ALPGEN update

M.Mangano, M.Chiesa, M.Moretti, F.Piccinini

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  - v2.14 release: Mar 2011. Minor update of 2.13: new PDFs, option to have different α_S in ME and shower evolution. Default params used in most analyses identical to v2.13

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- Proven as a reliable tool to describe multijet final states

- Updates focused on extending the dynamical domain, to match the needs of increase in energy and luminosity:
  - large Njet multiplicities
  - inclusion of EW corrections at high Q^2

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  - option to generate in bins of pt for the highest-pt jet — compatible with matching etc
  - option to veto hvq's produced by the shower

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- **Physics updates**
  - Increased number of final-state jet multiplicity.
    - in principle matrix-element generation up to 20 final state partons
    - in practice, CPU limits njet process-by-process. E.g. for Njets →10 jets, W+Njets →8 jets, …)
  - Inclusion of EW Sudakovs (optional) for most processes *(Denner-Pozzorini algorithm, hep-ph/0408068)*
- Interface to HW++/HW7/PY8 (K.Hamilton and A.Papafestathiou for HW, R. Corke for PY)
- Inclusion of spin correlations in top decays for all processes with tops (was only in ttbar and ttH, it's been added to tttt, ttbb, ttV, …)
- New hard procs: Zγ+jets, ZγQQ+jets
- Included 6-quark processes (e.g. qq->qqqq+ N gluons)

Examples: multijet rates

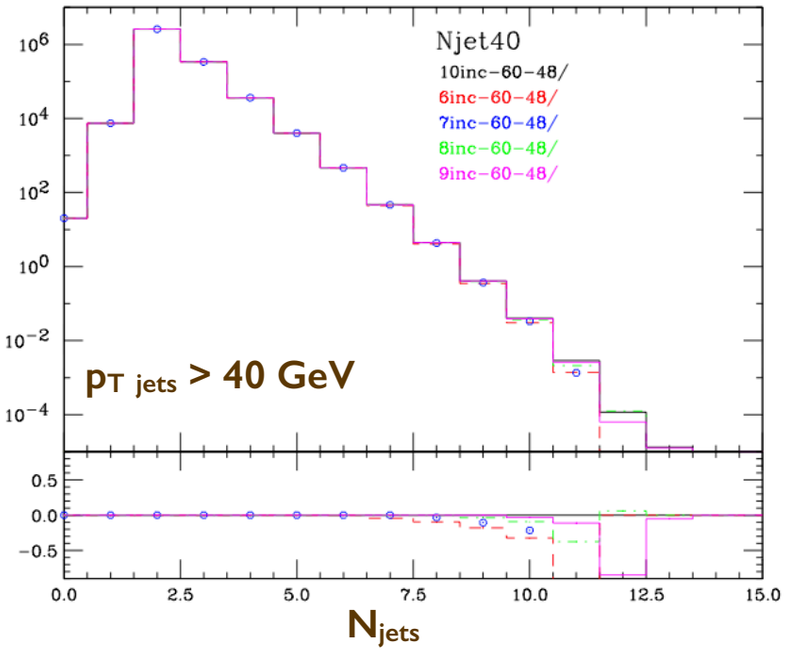
Example: multi jet rates

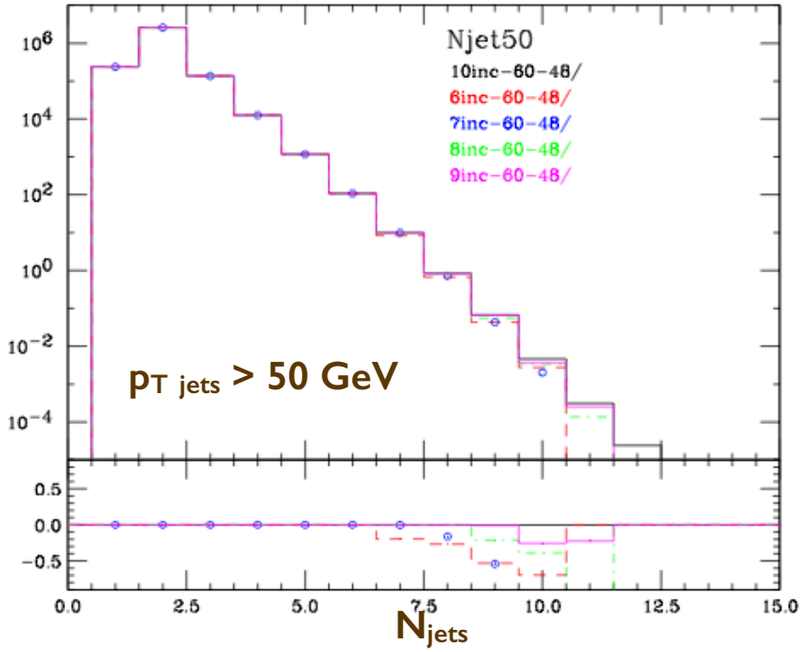
Generation (8 TeV):
ptmin=40 GeV etamax=5 Rmin=0.7

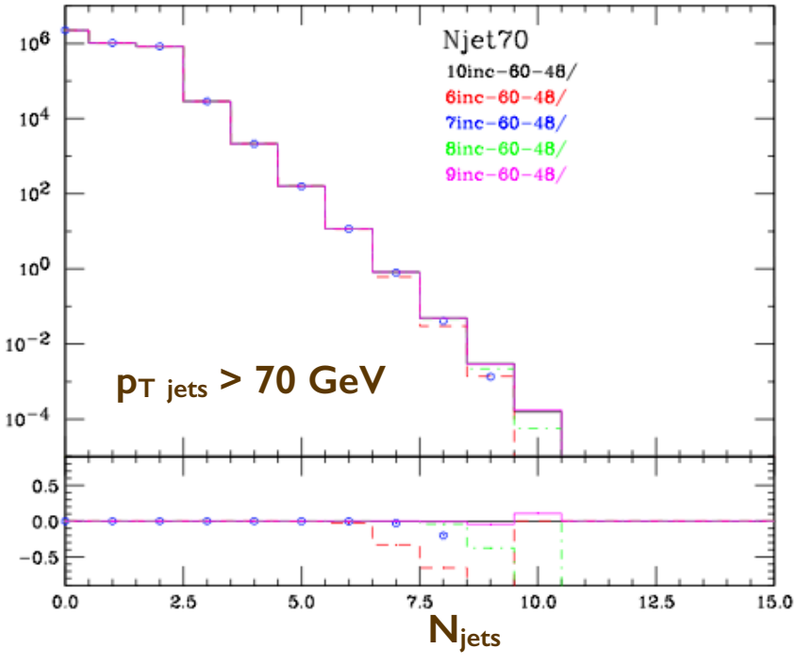
Matching:
etclus=48 GeV

Analysis:
1 jet > 60 GeV

Ninc in the plots means: used matrix elements up to N partons







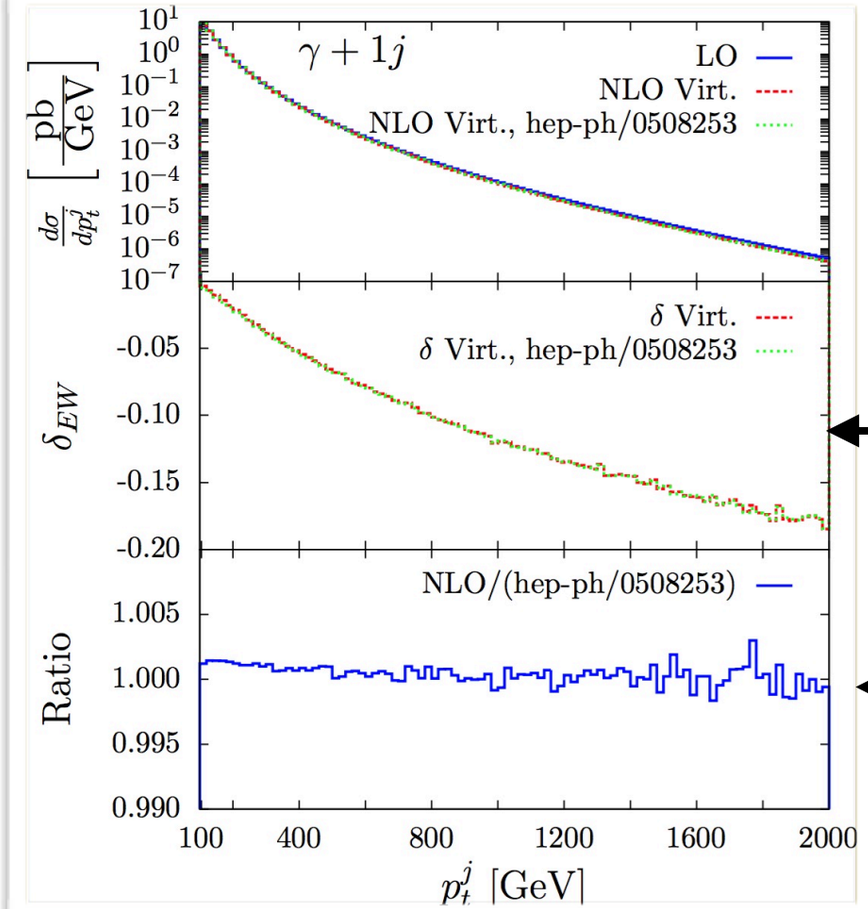
p_T>40 GeV	N_{max}=6	N_{max}=7	N_{max}=8	N_{max}=9	N_{max}=10
Njets=6	**390**	390	390	390	390
Njets=7	39	**41**	41	41	41
Njets=8	3.6	4.0	**4.1**	4.1	4.1
Njets=9	0.46	0.49	0.52	**0.53**	0.53
Njets=10	2E-02	2.5E-02	2.8E-02	3.1E-02	**3.2E-02**
Njets=11	2.2E-03	1.7E-03	2.0E-03	2E-03	2.2E-03
Njets=12	no stat	1.1E-04	1.1E-04	1.6E-04	1.4E-04

Example: multi jet rates

p_T>70 GeV	N_{max}=6	N_{max}=7	N_{max}=8	N_{max}=9	N_{max}=10
Njets=6	**11.1**	11.5	11.5	11.5	11.5
Njets=7	0.57	**0.76**	0.79	0.79	0.79
Njets=8	2.9E-02	3.3E-02	**4.7E-02**	4.8E-02	4.9E-02
Njets=9	1.1E-03	1.5E-03	1.8E-03	**2.7E-03**	2.9E-03
Njets=10	no stat	6.1E-05	6.5E-05	8.2E-05	**1.4E-04**

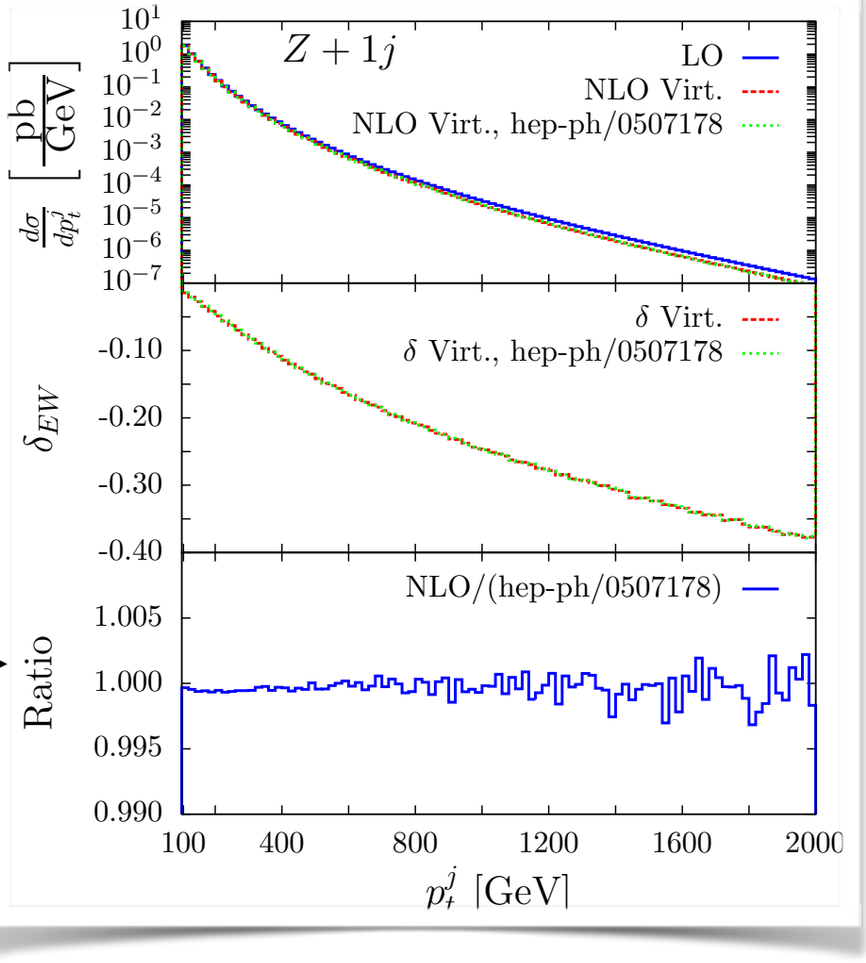
Examples: EW corrections

V+jets



Effect of EW virtual corrections

Alpgen vs full NLO

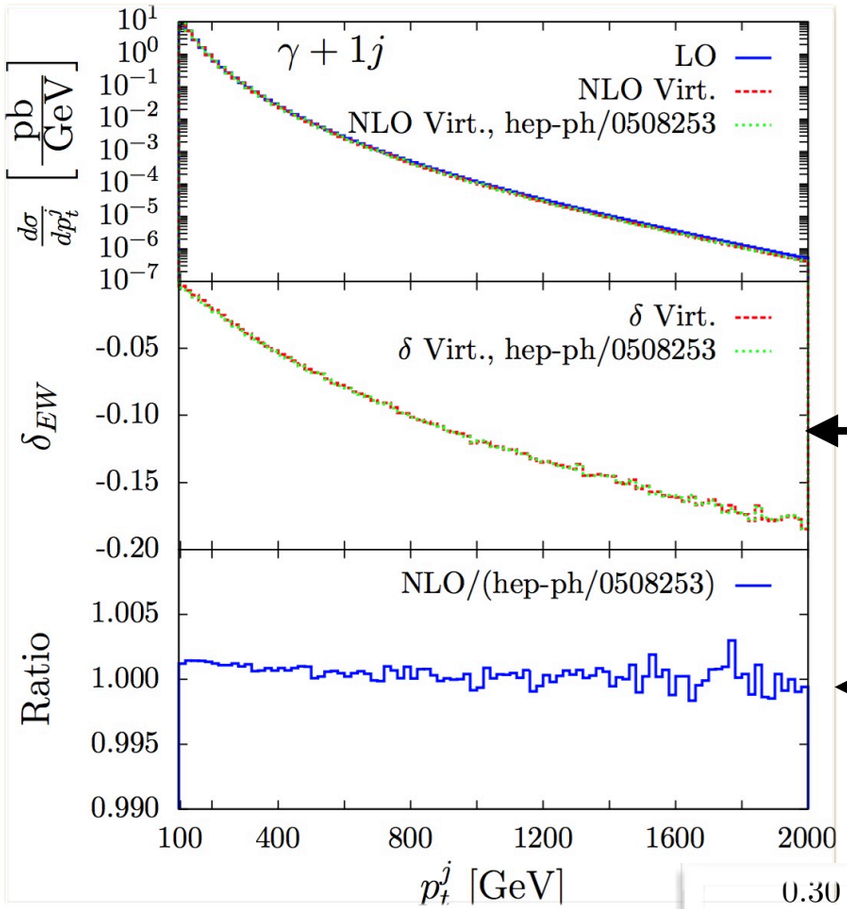


Alpgen QCD

Alpgen QCD +L&NL EW logs

Full NLO EW

V+jets



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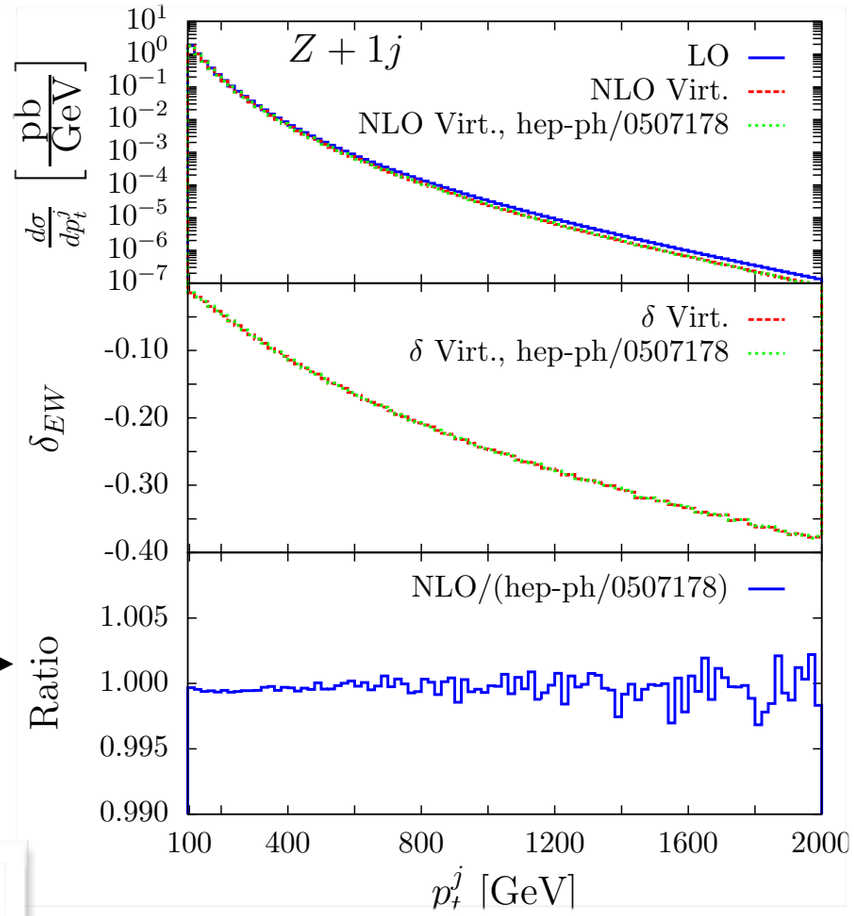

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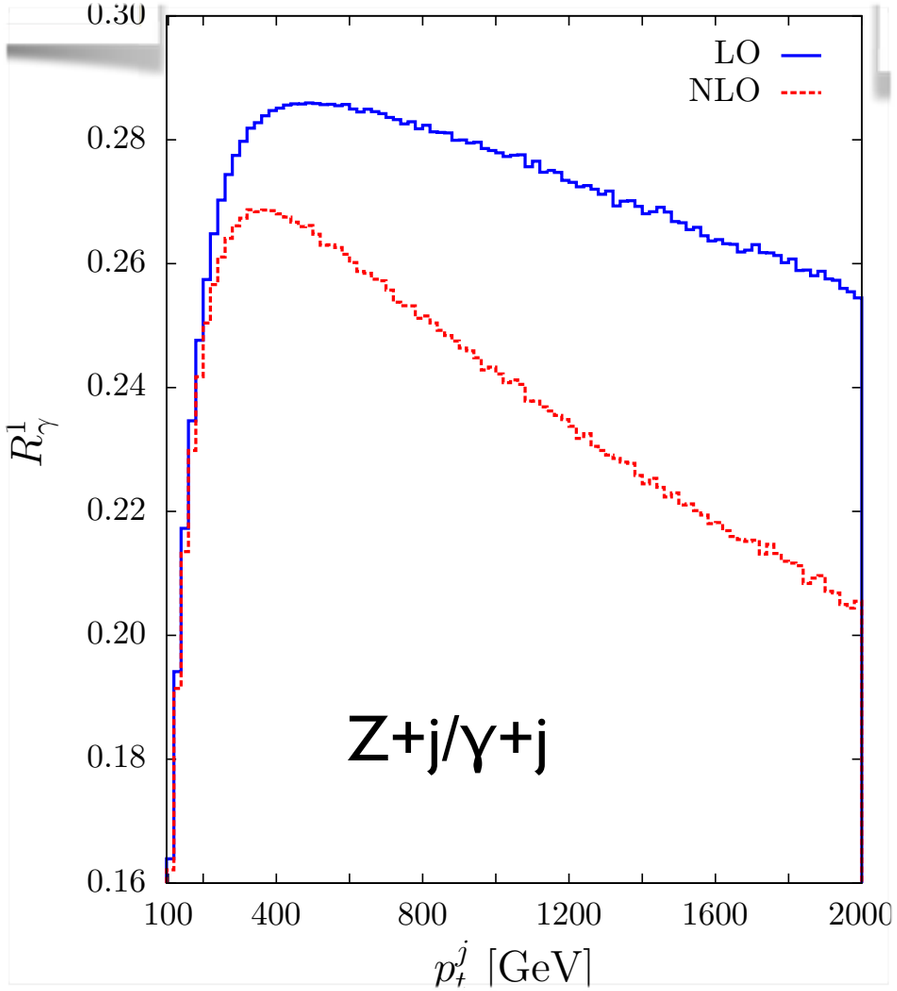
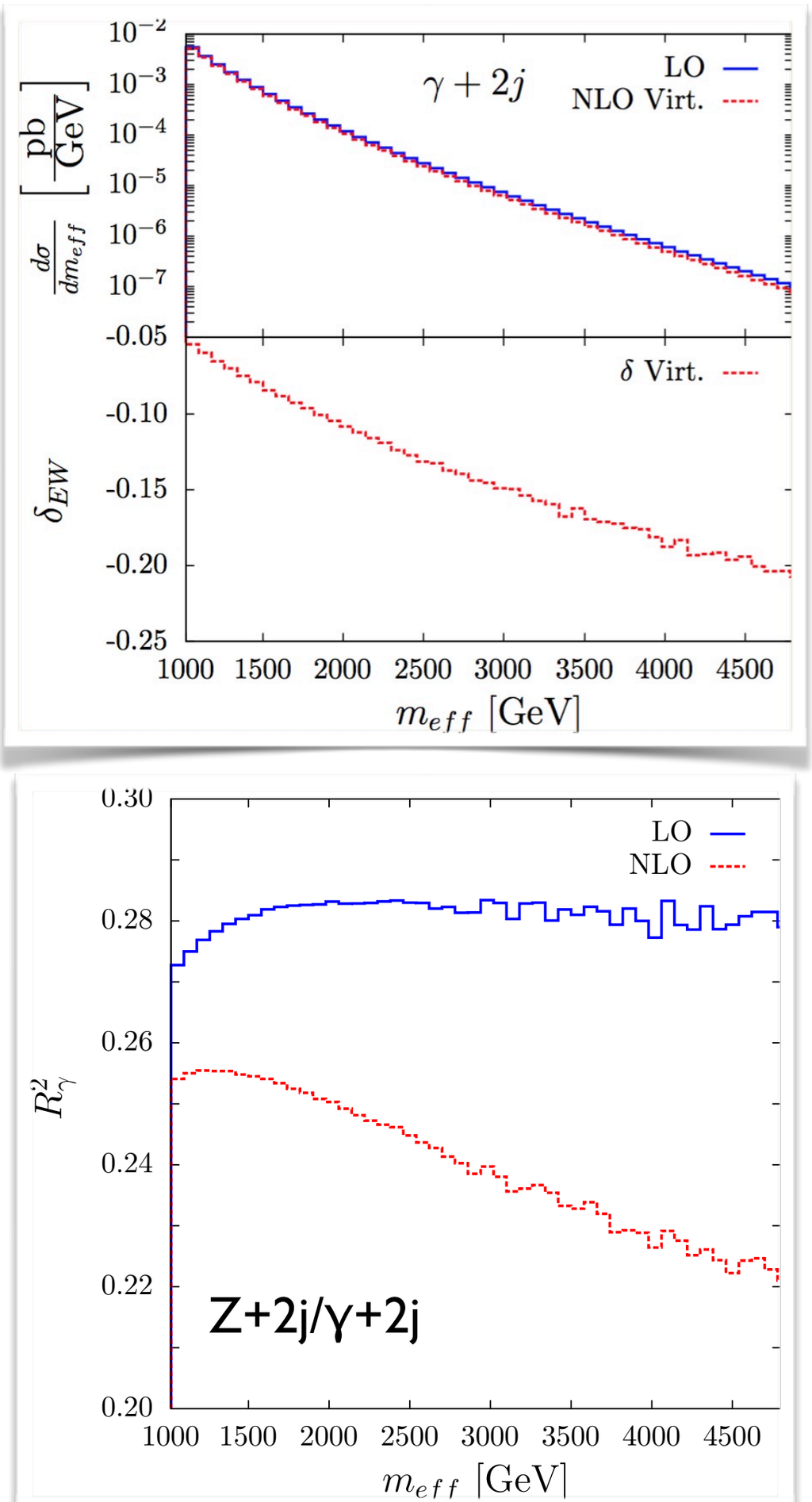
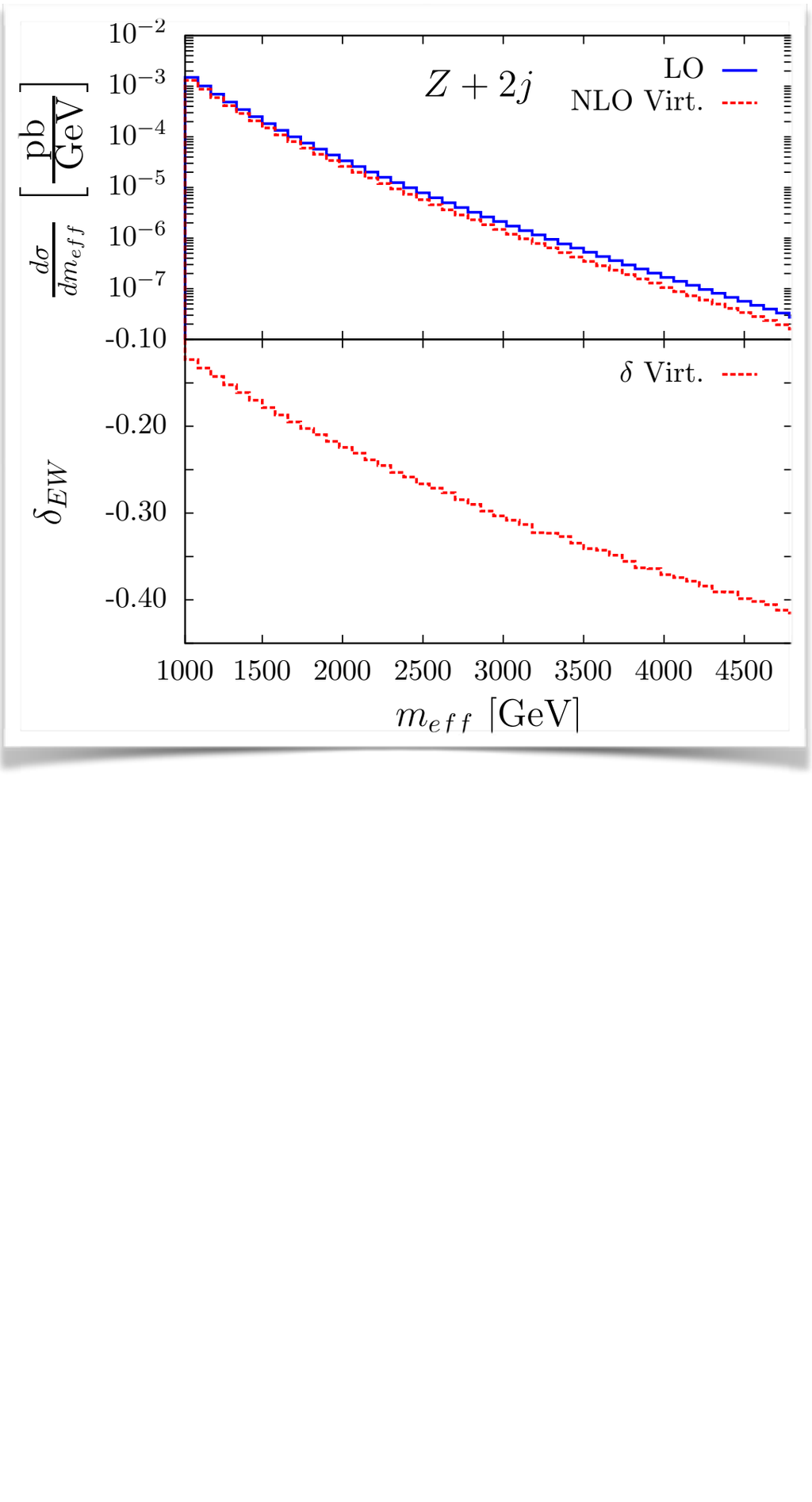
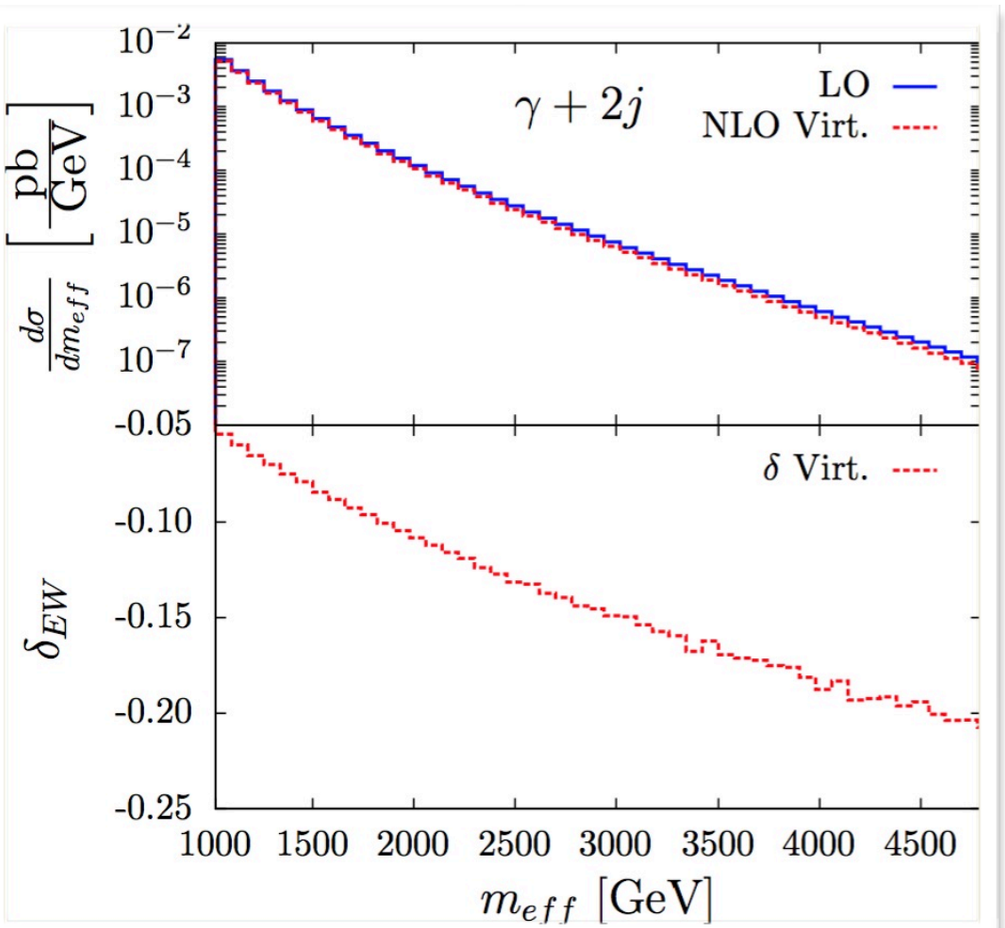
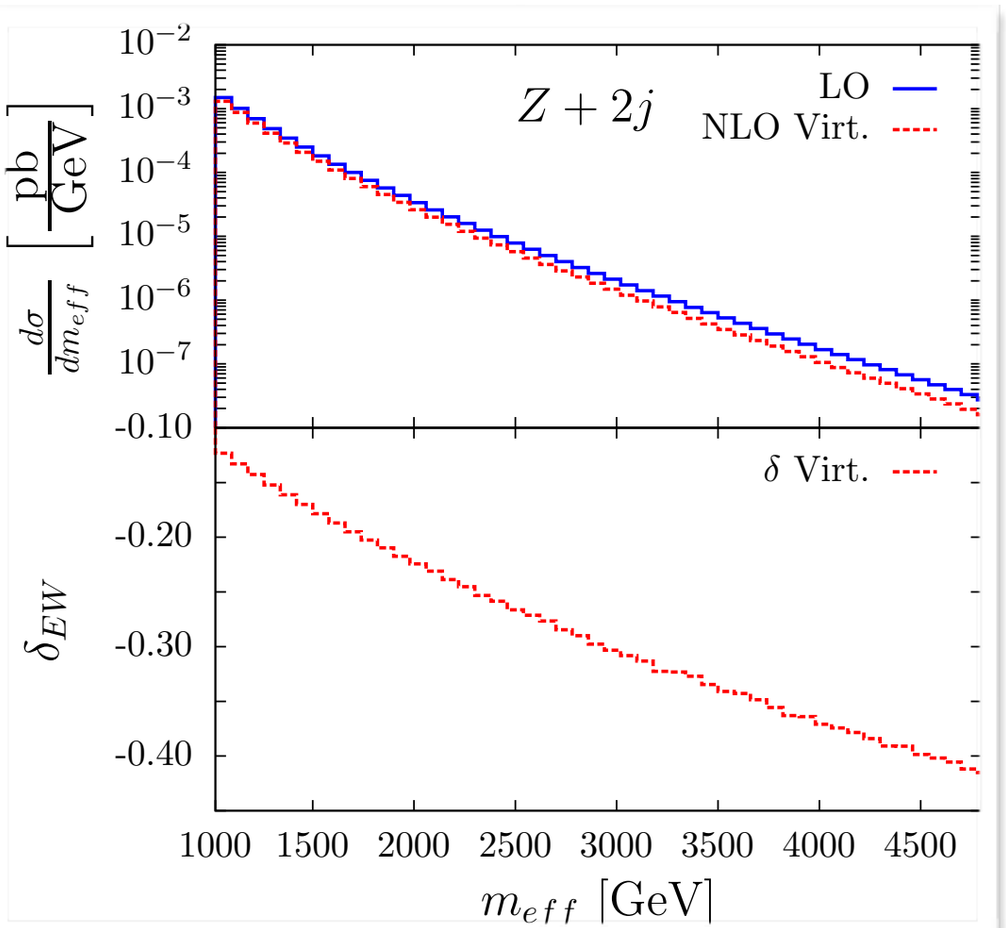


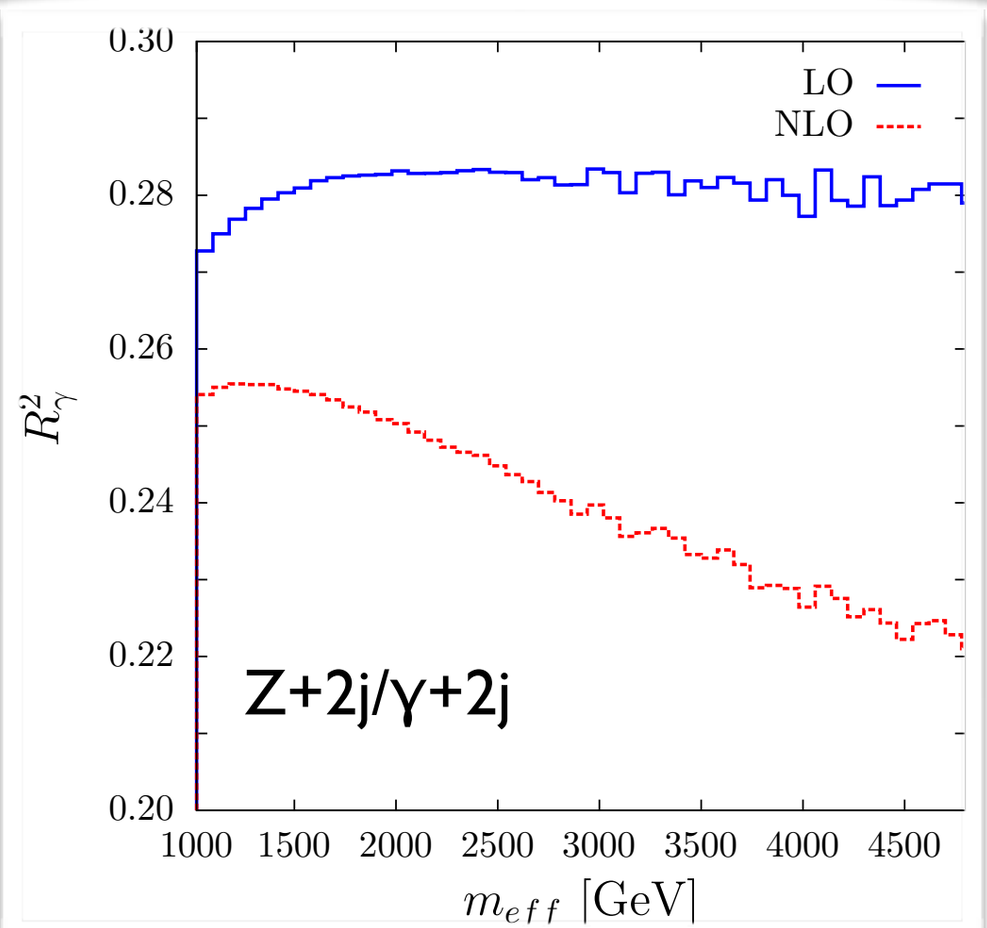

$\gamma + 2j$
LO
NLO Virt.
δ Virt.
$\frac{d\sigma}{dm_{eff}}$ $\left[\frac{\text{pb}}{\text{GeV}}\right]$
δ_{EW}
m_{eff} [GeV]

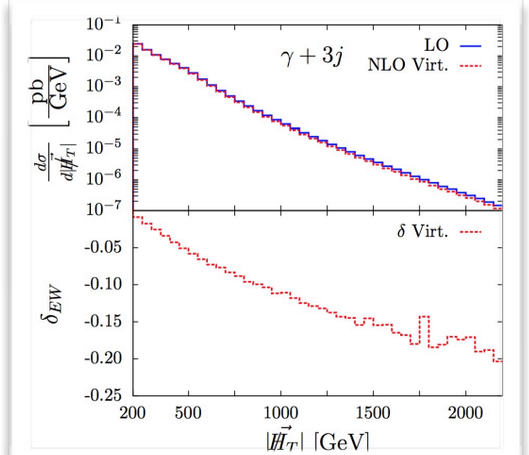

$Z + 2j$
LO
NLO Virt.
δ Virt.
$\frac{d\sigma}{dm_{eff}}$ $\left[\frac{\text{pb}}{\text{GeV}}\right]$
δ_{EW}
m_{eff} [GeV]

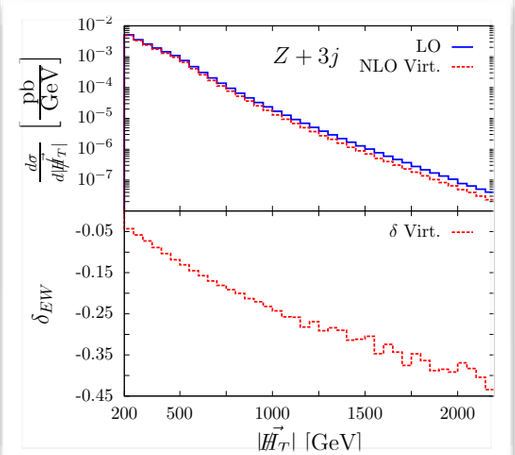
LO
NLO
R^2_γ
Z+2j/γ+2j
m_{eff} [GeV]


$\gamma + 2j$
LO
NLO Virt.
$\frac{d\sigma}{dm_{eff}}$ $\left[\frac{\text{pb}}{\text{GeV}}\right]$
δ Virt.
δ_{EW}
m_{eff} [GeV]


$Z + 2j$
LO
NLO Virt.
$\frac{d\sigma}{dm_{eff}}$ $\left[\frac{\text{pb}}{\text{GeV}}\right]$
δ Virt.
δ_{EW}
m_{eff} [GeV]


LO
NLO
R^2_γ
Z+2j/γ+2j
m_{eff} [GeV]


$\gamma + 3j$
LO
NLO Virt.
$\frac{d\sigma}{d|\vec{\not{H}}_T|}$ $\left[\frac{\text{pb}}{\text{GeV}}\right]$
δ Virt.
δ_{EW}
$|\vec{\not{H}}_T|$ [GeV]


$Z + 3j$
LO
NLO Virt.
$\frac{d\sigma}{d|\vec{\not{H}}_T|}$ $\left[\frac{\text{pb}}{\text{GeV}}\right]$
δ Virt.
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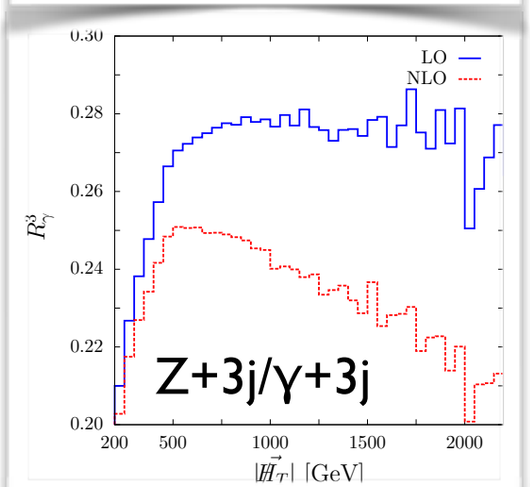
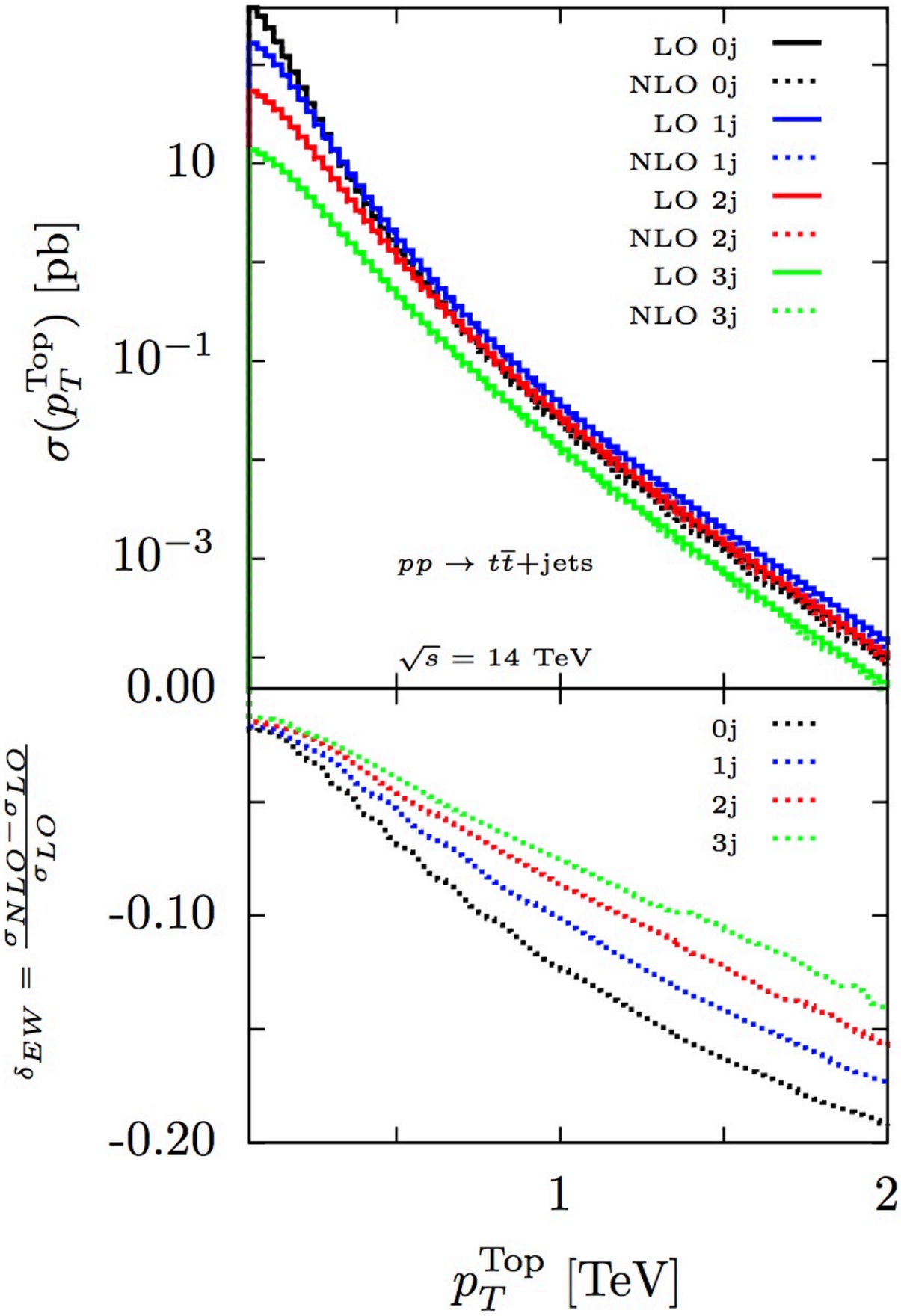

LO
NLO
R^3_γ
Z+3j/γ+3j
$|\vec{\not{H}}_T|$ [GeV]

tt+jets


LO 0j
NLO 0j
LO 1j
NLO 1j
LO 2j
NLO 2j
LO 3j
NLO 3j
$pp \to t\bar{t}$+jets
$\sqrt{s} = 14$ TeV
0j
1j
2j
3j
10
10^{-1}
10^{-3}
0.00
-0.10
-0.20
1
2
$\sigma(p_T^{\rm Top})$ [pb]
$\delta_{EW} = \frac{\sigma_{NLO} - \sigma_{LO}}{\sigma_{LO}}$
$p_T^{\rm Top}$ [TeV]