Multiple photon production at the LHC

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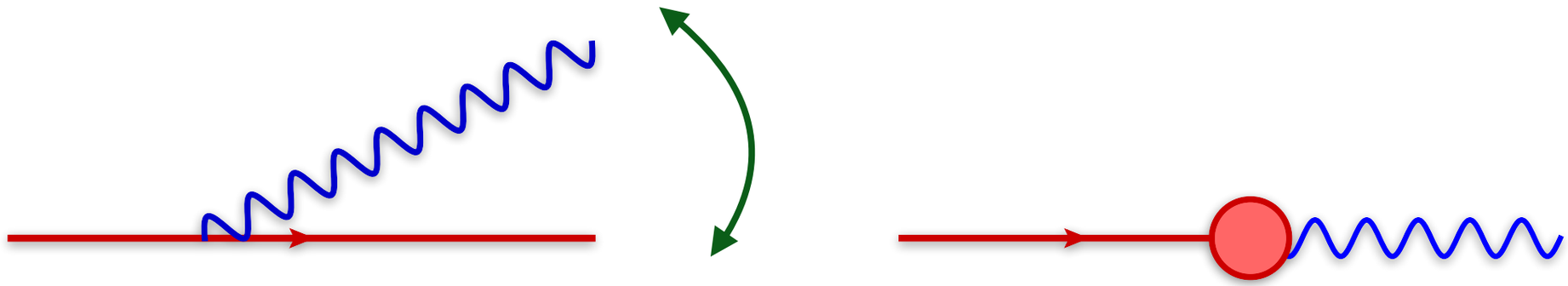
1403.2641 (three photons Campbell, CW)
1411.3237 (four photons Dennen, CW)

Fragmentation in MCFM



At NLO, final state collinear is absorbed into Fragmentation function.

MCFM has several fragmentation sets implemented:
GdRG (LO and NLO expansions)
BFG Sets I and II $\mathcal{O}(\alpha_s^n \log^{n+1} \mu_F^2)$

Phase space cuts

Basic phase space selection cuts are applied

$$p_T^\gamma > 30 \text{ GeV}, \quad |\eta_\gamma| < 2.5 \ , \quad R_{\gamma\gamma} > 0.4 \ .$$

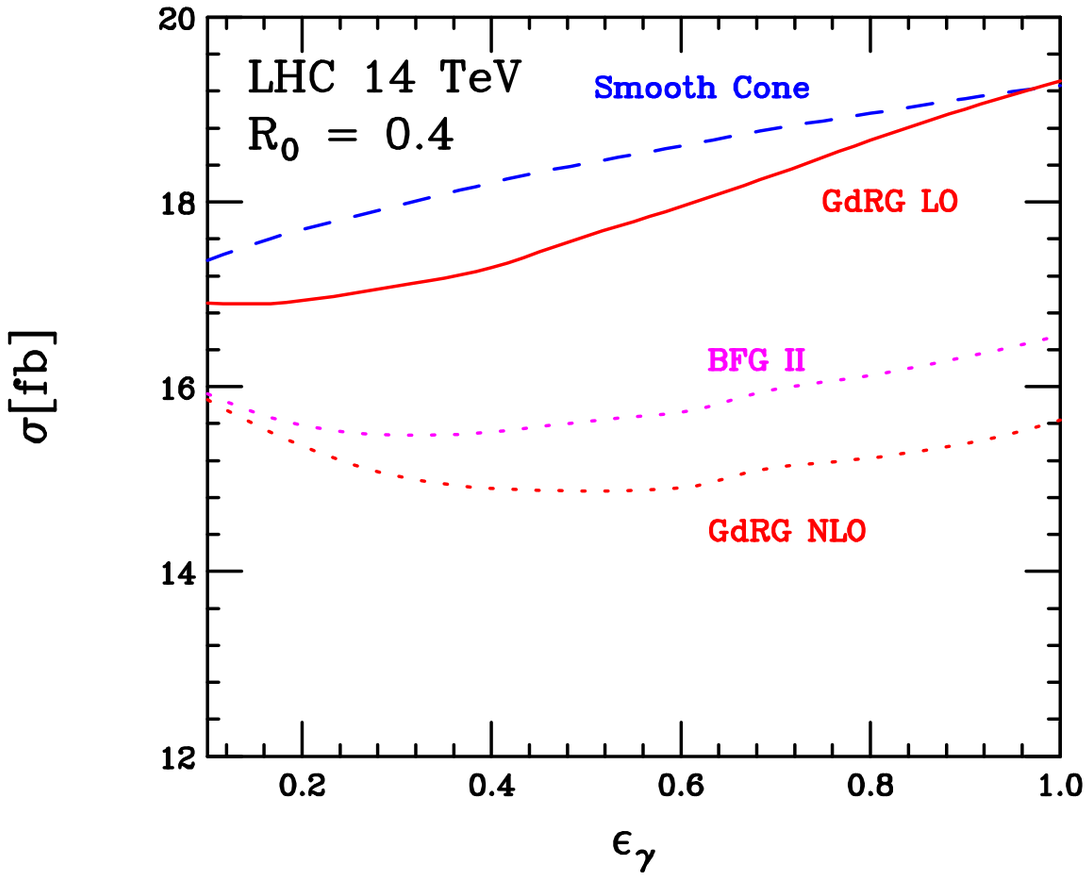
Smooth cone isolation is defined as,

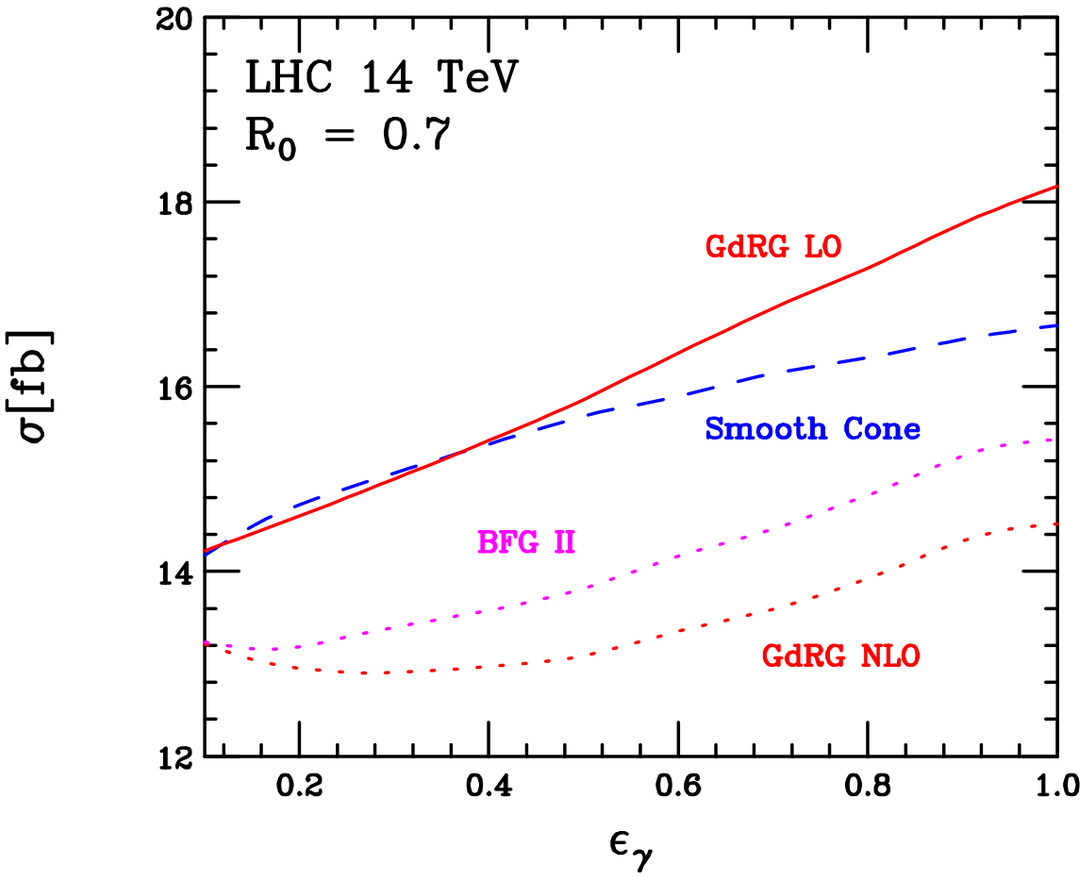
$$\sum_{\text{had}} E_T^{\text{had}} \theta(R - R_{\text{had},\gamma}) < \epsilon_\gamma p_T^\gamma \left(\frac{1-\cos R}{1-\cos R_0} \right)^n \qquad \text{for all } R \leq R_0 \ .$$

Fractional isolation is then defined as,

$$\sum_{\text{had} \in R_0} E_T^{\text{had}} < \epsilon_\gamma p_T^\gamma .$$

Triphotons



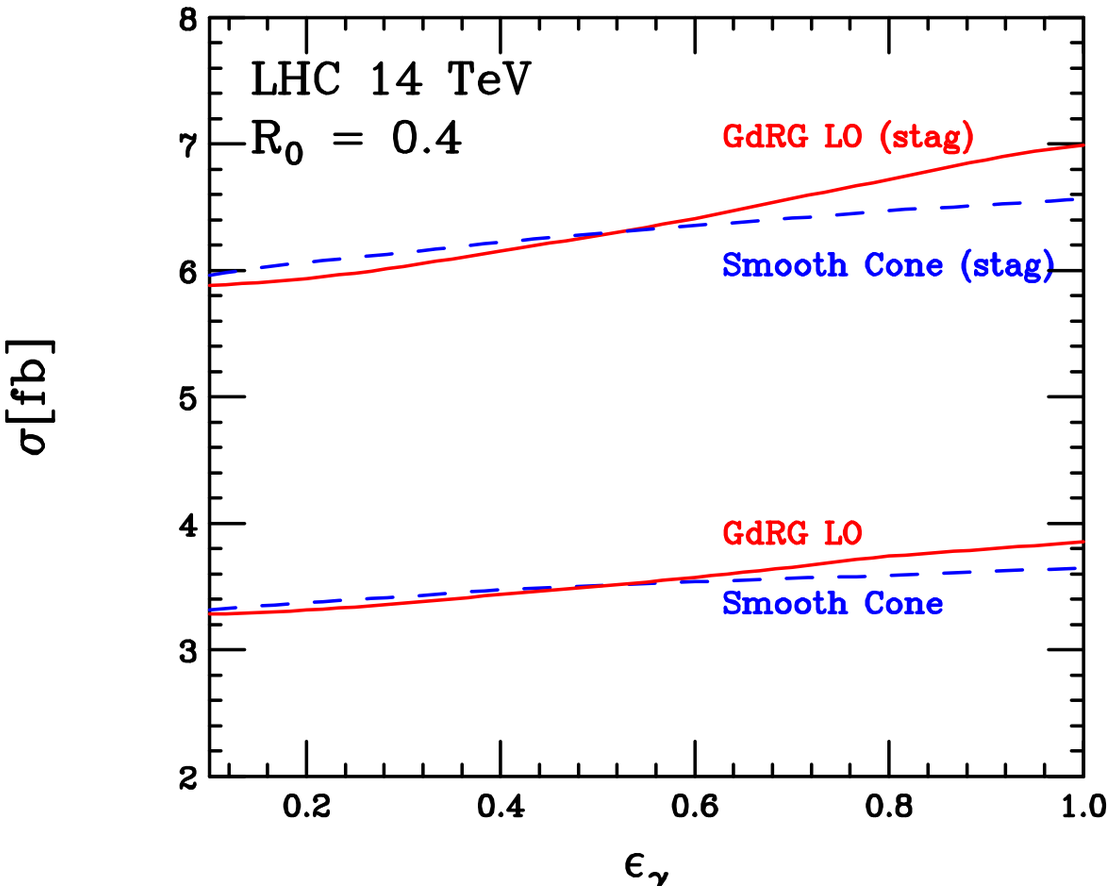


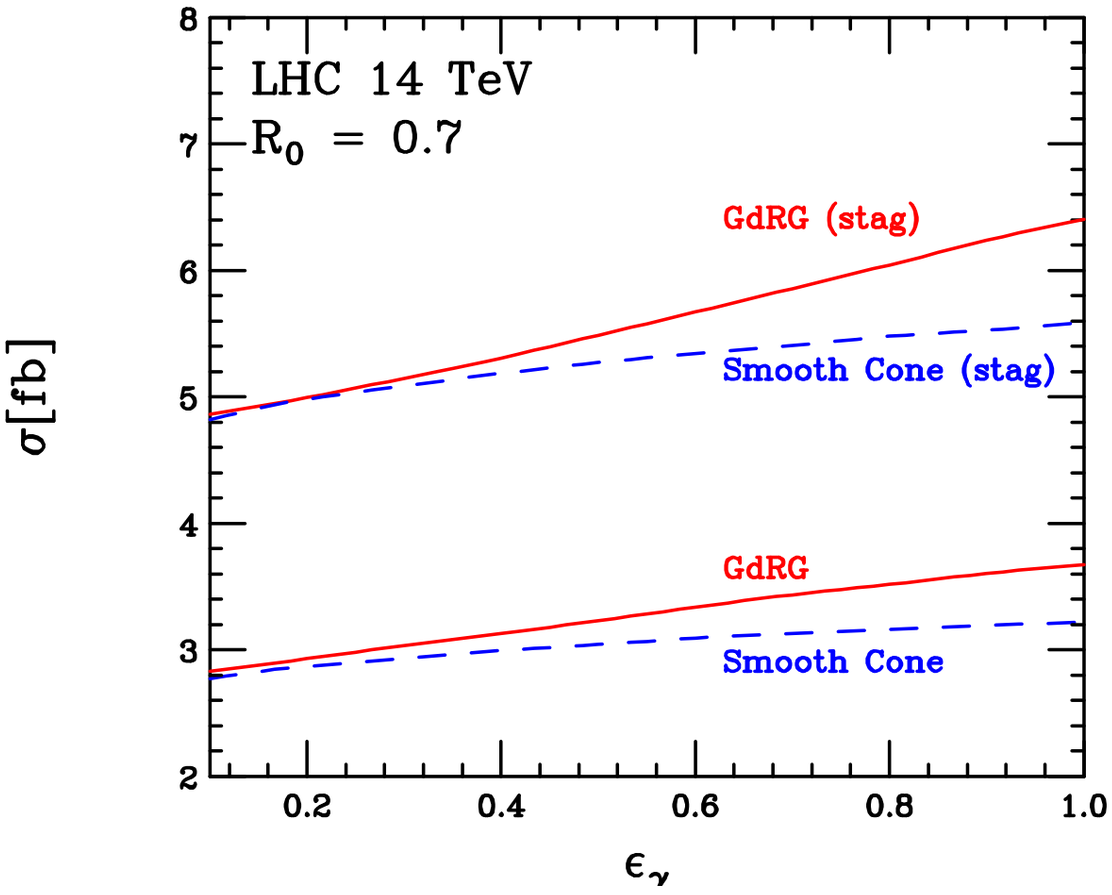
Should be “easily” measurable at the LHC,

Differences in total rate are not large between LO frag and smooth cone,

Larger differences noted if higher order sets are used in conjunction with NLO fixed order.

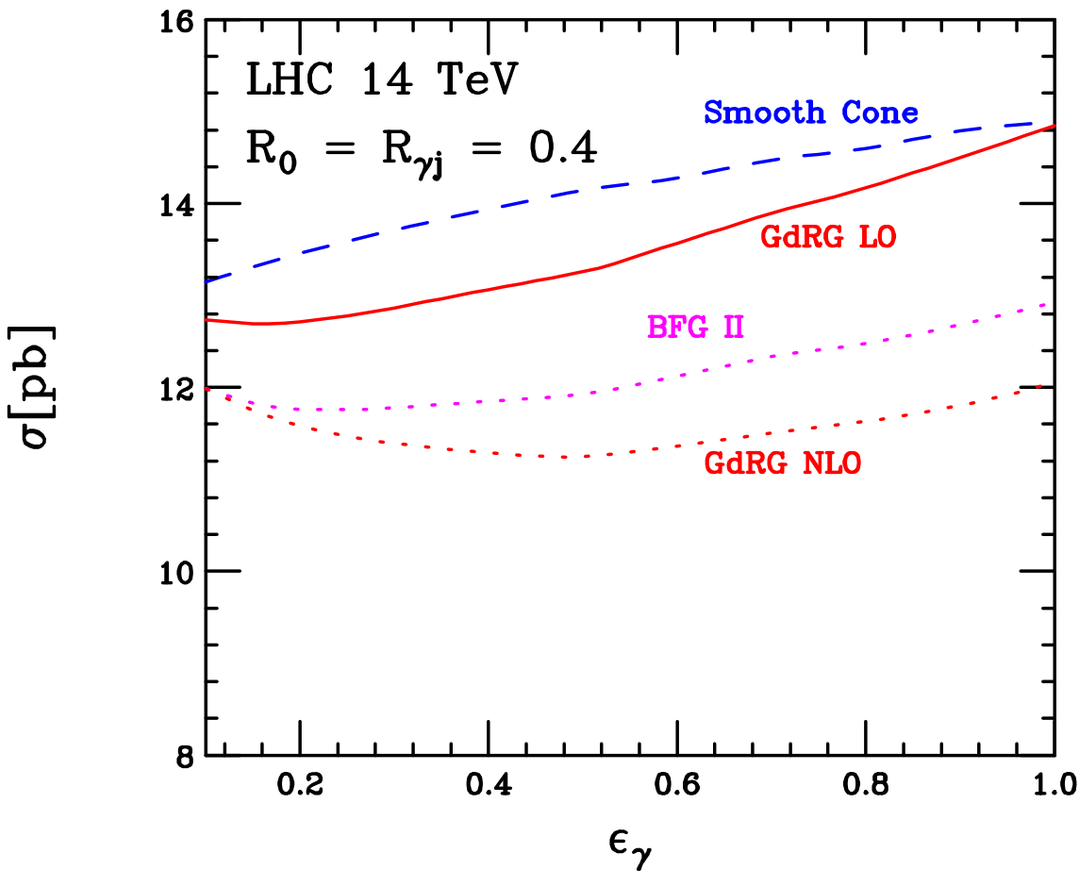
Triphotons, different cuts

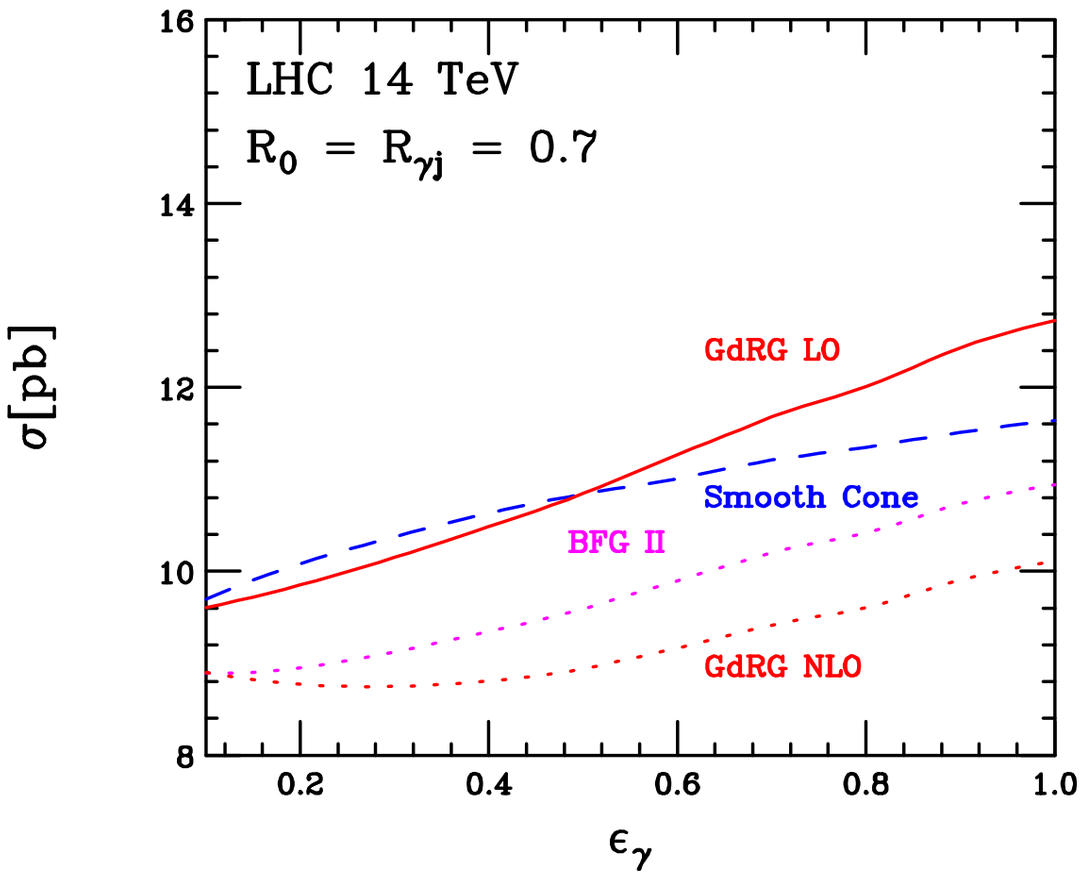




Harder cut (>50) do not seem to change the picture much.

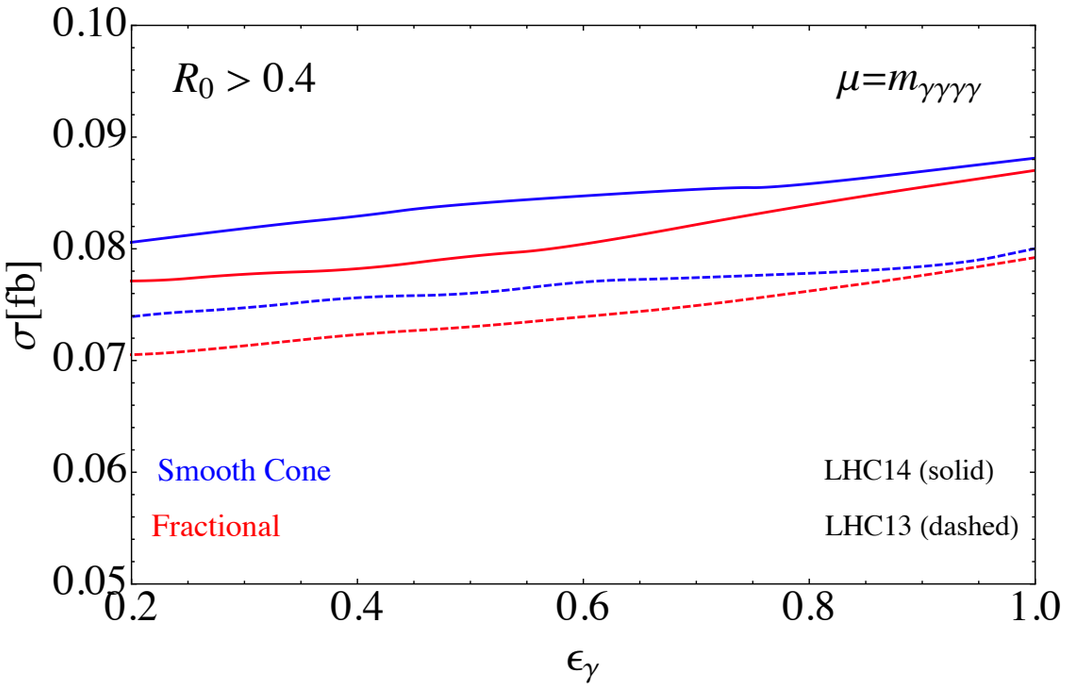
Diphoton + jet comparison

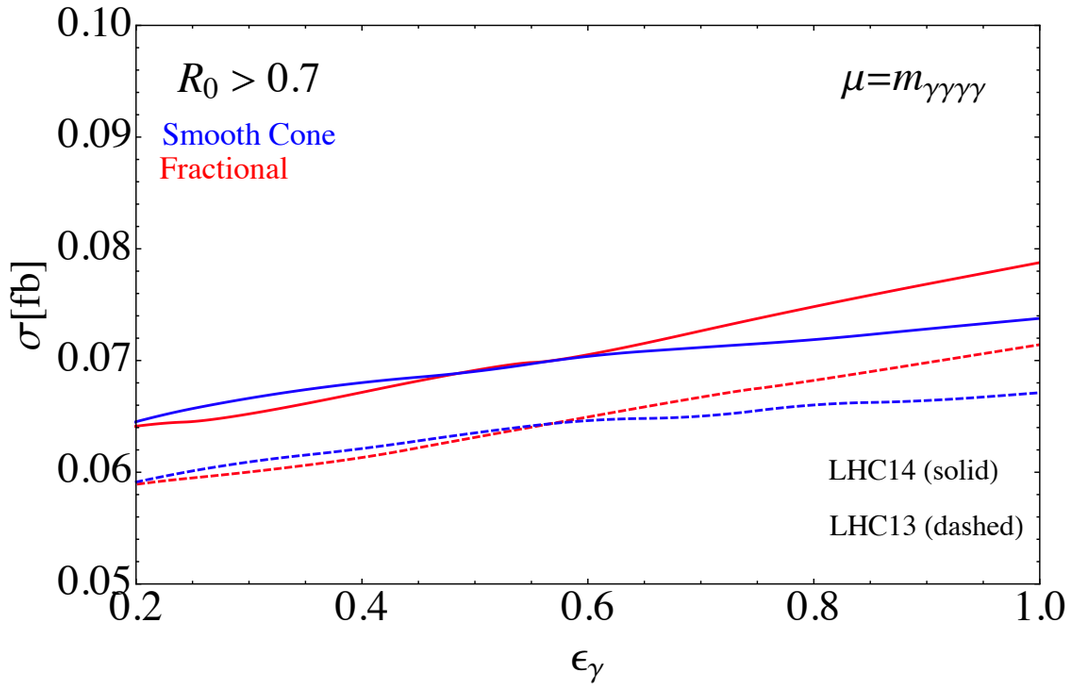




Similar behavior noted in diphotons + jet process indicating that 2->3 kinematics is more important than # of photons.

Four photon production





Also four photons are similar too! Although much harder to measure!