

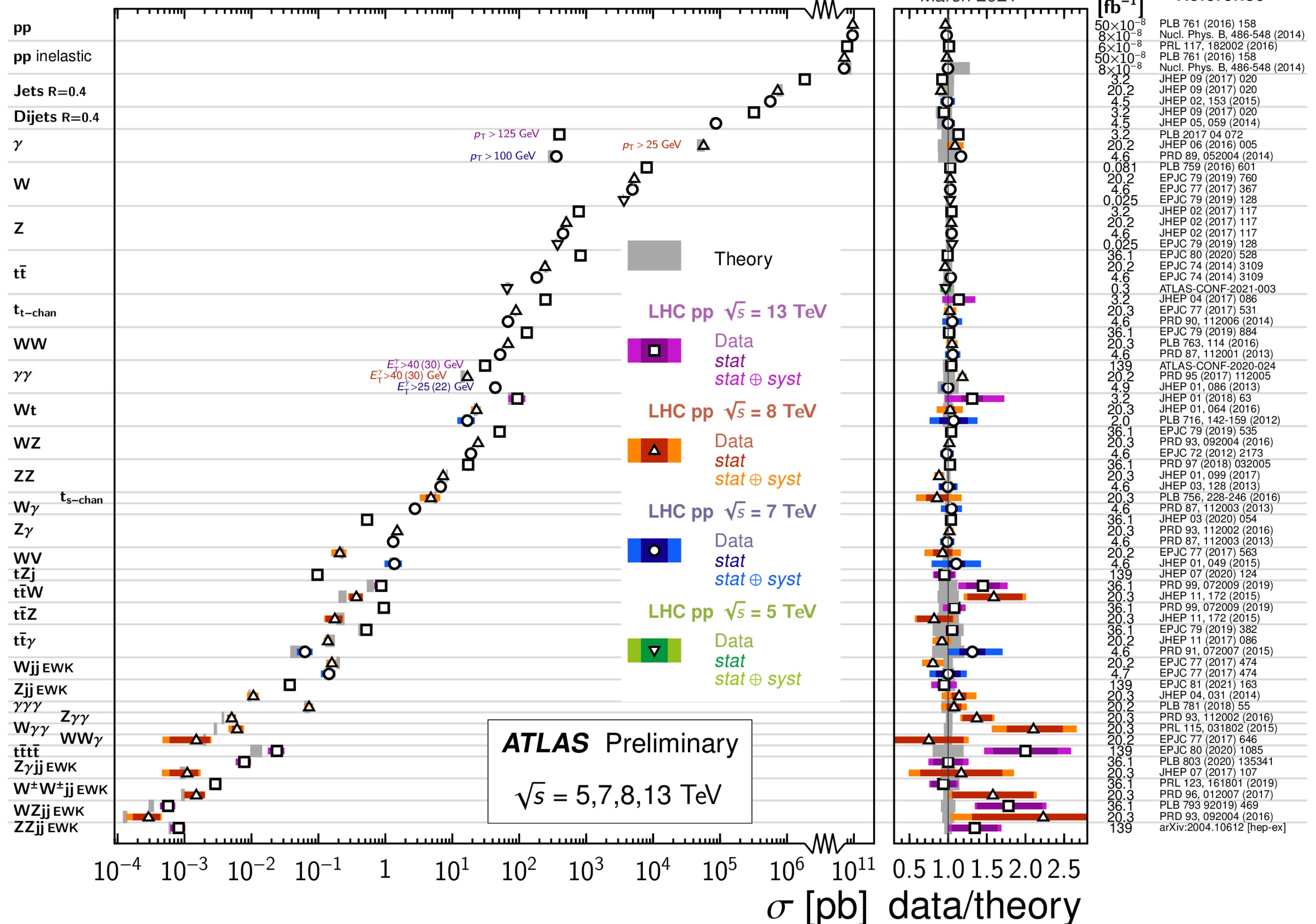
学习总结

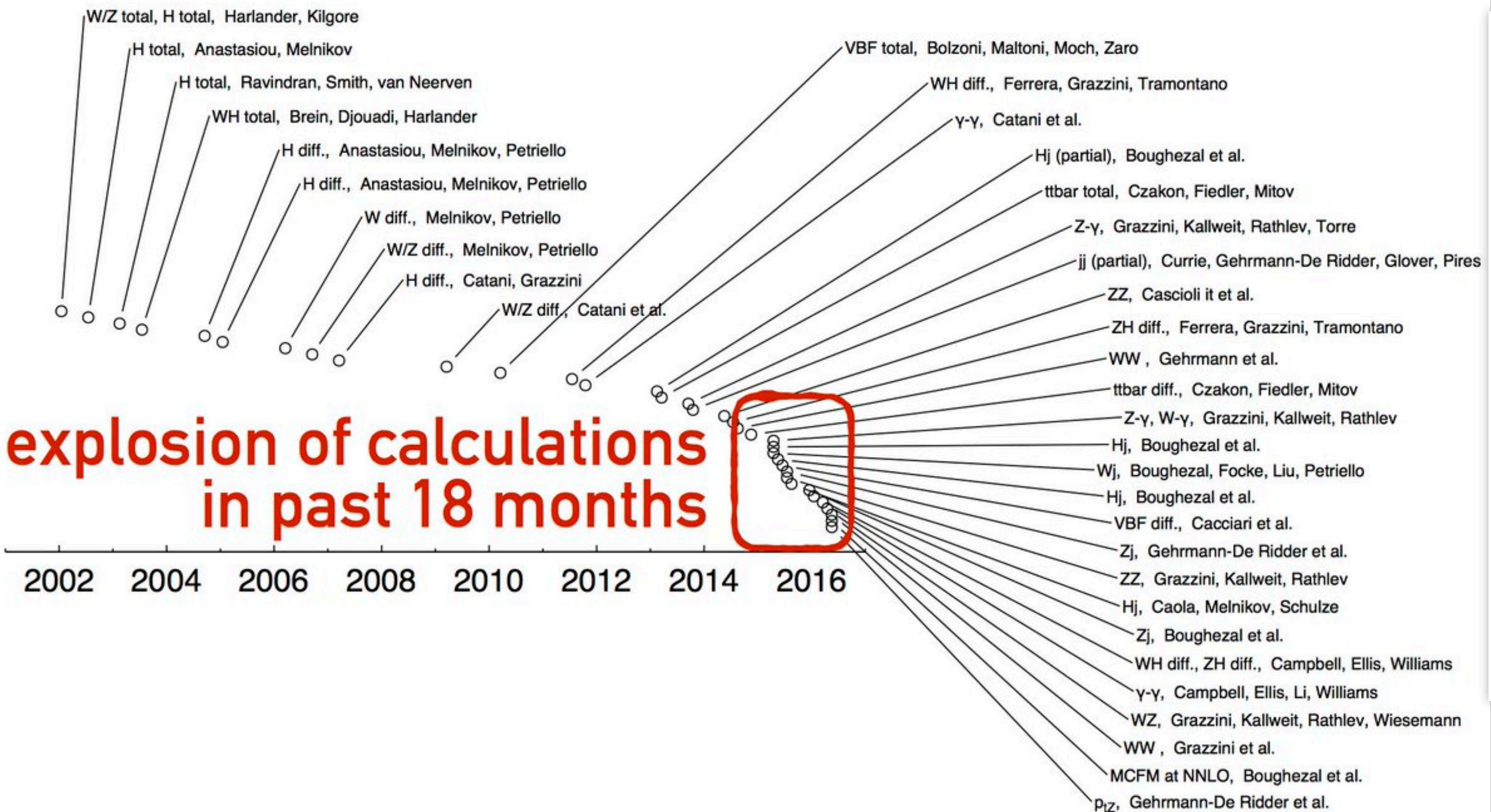
龙明明
中国科学技术大学
2021 07 02

Precision Era

Standard Model Production Cross Section Measurements

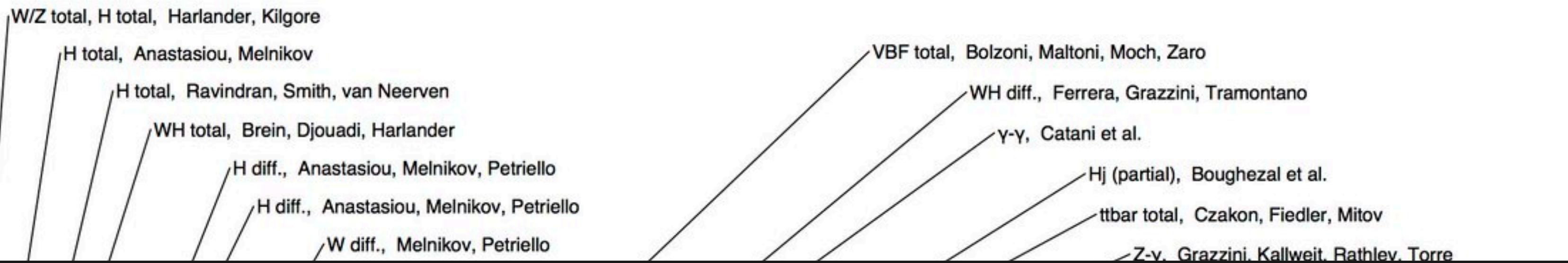
Status:
March 2021





Since 2016

- Mixed QCD-EW corrections (ggH , Drell-Yan, $V+j$)
- Top quark mass effects ($ggHH$, $ggVV$, $ttbar$)
- 5-point 2-loop integrals
- 2->3 @ NNLO (3γ , γjj , $\gamma\gamma j$)
- ...

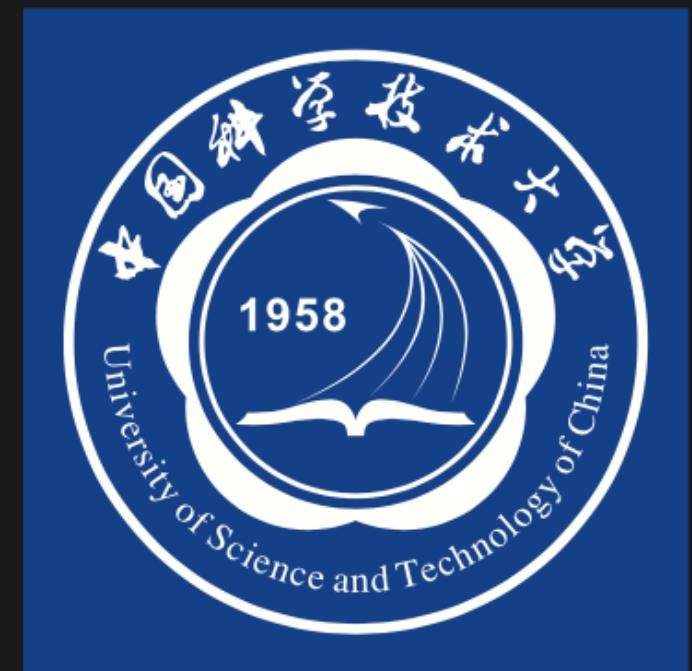


Master integrals for the mixed QCD-QED corrections to the Drell-Yan process with lepton mass dependence

Ming-Ming Long^a, Ren-You Zhang^a, Shao-Ming Wang^b, Wen-Gan Ma^a, Zhe Li^a, Shuai-Shuai Wang^a, Yi Jiang^a

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^bDepartment of Physics, Chongqing University



2002 2004 2006 2008 2010 2012 2014 2016

- Zj, Gehrmann-De Ridder et al.
- ZZ, Grazzini, Kallweit, Rathlev
- Hj, Caola, Melnikov, Schulze
- Zj, Boughezal et al.
- WH diff., ZH diff., Campbell, Ellis, Williams
- γ-γ, Campbell, Ellis, Li, Williams
- WZ, Grazzini, Kallweit, Rathlev, Wiesemann
- WW, Grazzini et al.
- MCFM at NNLO, Boughezal et al.
- p_{tZ} , Gehrmann-De Ridder et al.

, jjj)

• ...

About me



My Keywords

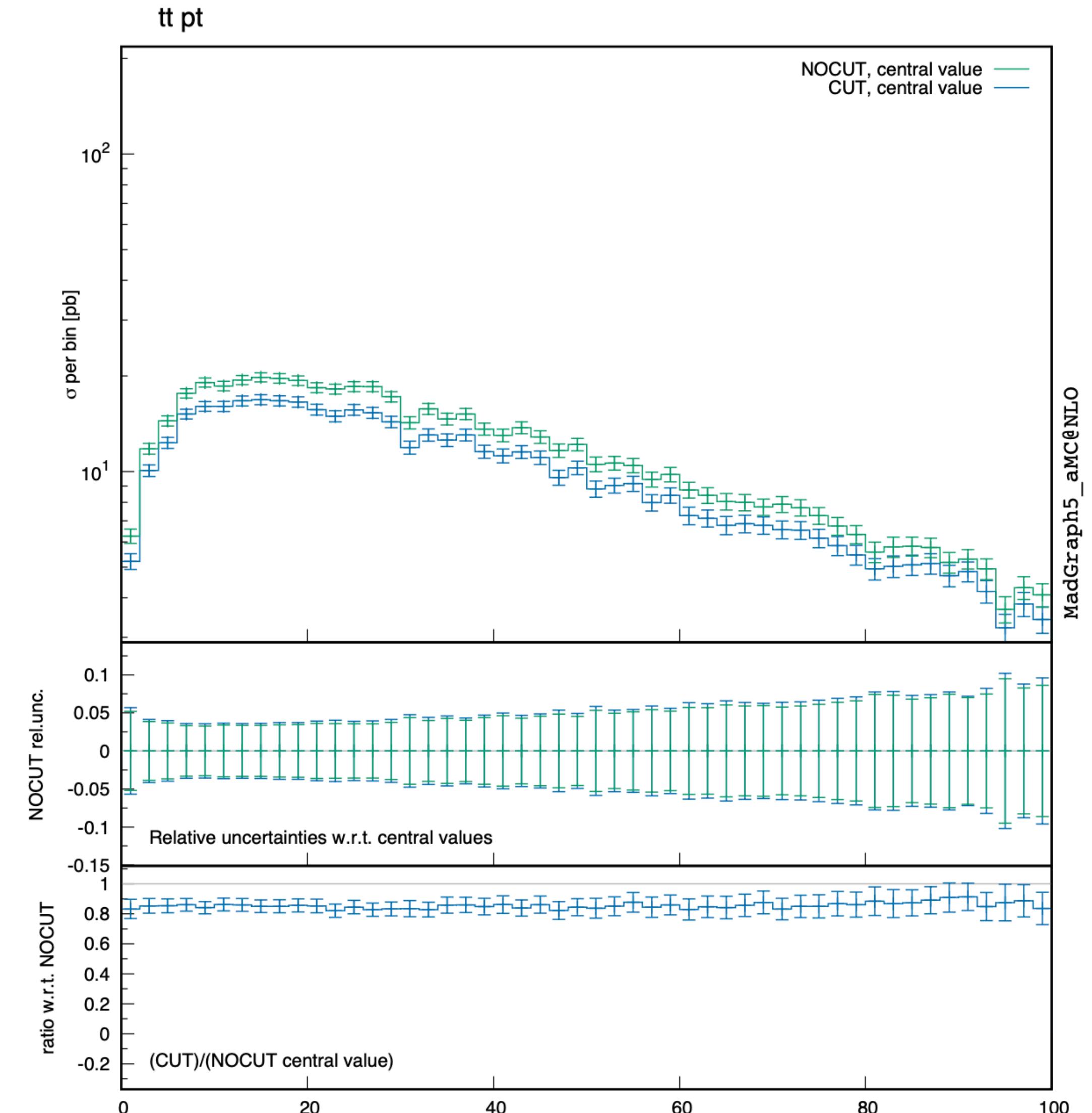
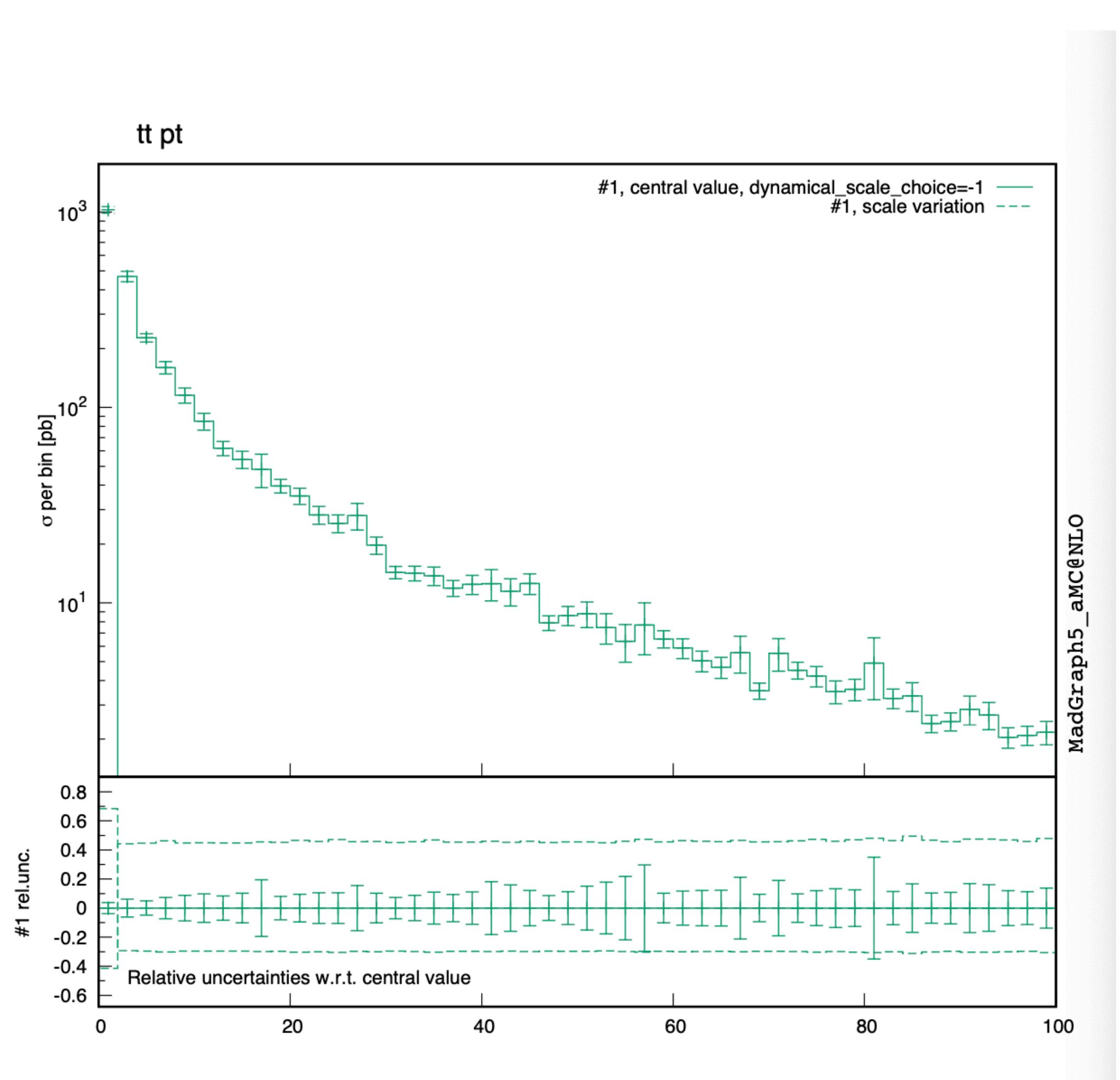
- Feynman (loooop) integrals
- Family/Topology
- IBP & ODE
- MPL/GPL
- Canonical basis
- FIRE/Kira



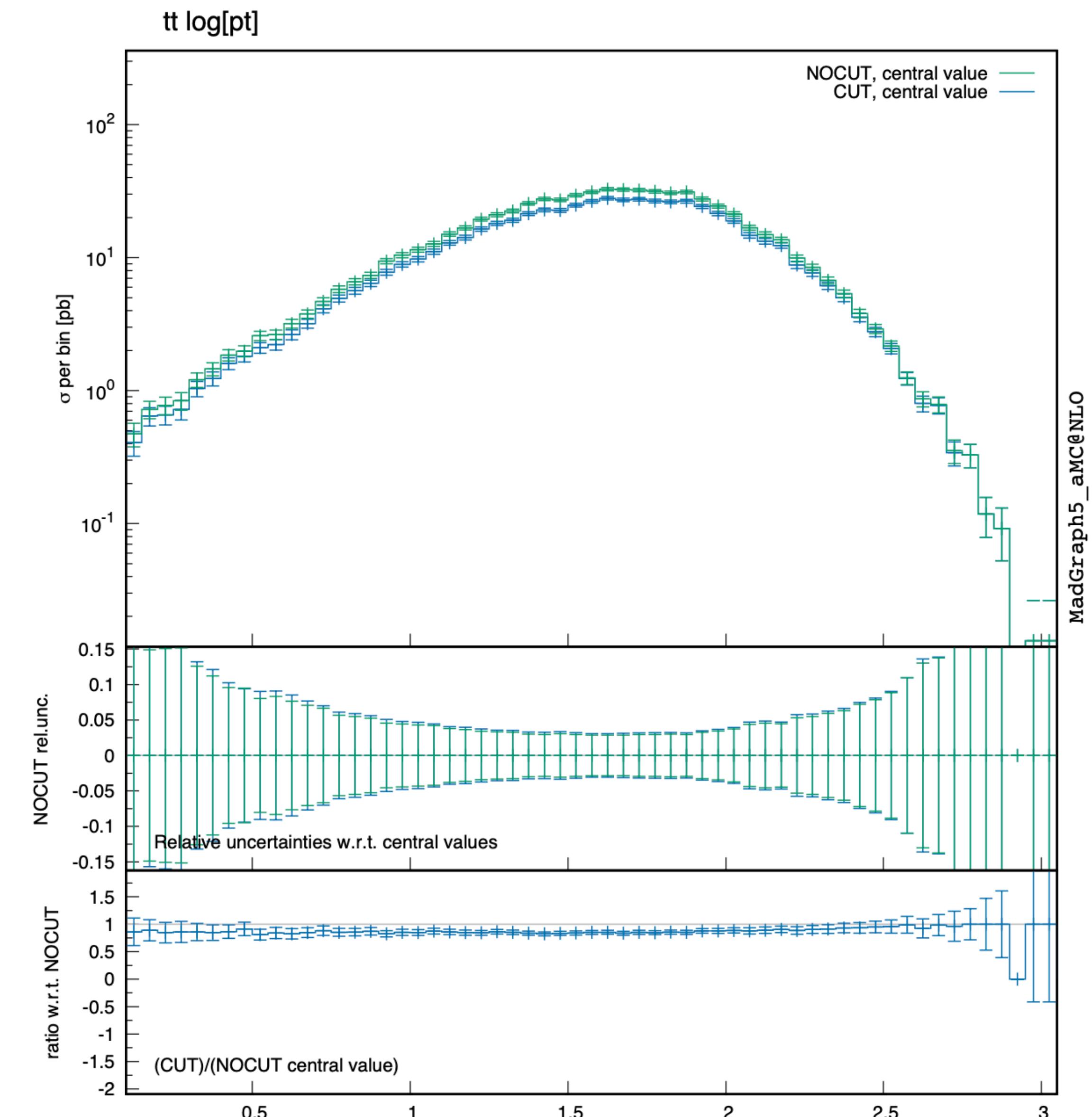
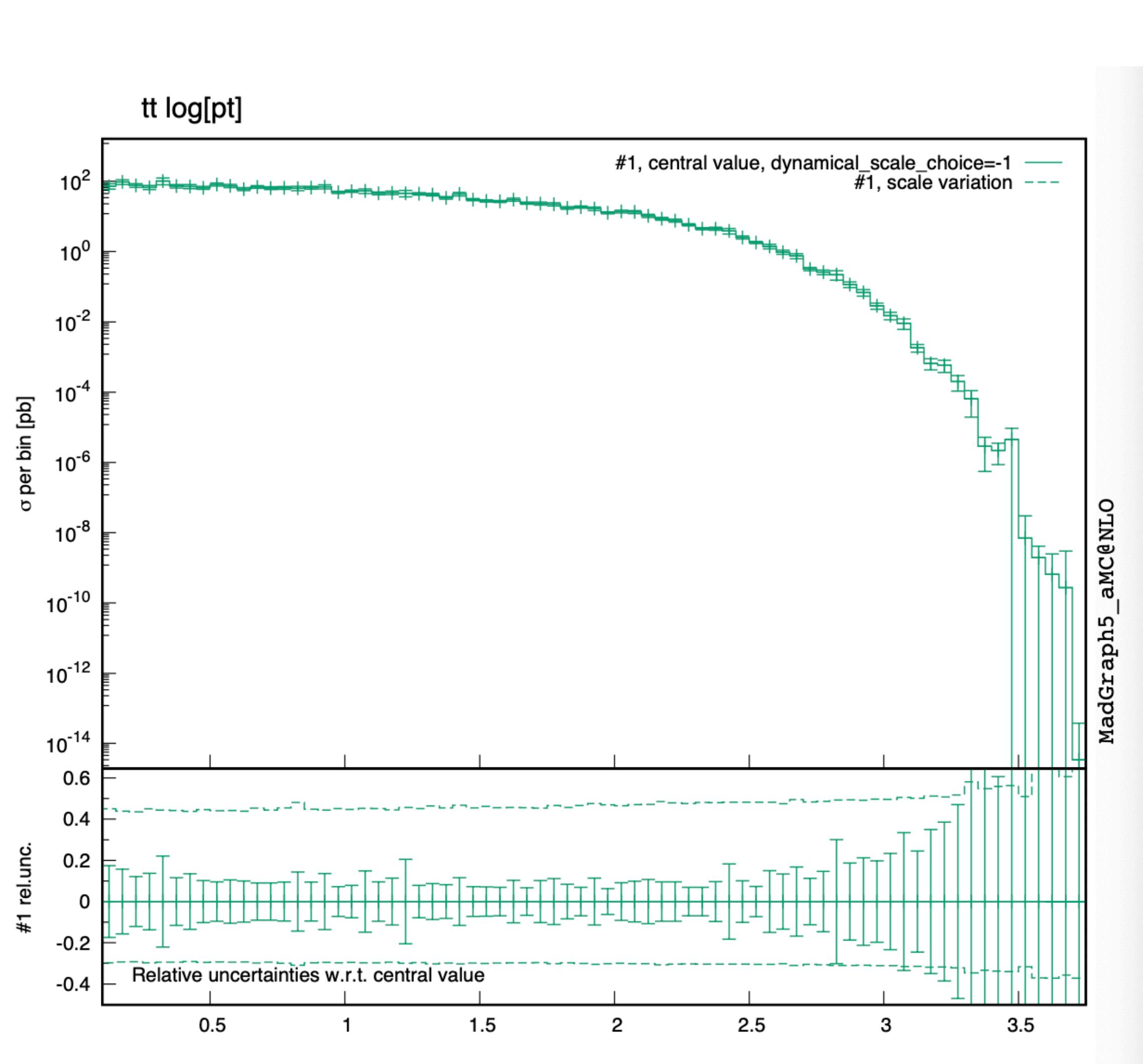
New For Me

- Event generator
- Simulation
- Match & Merging
- Analysis
- Rivert-*
- Contur

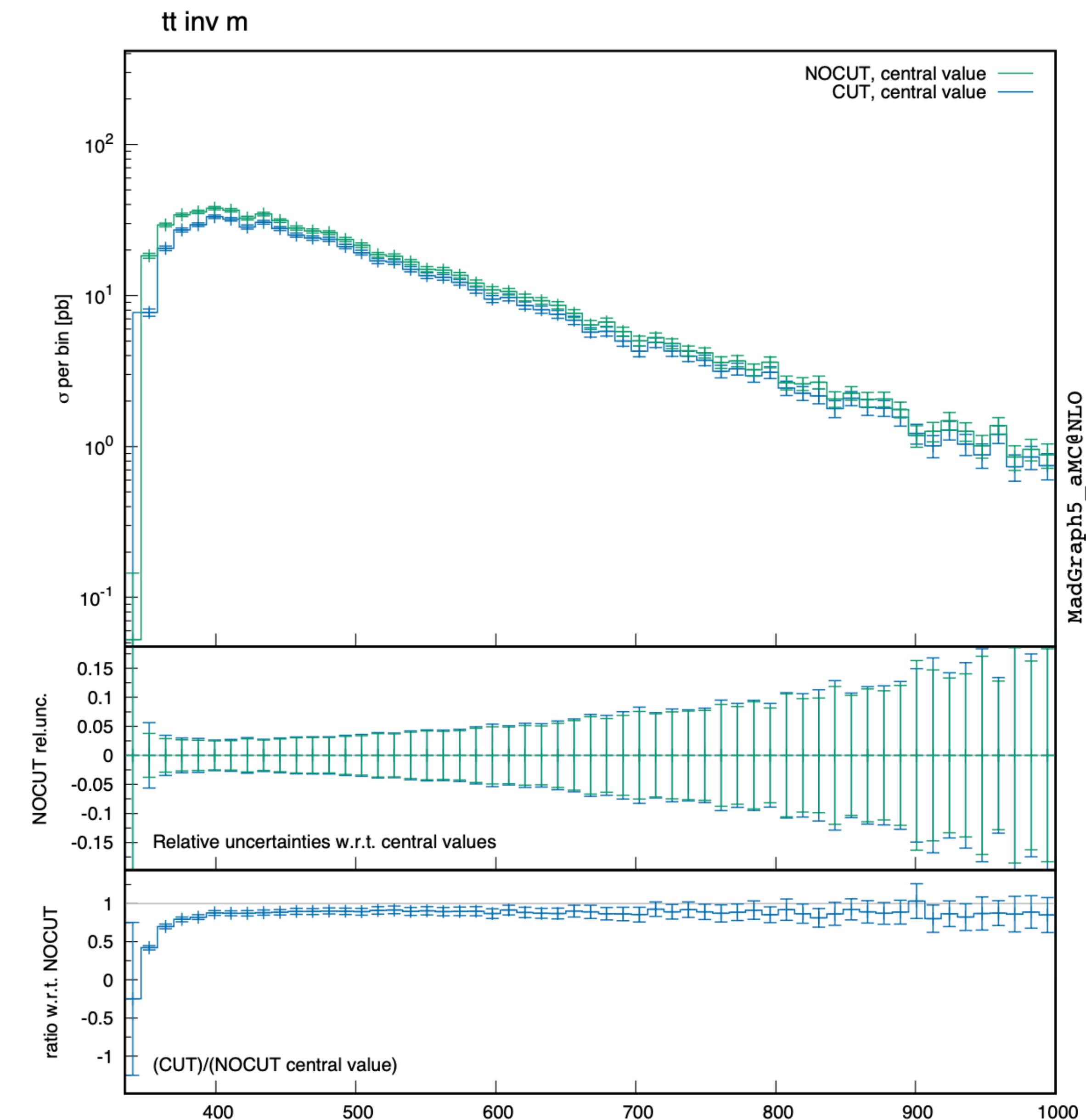
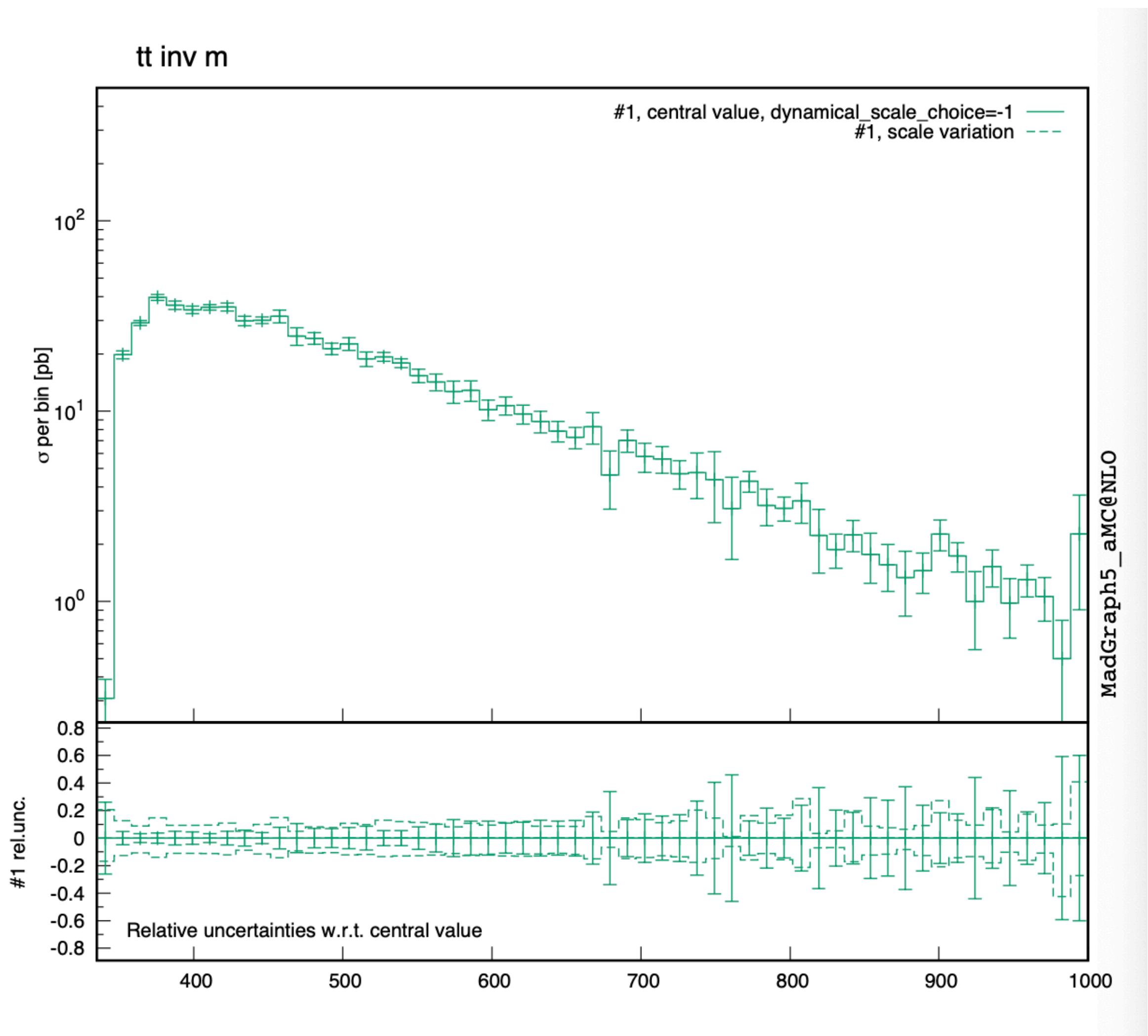
My first Parton Shower $pp \rightarrow t\bar{t}$



My first Parton Shower $pp \rightarrow t\bar{t}$



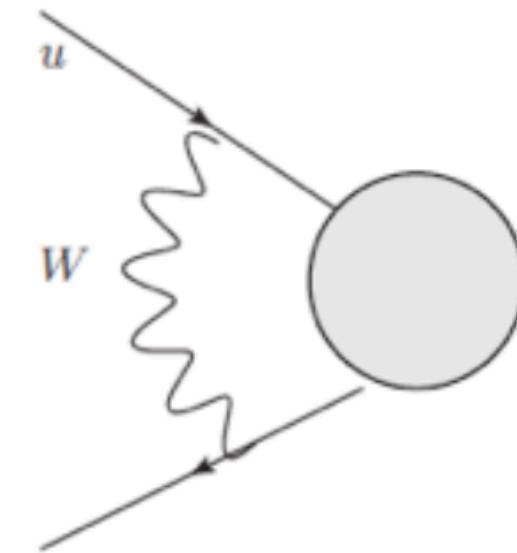
My first Parton Shower $pp \rightarrow t\bar{t}$



ENHANCE EW CORRECTIONS



- Enhance EWC by Yukawa coupling
 - e.g. H+2jets at LHC, EWC $\sim \frac{\alpha}{\pi s_w^2} \frac{M_t^2}{M_W^2} \sim 5\%$
- Enhance EWC by electromagnetic logarithms
 - Initial-state radiation at electron-positron collision, EWC $\sim \alpha \log \frac{M_Z^2}{m_e^2} \sim 3\%$
 - Final-state radiation for exclusive muon, EWC $\sim \alpha \log \frac{M_Z^2}{m_\mu^2} \sim 2\%$
- Enhance EWC by EW Sudakov logarithms
 - EW Sudakov logarithms come from exchange of virtual weak bosons



Leading Log Next-to-Leading Log

$$\sim -c_{\text{LL}} \frac{\alpha}{\pi s_w^2} \log^2 \frac{Q^2}{M_W^2} + c_{\text{NLL}} \frac{3\alpha}{\pi s_w^2} \log \frac{Q^2}{M_W^2} + \dots$$

e.g.

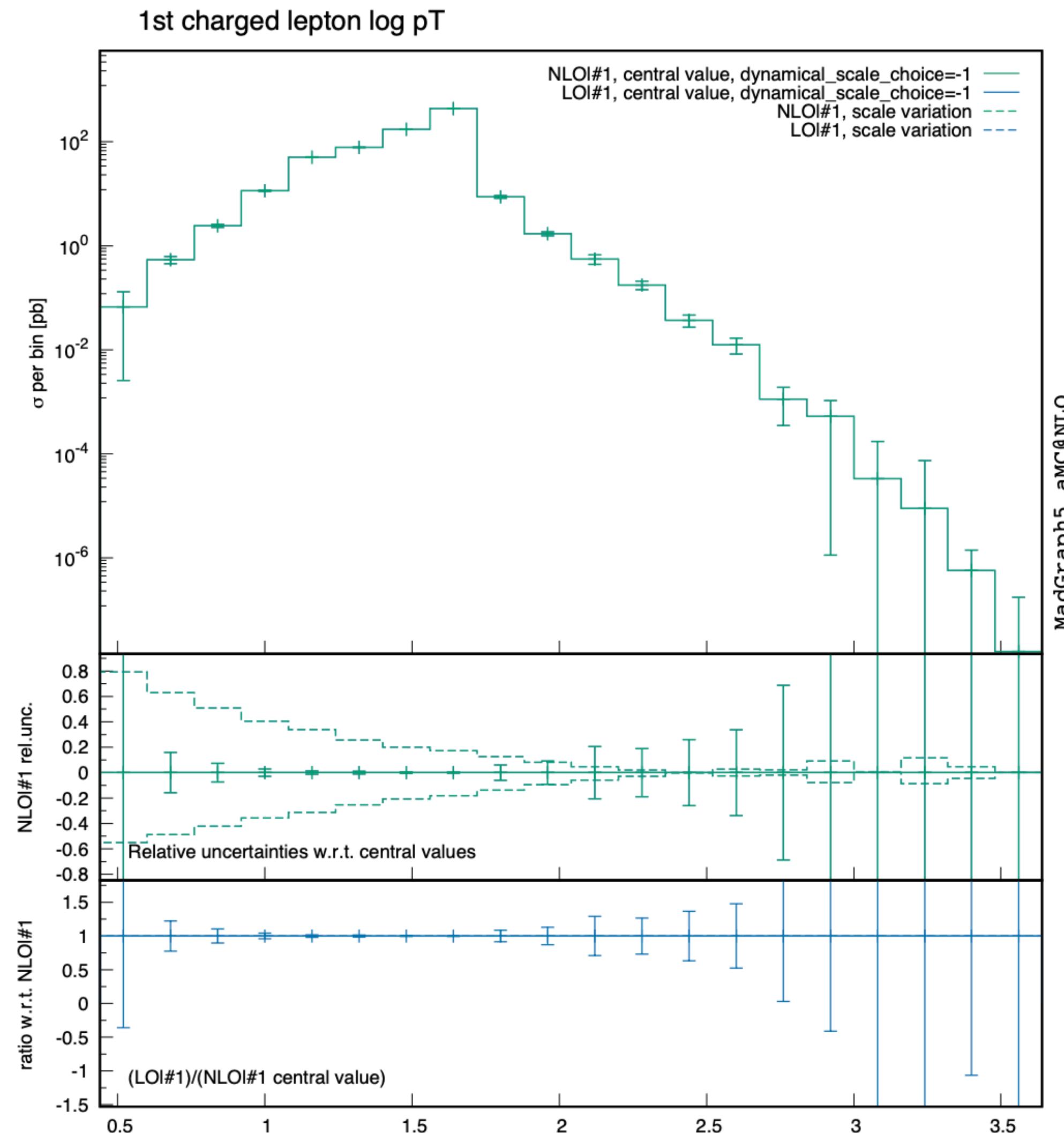
$$Q = 1 \text{ TeV} \quad -c_{\text{LL}} \times 26\% + c_{\text{NLL}} \times 16\%$$

• $pp \rightarrow e^+e^-$ NLO EW

- Want to see what observables are sensitive to lepton mass
- Need to provide a restriction file to model `loop_qcd Qed-sm`

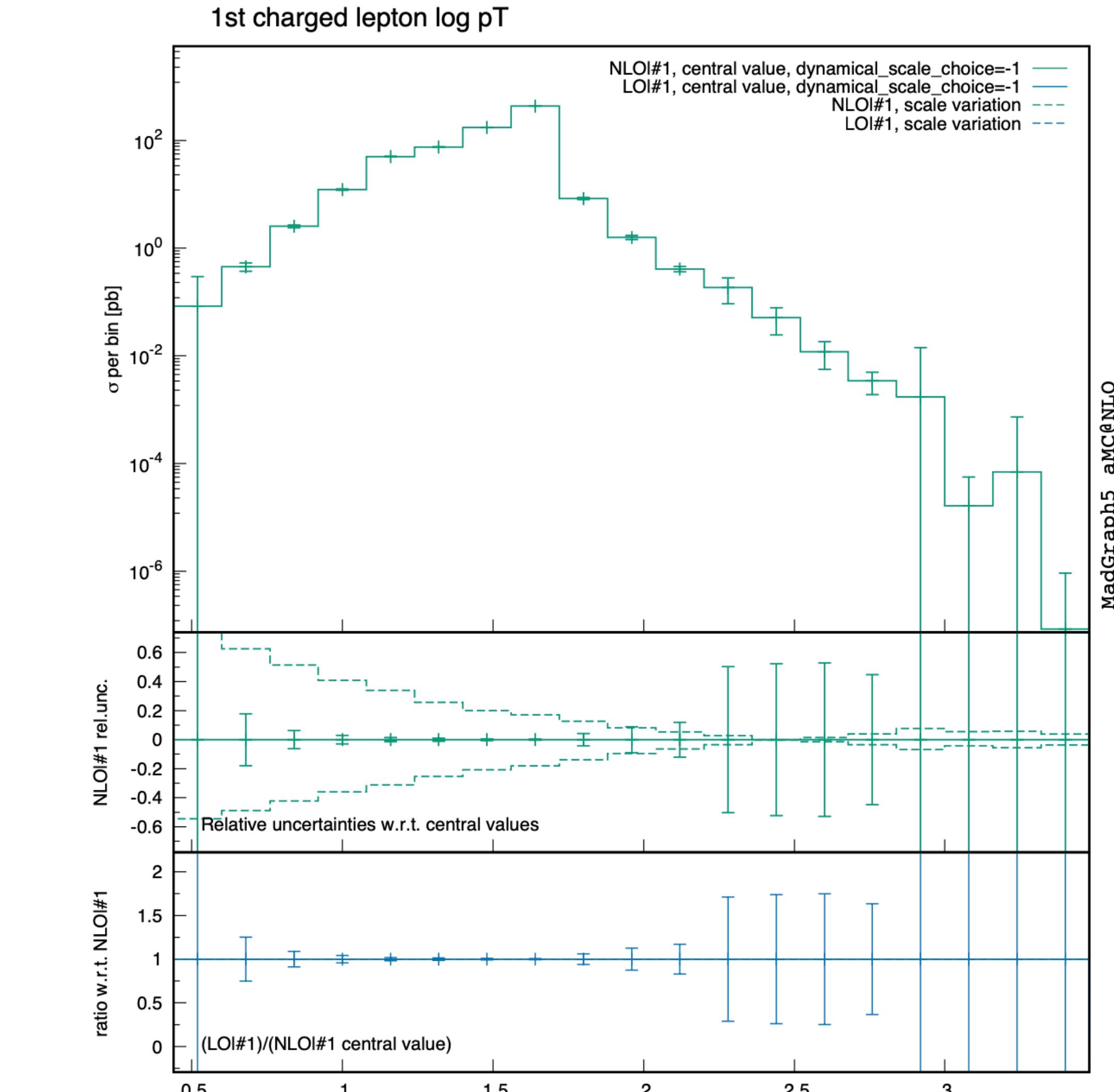
• Massless lepton

Run	Collider	Banner	Cross section (pb)	Events	Data
run_01_LO	p p 6500.0 x 6500.0 GeV	tag_1	760.2 ± 2.3	0	parton

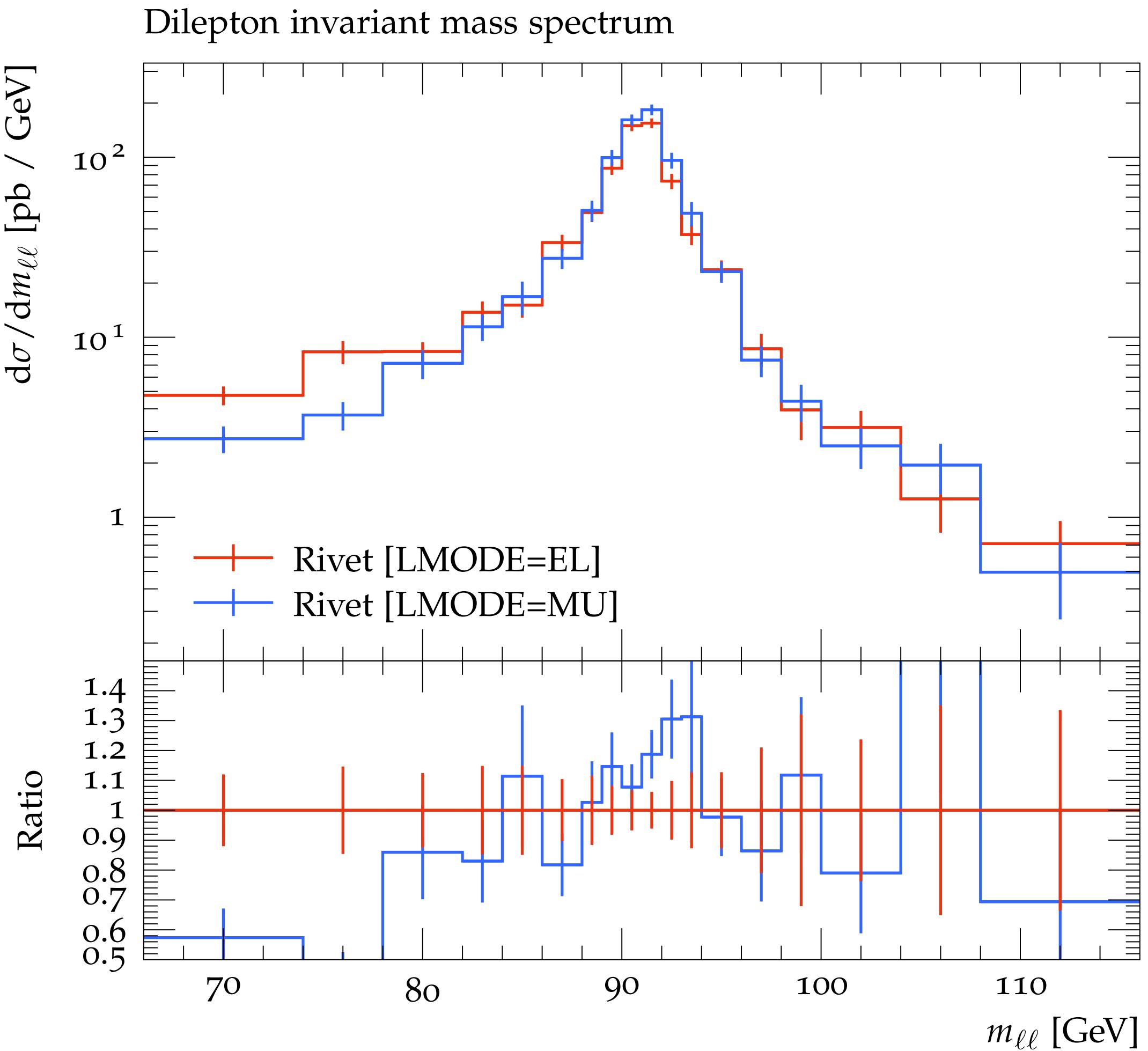


• Massive lepton

Run	Collider	Banner	Cross section (pb)	Events	Data
run_01_LO	p p 6500.0 x 6500.0 GeV	tag_1	761.7 ± 2.3	0	parton LO

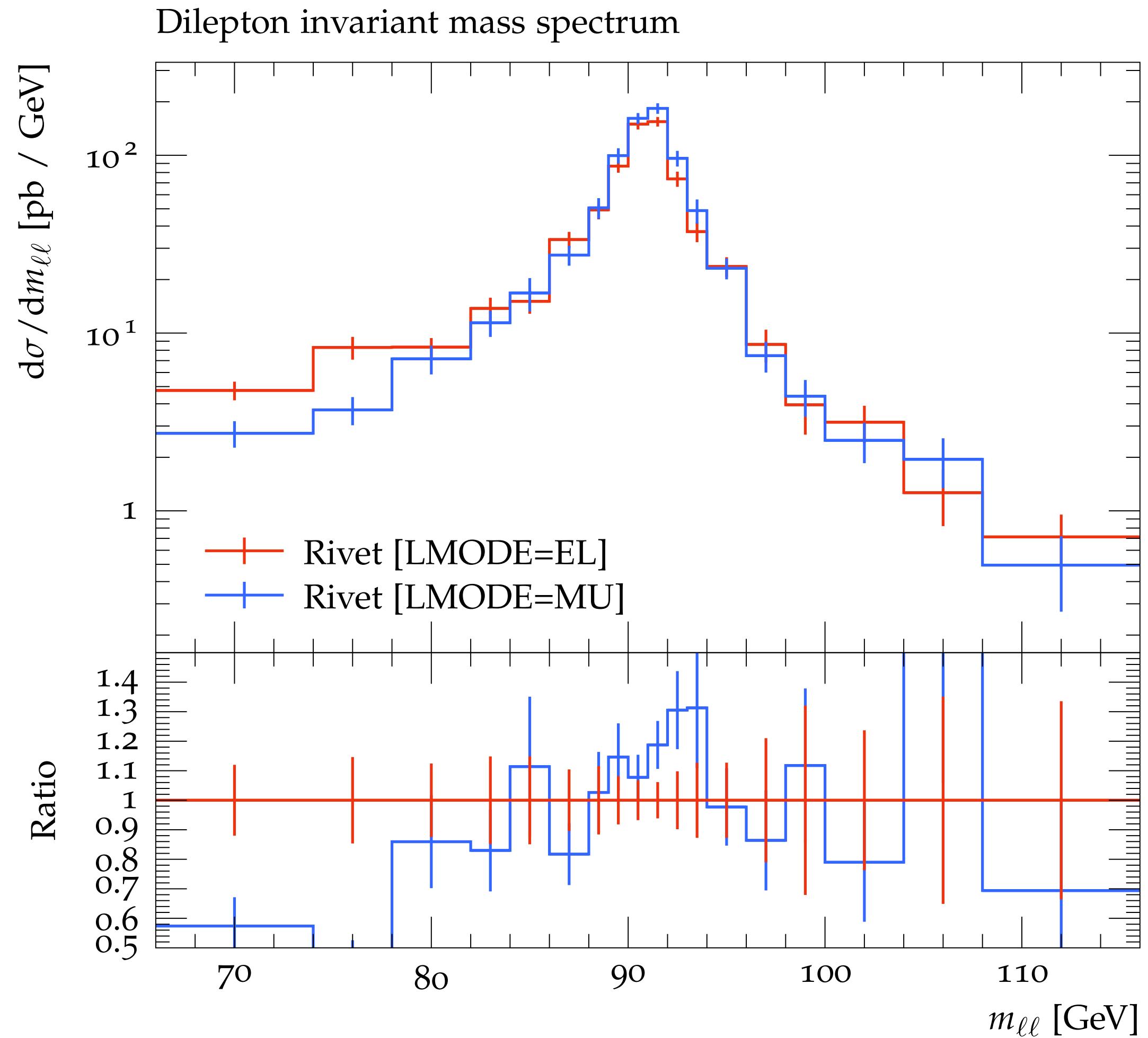


My first Pythia & Rivet



- Try Rivet analysis with MG5 event data
 - Try to compare `Wjets13TeV_10k.hepmc.gz` with predictions by MG5

My first Pythia & Rivet

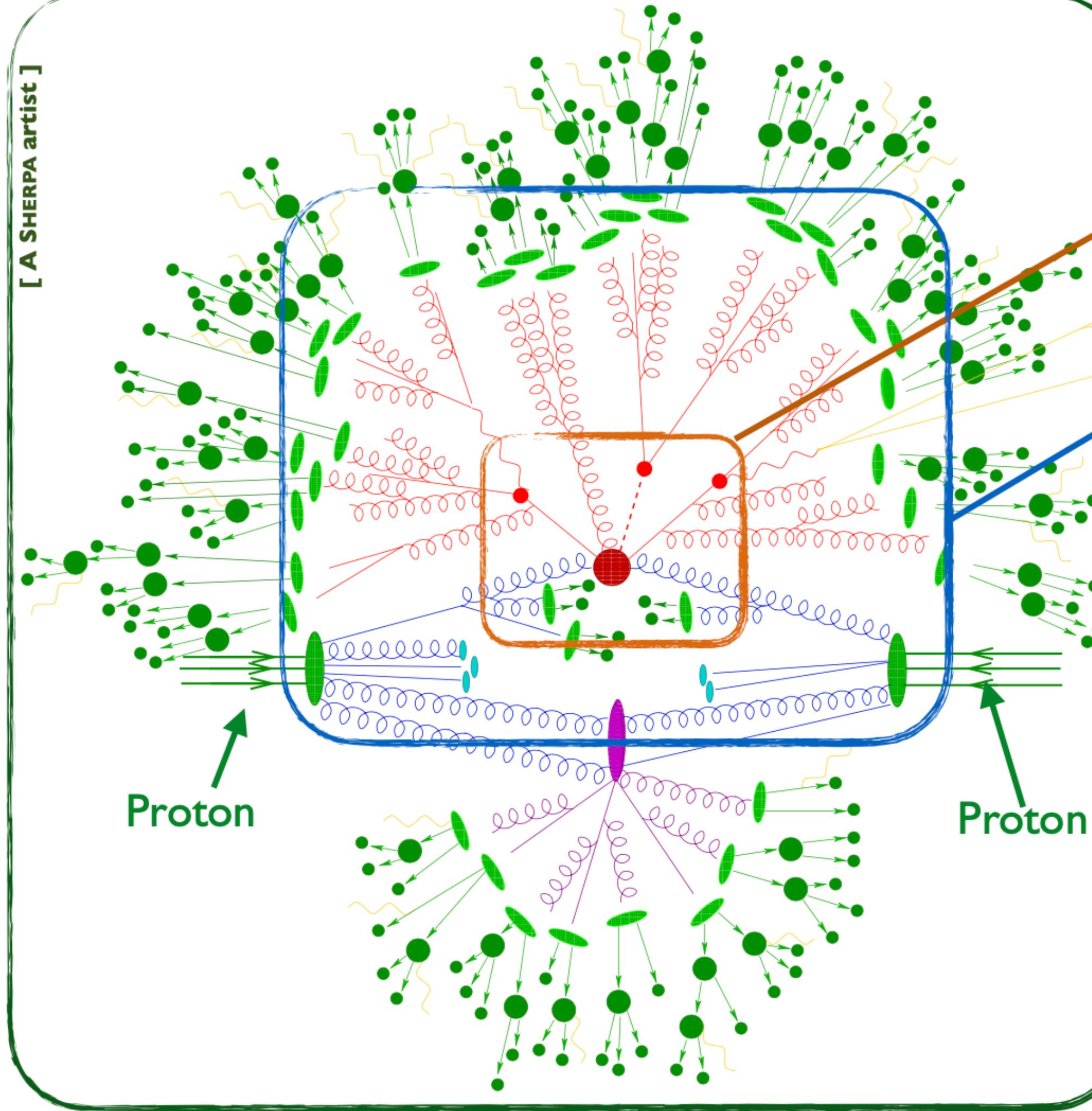


- Try Rivet analysis with MG5 event data
 - Try to compare `Wjets13TeV_10k.hepmc.gz` with predictions by MG5

Not Done Yet

Beyond NLO

Deciphering a proton-proton collision



- ◆ Hard process
 - ❖ Depends on the physics model (SM, BSM,...)
 - ❖ Perturbative QCD

- ◆ Parton showering
 - ❖ Universal (QCD)

- ◆ Hadronisation
 - ❖ Model-based, universal
- ◆ Underlying event
 - ❖ Model-based, non-universal

- ◆ Detector simulation

- “MG5@NNLO” not available
- No general loop integral routine
- No one-rule-all IR subtraction method
- Always done case by case

革命尚未成功

Good luck to us all

Thank you!