Not so) Early Data (→1fb^{-1})



Discover / Exclude (5σ)

500pb^{-1} → 500 GeV @ k/Mpl = 0.01



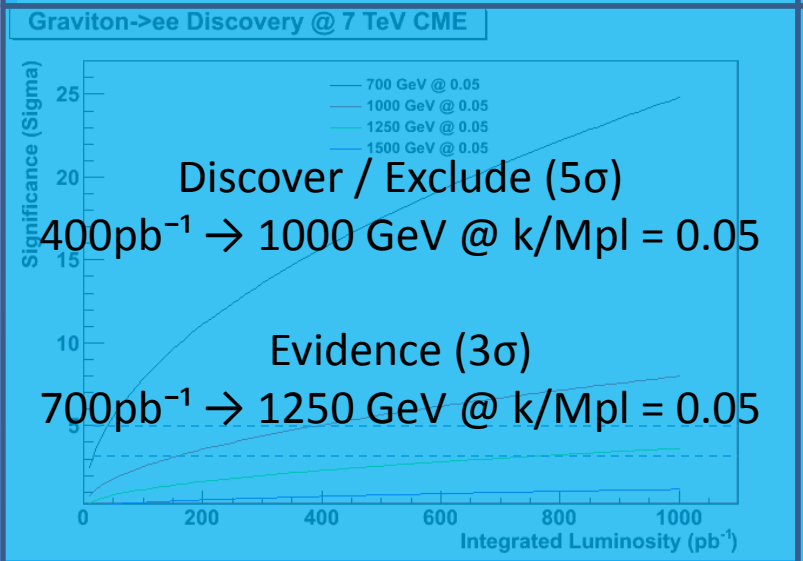
Discover / Exclude (5σ)

300pb^{-1} → 800 GeV @ k/Mpl = 0.03

≈1000pb^{-1} → 1000 GeV @ k/Mpl = 0.03

Evidence (3σ)

600pb^{-1} → 1000 GeV @ k/Mpl = 0.03

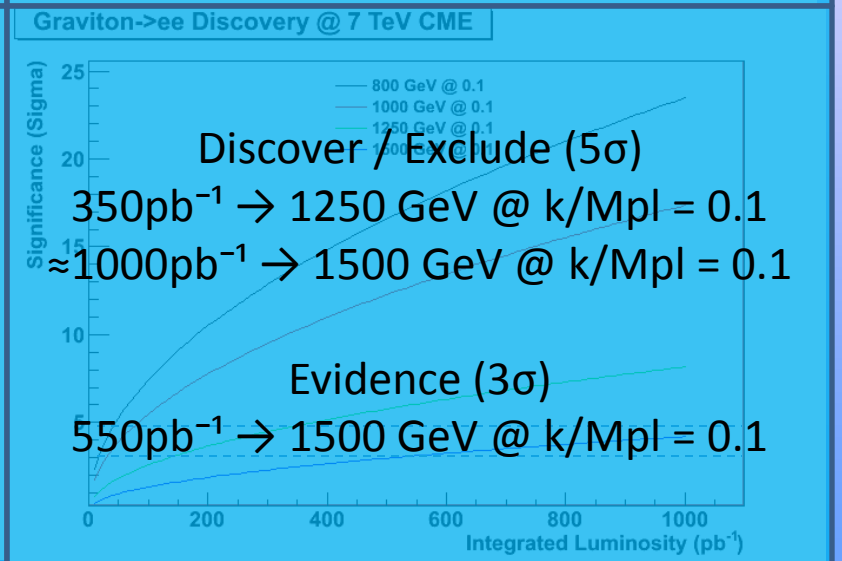


Discover / Exclude (5σ)

400pb^{-1} → 1000 GeV @ k/Mpl = 0.05

Evidence (3σ)

700pb^{-1} → 1250 GeV @ k/Mpl = 0.05



Discover / Exclude (5σ)

350pb^{-1} → 1250 GeV @ k/Mpl = 0.1

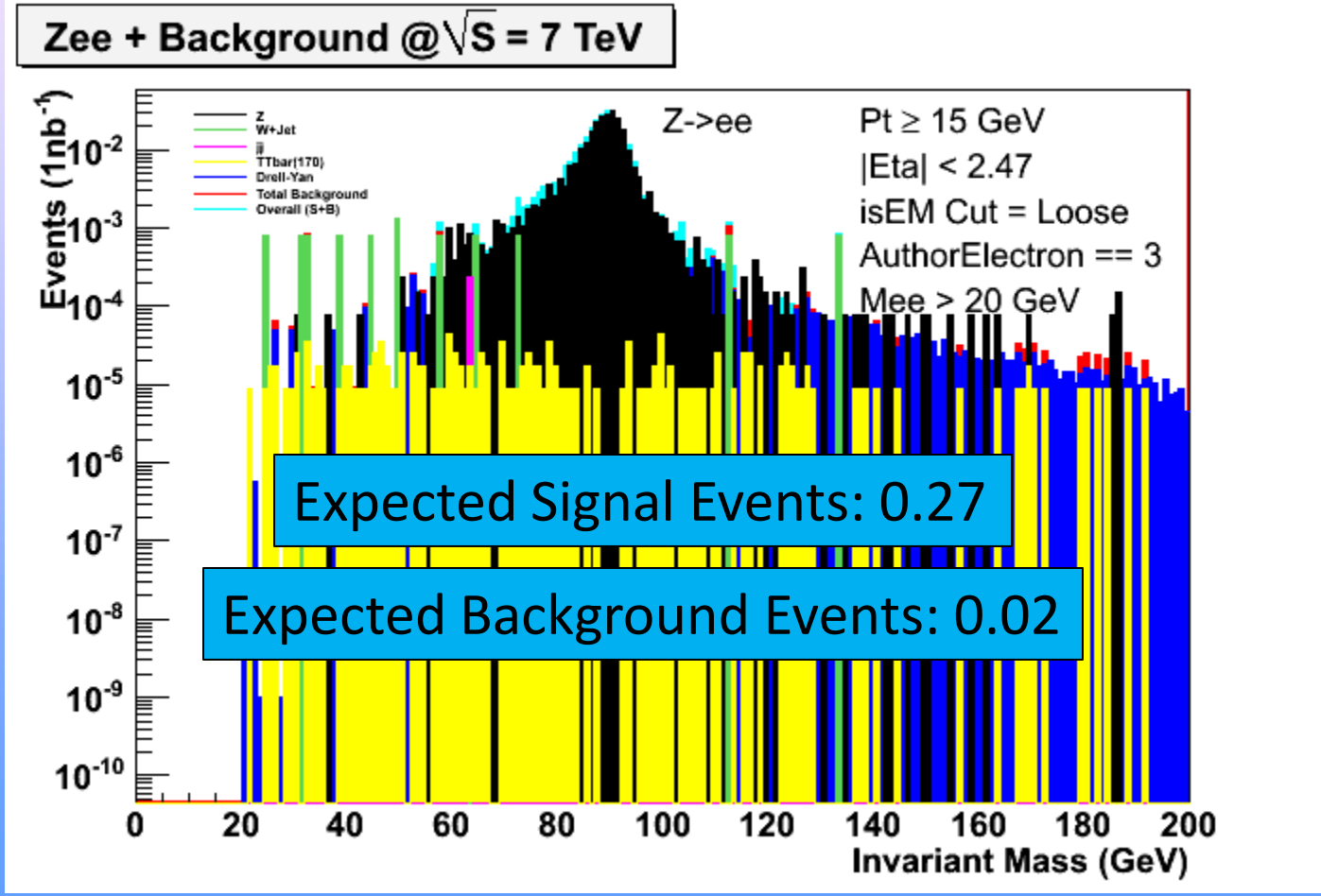
≈1000pb^{-1} → 1500 GeV @ k/Mpl = 0.1

Evidence (3σ)

550pb^{-1} → 1500 GeV @ k/Mpl = 0.1

Digression

- Also able to look at Z peak (Window 70 – 110 GeV).
- Currently have approximately 1 nb^{-1} of Real Data.



Future Improvements

- Where is G? Ability to scan Mass Window . (RooStats)
- Clean lower mass region further.
- More Useful Statistical Significance Calculation (RooStats).

Future Work

- Monte Carlo vs Data Comparisons.
- Looking into Combinations of Channels ($\mu^+\mu^-$, $\gamma\gamma$).
- Further Work on Z because of its Early Importance.