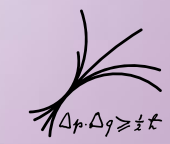
Diphotons plus jet at NLO with GoSam

T. Gehrmann, G. Heinrich, N. Greiner

[arXiv:1303.0824]

Les Houches, June 10, 2013

MAX-PLANCK-GESELLSCHAFT



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Diphotons + jet

hard photons can have several origins:

- direct production in hard subprocess
- fragmentation of large-p_T partons into a photon and hadrons: non-perturbative, described by fragmentation function

need isolation from hadronic background

standard cone isolation:

$$E_{\text{cone}}^{\text{had}} \leq \epsilon_c \, p_T^{\gamma}$$

$$z_c = \frac{|\vec{p}_{T,\text{cone}}^{\,\text{had}}|}{|\vec{p}_T^{\,\gamma} + \vec{p}_{T,\text{cone}}^{\,\text{had}}|} \leq z_{\text{cut}}$$

$$z_c = \epsilon_c/(1+\epsilon_c)$$

smooth isolation (Frixione):

$$E_{\text{had,max}}(r_\gamma) = \epsilon \, p_T^{\gamma} \left(\frac{1-\cos r_\gamma}{1-\cos R} \right)^n$$

Diphotons + jet: codes

public codes:

- NLOJET++ [DelDuca,Maltoni,Nagy,Trocsanyi '03]
  Frixione isolation only
- GoSam+MadDipole/MadGraph/MadEvent
  [Gehrmann, Greiner, GH '13, arXiv:1303.0824]
  fragmentation part included (frag functions $\mathcal{O}(\alpha)$) $\Rightarrow$ allows comparison of standard cone isolation and Frixione isolation

available at

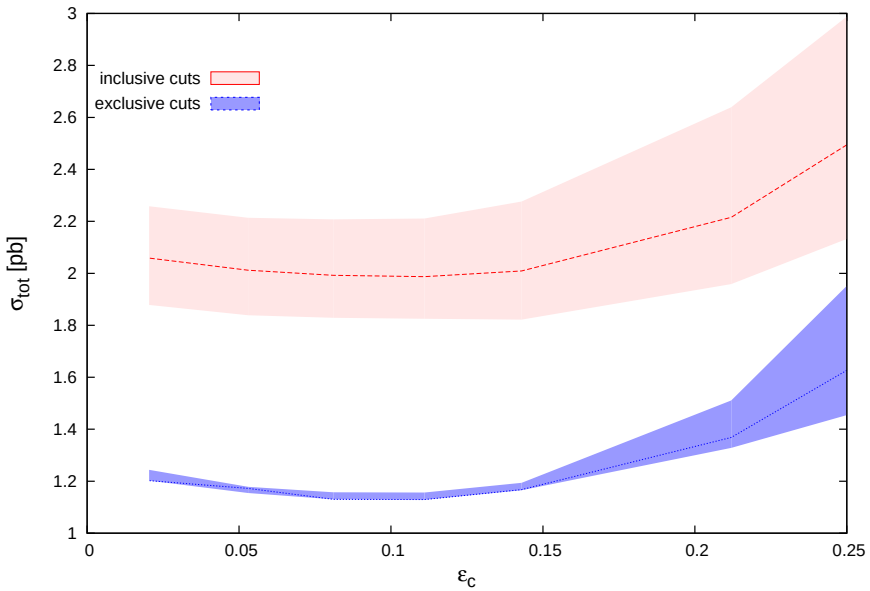
http://gosam.hepforge.org/diphoton

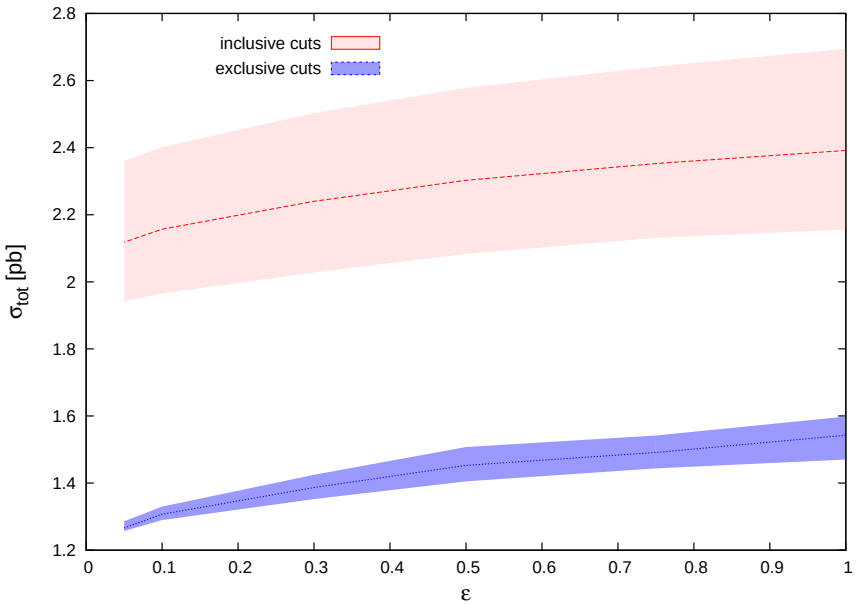
Diphotons + jet: dependence on isolation prescription

scales: $\mu_0^2 = \frac{1}{4}\left(m_{\gamma\gamma}^2 + \sum_j p_{T,j}^2\right)$; $\mu = \mu_r = \mu_F$; $x = \mu/\mu_0$

cuts: $p_T^{\rm jet} > 40\,\text{GeV}$, $p_T^{\gamma} > 20$, $|\eta^{j,\gamma}| \leq 2.5$, $R_{\gamma j} > 0.4$, $R_{\rm cone} = 0.4$, $100\,\text{GeV} \leq m_{\gamma\gamma} \leq 140\,\text{GeV}$

bands: scale variations $0.5 \leq x \leq 2$





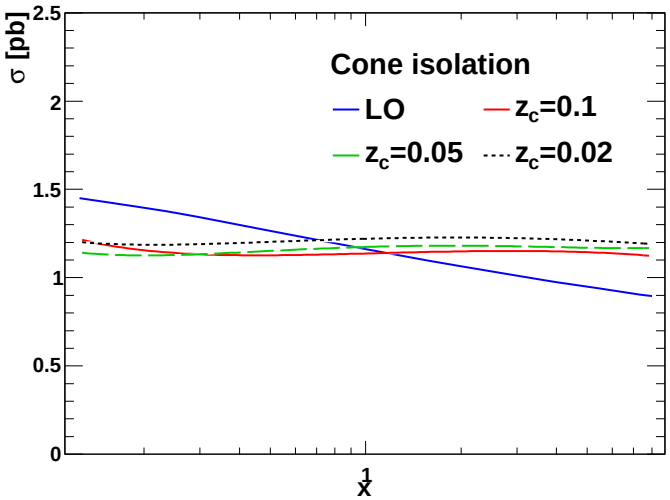
Dependence on the cone isolation parameter ϵ_c resp. Frixione parameter ϵ

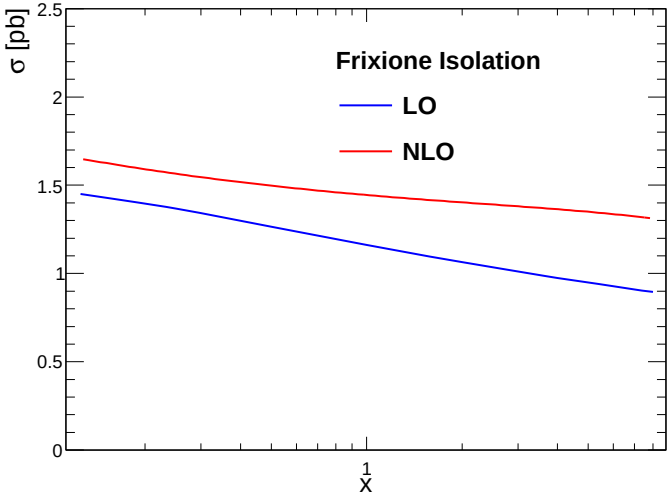
red: inclusive cuts ; blue: exclusive cuts

exclusive cuts: veto on second jet: $p_{T,j2} \leq 30\,\text{GeV}$

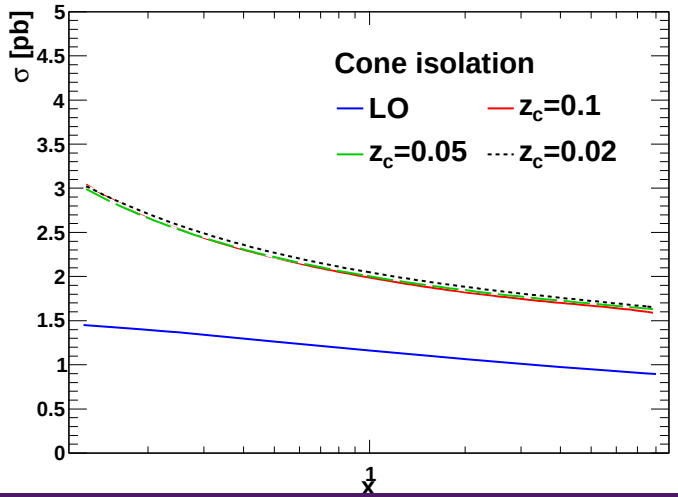
Diphotons + jet: scale dependence

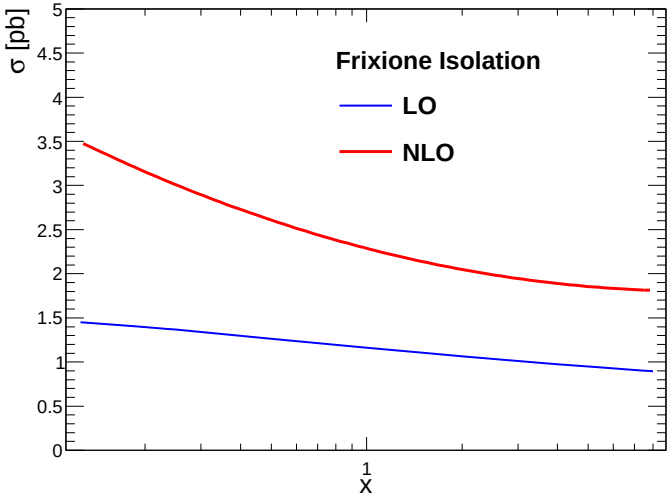
exclusive cuts:





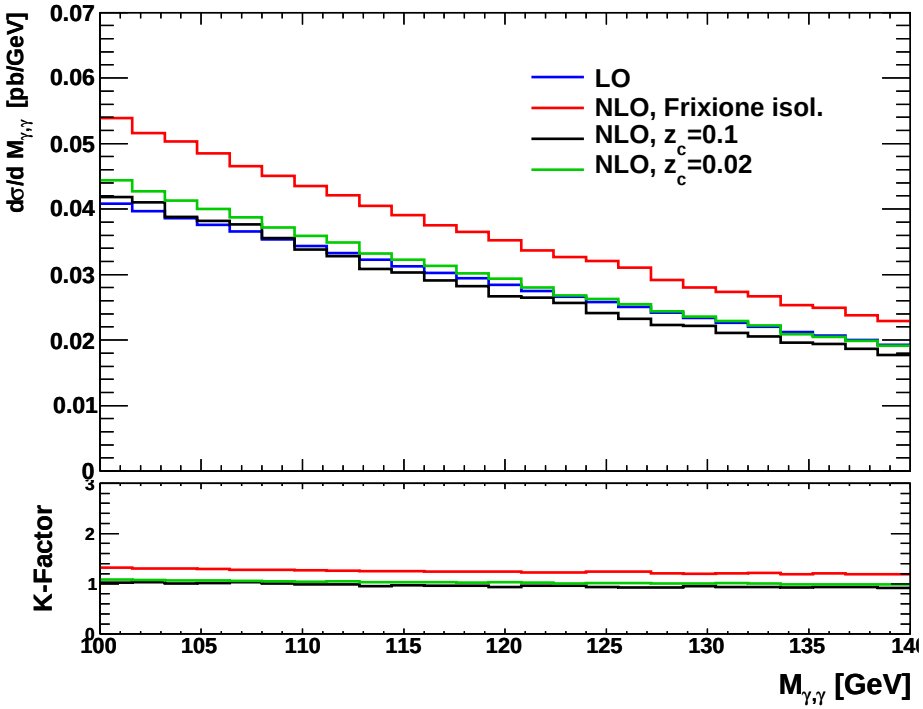
1-jet inclusive:

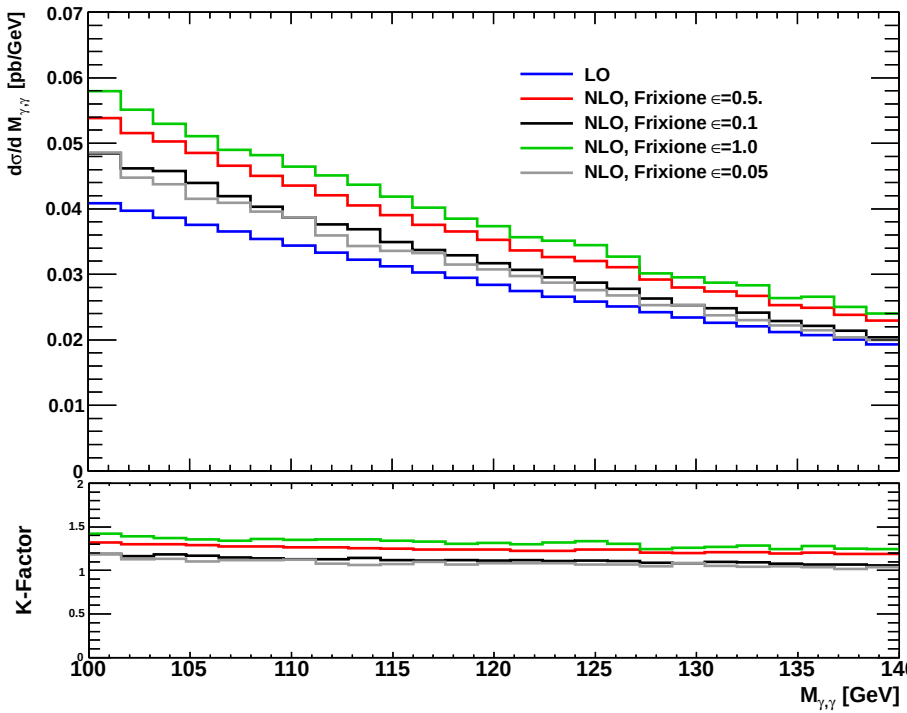




Diphoton invariant mass

comparison of isolation parameters for $\gamma\gamma$ invariant mass $M_{\gamma,\gamma}$ (exclusive cuts)





differences between standard cone isolation and Frixione isolation decrease for decreasing z_c resp. ϵ