AMC@NLO: MATCHING/MERGING AT NLO

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My INTERESTS:

- LHC phenomenology
- MC event generators
- Perturbative QCD and higher order corrections applied to collider physics
- Matching and merging fixed order (NLO) calculations to parton showers
- # aMC@NLO

NLO + PARTON SHOWER

- Reduced theoretical uncertainties due to meaningful scale dependence
- * Proper estimate of the PDF uncertainties
- Description of pure higher order effects (like ttbar Forward-Backward asymmetry)
- # Parton shower:
 - Resums logarithms: excellent descriptions when partons are close in phase-space
 - * Proper exclusive description of events: can include hadronization
 - * Events can be passed through detector simulation
- Combine the two approaches: NLO+PS

MATCHING NLO TO PS: DOUBLE COUNTING



- There is double counting between the real emission matrix elements and the parton shower: the extra radiation can come from the matrix elements or the parton shower
- There is also an overlap between the virtual corrections and the Sudakov suppression in the zero-emission probability

MC@NLO PROCEDURE

Frixione & Webber (2002)



Double counting is explicitly removed by including the "Monte Carlo subtraction terms"

AMC@NLO

Hirschi, Zaro, Alwall, RF, Mattelaer, Torrielli, Frixione, Maltoni, Pittau (2012)

- * aMC@NLO ("automatic MC@NLO") is a tool that we have been developing over the last couple of years
- It can generate any SM process at NLO accuracy, including the MC subtraction terms, in a completely automatic way
- It's build upon the madgraph5 framework and uses the same syntax as the original leading order code
- Became publicly available YESTERDAY!

http://amcatnlo.cern.ch

AMC@NLO: QUICK GUIDE

Hirschi, Zaro, Alwall, RF, Mattelaer, Torrielli, Frixione, Maltoni, Pittau (2012)

- % Open the madgraph python shell:
 \$./bin/mg5
- From the shell generated the requested process: MG5> generate p p > e+ e- mu+ mu- [QCD] (the tag "[QCD]" means: do NLO corrections). This generates the process internally in the code
- Output the process and write it to disk: aMC@NLO> output my_NLO_eemumu_process
- And launch the event generation: aMC@NLO> launch
- And wait for the code to generate the NLO events



FOUR-LEPTON PRODUCTION



4-lepton invariant mass is almost insensitive to parton shower effects.
 4-lepton transverse moment is extremely sensitive

Including scale uncertainties

WHAT IS STILL WORK IN PROGRESS...

- * aMC@NLO for BSM processes (in particular the ones that need new UV counterterms)
- # aMC@NLO for QED or EW corrections
- # aMC@NLO for processes with intermediate colored resonances
- * aMC@NLO for merging different multiplicities at NLO ... but we do have some results here ...





Transverse momentum of the Higgs and of the 1st jet.

- * Agreement with H+0j at MC@NLO and H+1j at MC@NLO in their respective regions of phase-space; Smooth matching in between; Small dependence on matching scale
- Alpgen (LO code) shows larger dependence on matching scale

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RF & Frixione, 2012

FXFX MERGING AT NLO: HIGGS PRODUCTION



Differential jet rates for 1->0 and 2->1

FXFX MERGING AT NLO: HIGGS PRODUCTION



- Differential jet rates
- Matching up to 2 jets at NLO
- Results very much consistent with matching up to 1 jet at NLO

CONCLUSIONS

- I've been working on the aMC@NLO project for the last couple of years.
- We've come a long way: the first version of the code is publicly available and easy to use
- Still some improvements, additions, optimization, etc to do...
- ** ... but definitely ready to be used

http://amcatnlo.cern.ch

COLLIDER CROSS TALK

- Collider Cross Talks are informal (mostly blackboard) joined theory and experimental talks and discussion sessions
- I just joined the Collider Cross Talk team (taking over from Jan Winter)
 - If you have a topic that could be interesting for collider phenomenologists and/or our experimental colleagues from ATLAS, CMS, LHCb or ALICE, let me (or Nazila) know and we can try to schedule a talk