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Deutsche Forschungsgemeinschaft DFG

Smooth Photon Isolation
- Probing the limits -

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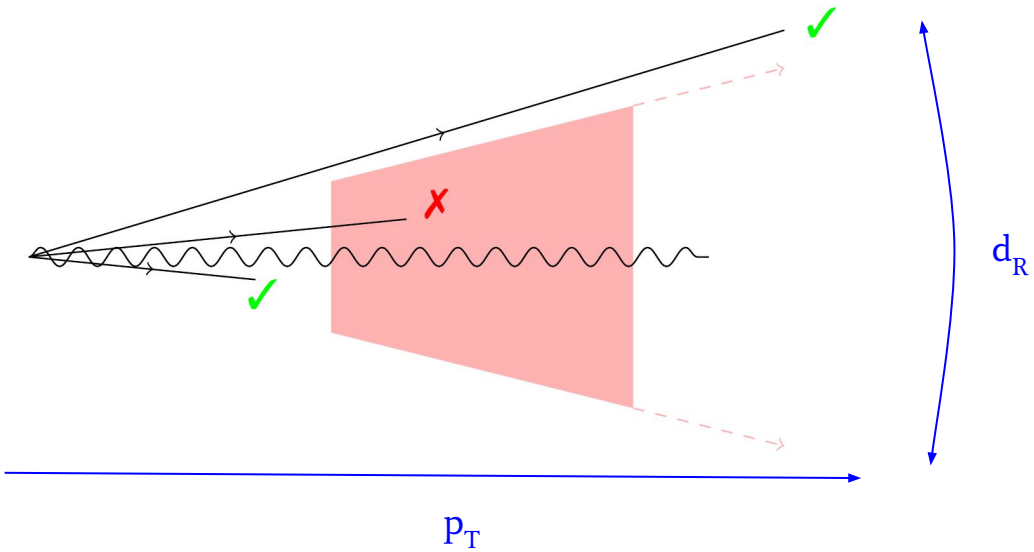
Dealing with the collinear photon divergence

Measurements

- Detector: discrete resolution in energy and angular distance
- infrared safety needed

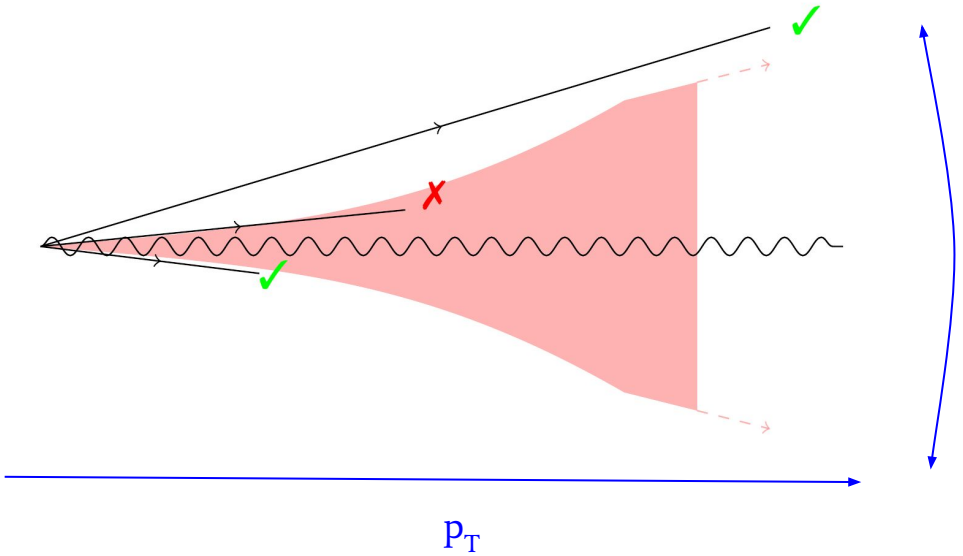


$E_{T,threshold}$ no isolation, if p_T below

dR isolation cone radius

Theory Predictions

- Collinear limit must be damped (or absorbed into FF functions)
- Infrared singularities (e.g. soft gluons) must be respected

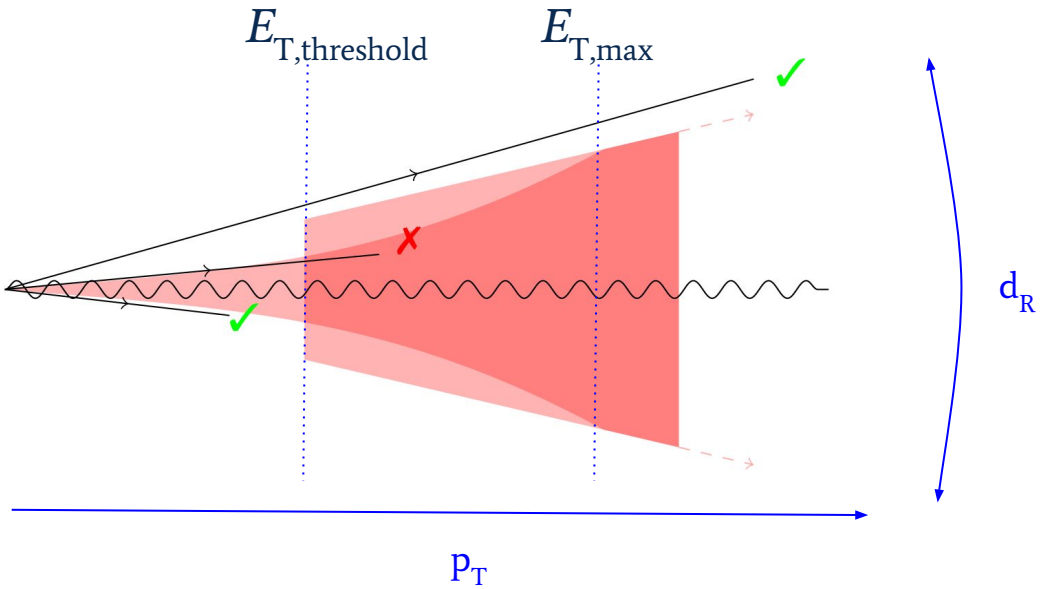


Smooth isolation:
[arXiv:hep-ph/9801442]

$E_{T,max}$	upper boundary for smoothening
r_0	isolation cone radius
n	curvature behavior

Combining both approaches: "hybrid" isolation

- Use smooth cone below $E_{T,threshold}$ and the experimental one above



- region of interest: below $E_{T,threshold}$!
- smooth cone there: can be controlled by n, $E_{T,max}$ or r_0

Here studied:

- pp → γj @NLO
- limits of hybrid isolation cone: → variation of $E_{\mathrm{T,max}}$
- smooth (hybrid) cone predictions by Sherpa[arXiv:1905.09127] (+ Rivet[arXiv:1003.0694])
- comparisons to Jetphox [arXiv:hep-ph/0204023] and ATLAS data

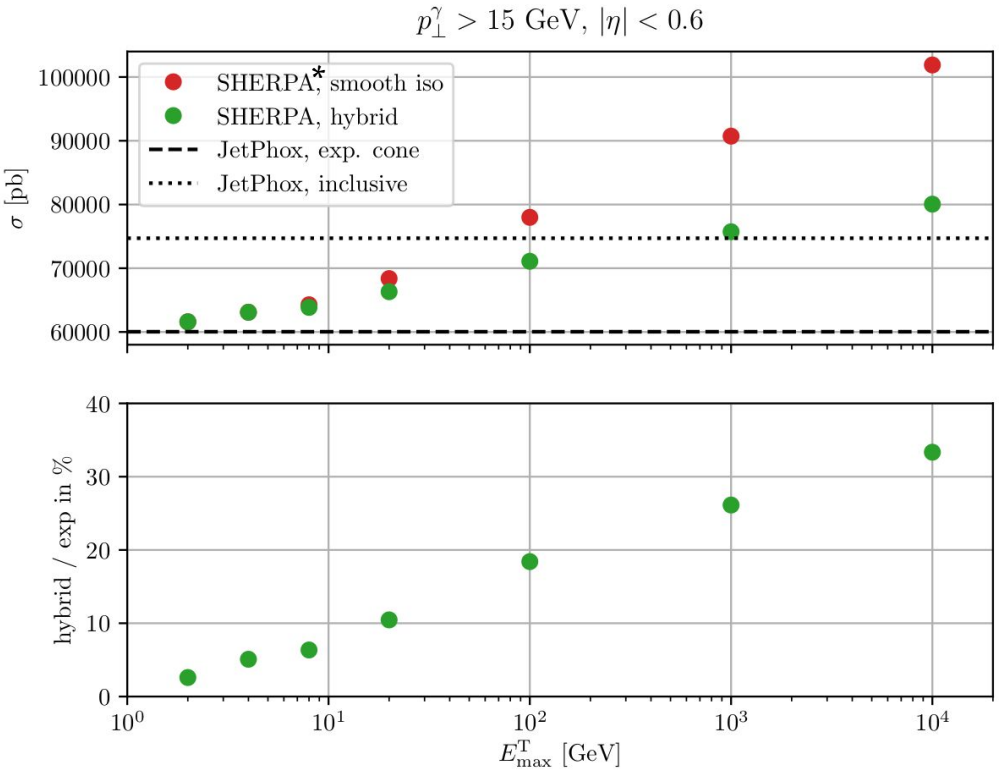
fixed-order NLO: $p_{T,photon} > 15$ GeV

Analysis

- $p_{T,photon} > 15$ GeV
- isolation:
  - $E_{T,threshold} = 4$ GeV
  - $dR = 0.4$

Prediction

- smooth / hybrid cone
- $r_0 = 0.4$, $n = 1$
- 2 GeV < E_{Tmax} < 10000 GeV



* Sherpa results cross checked with Jetphox,
thanks to Gudrun Heinrich for providing a implementation!

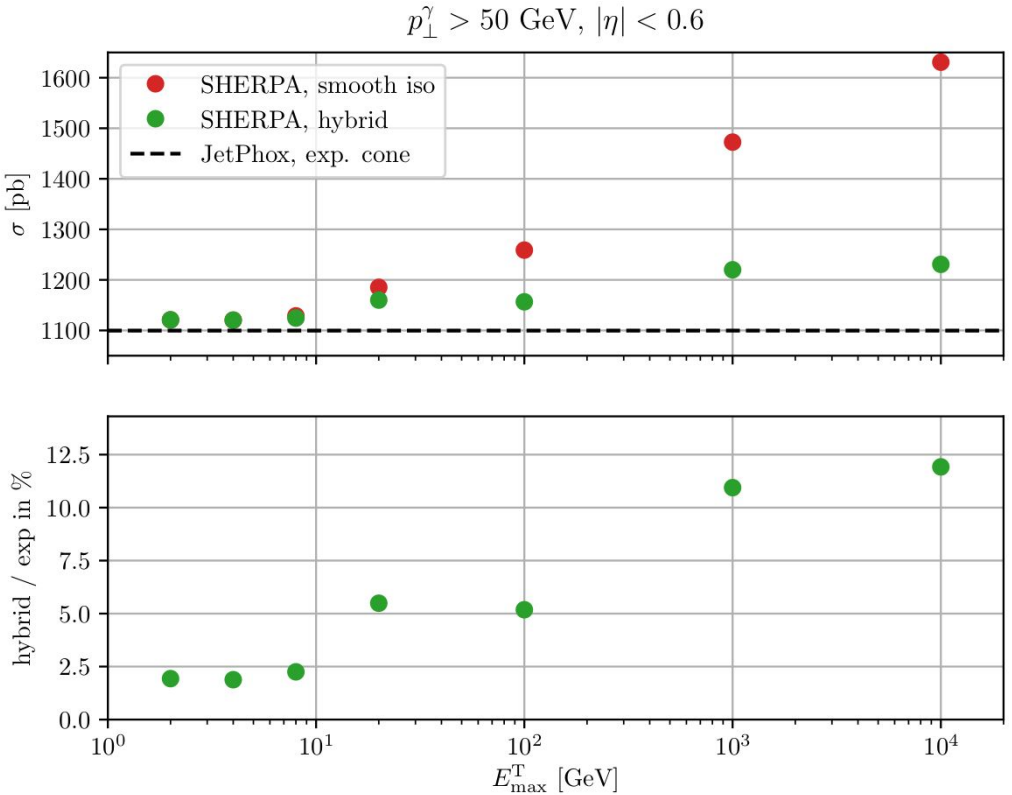
fixed-order NLO: $p_{T,photon} > 50$ GeV

Analysis

- $p_{T,photon} > 50$ GeV
- isolation:
  - $E_{T,threshold} = 4$ GeV
  - $dR = 0.4$

Prediction

- smooth / hybrid cone
- $r_0 = 0.4$, $n = 1$
- 2 GeV < E_{Tmax} < 10000 GeV



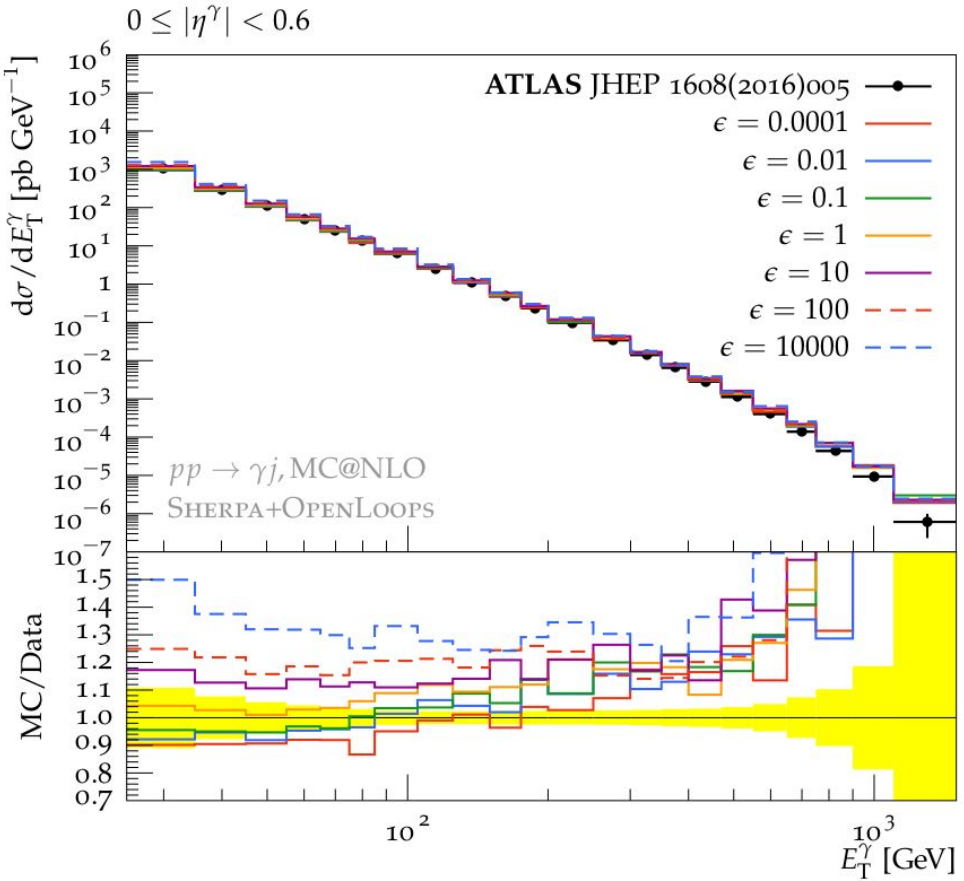
NLO+PS, $|\eta_{photon}| < 0.6$

Data

- Inclusive, prompt photon production
- ATLAS, 8 TeV [arXiv:1605.03495]
- Isolation:
  - $E_{T,threshold}$ = 4.8 GeV + corrections
  - $dR = 0.4$

Prediction

- Sherpa, NLO+PS
- Smooth cone with $n = 1$, $r_0 = 0.4$ and $E_{T,max} = \varepsilon * E_{T,photon}$



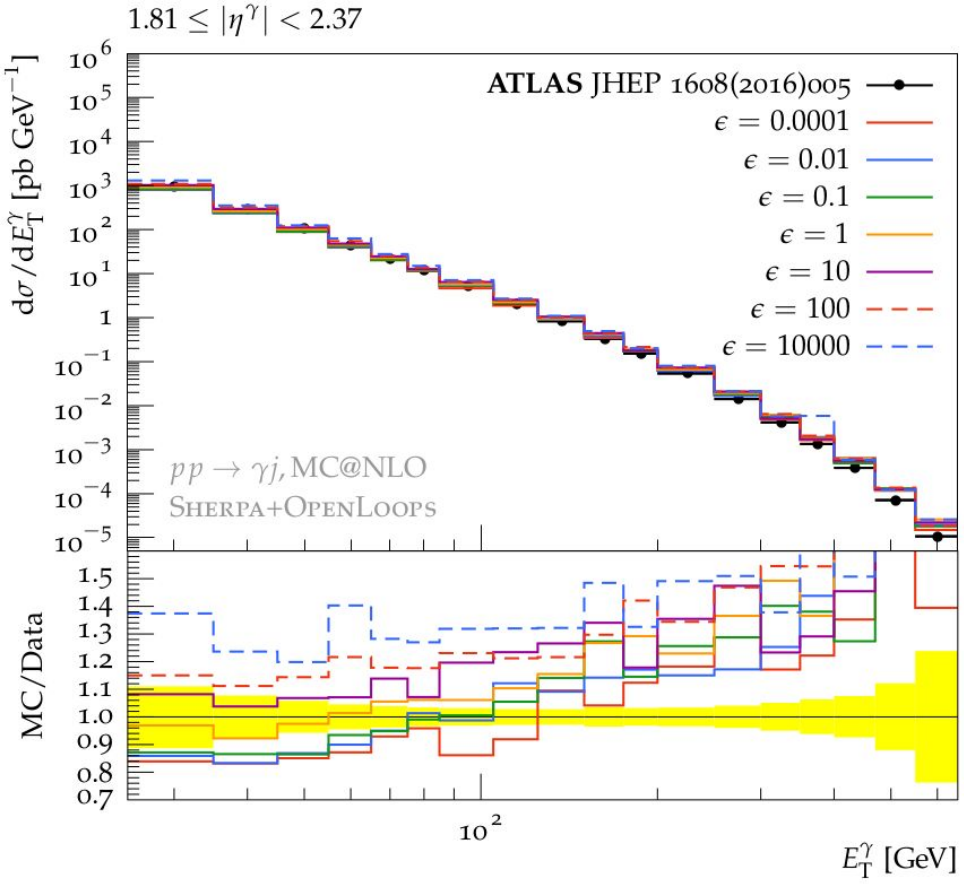
NLO+PS, $1.81 < |\eta_{photon}| < 2.37$

Data

- Inclusive, prompt photon production
- ATLAS, 8 TeV [arXiv:1605.03495]
- Isolation:
  - $E_{T,threshold}$ = 4.8 GeV + corrections
  - $dR = 0.4$

Prediction

- Sherpa, NLO+PS
- Smooth cone with $n = 1$, $r_0 = 0.4$ and $E_{T,max} = \varepsilon * E_{T,photon}$



Discussion

wanted:

- Event generation as inclusive as possible
- no cut dependence

Is there really an issue?

- Extreme choices of parameters discussed here
- still good agreement if parameters are matched

Uncertainties

- Is the choice of isolation parameters a separate uncertainty?
- How to estimate it?

How to overcome this problem?

- No calculations available using FFs beyond NLO-FO
- Use QED showers?
  - QCD+QED merging (LO only): [arXiv:0912.3501]
  - QED shower with Powheg: [arXiv:1709.04154, arXiv:1610.02275]