aMC@NLO status III: interface to HERWIG and PYTHIA

Paolo Torrielli

EPFL

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MC@NLO in one slide

$$\frac{d\sigma_{\text{MC@NLO}}}{dO} = \left[d\Phi_B(B + V + \int d\Phi_{(+1)} MC)\right] I_{\text{MC}}^{(n)}(O) + \left[d\Phi_B d\Phi_{(+1)}\,(R - MC)\right] I_{\text{MC}}^{(n+1)}(O).$$

Simplified structure of the Monte Carlo counterterm:

$$MC = \left|\frac{\partial(t^{\text{MC}}, z^{\text{MC}}, \phi)}{\partial\Phi_{(+1)}}\right| \frac{1}{t^{\text{MC}}}\Theta(DZ)\frac{\alpha_S}{2\pi}\frac{1}{2\pi}P(z^{\text{MC}})B.$$

- It is the cross section for the first emission in the parton shower.
- It acts as a local counterterm for the real and virtual amplitudes.
- Its process-dependence is trivial.
- It depends on the Monte Carlo one is interfacing the NLO computation to.

aMC@NLO: automation of the MC counterterm

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Kinematics + color

- Assignment of the splitting type (ISR from leg 1 or 2, FSR from massive or massless leg).
- Assignment if color flow and color partner of the splitting parton (MC scales and variables may depend on it).

Achieved in a way completely independent of the process and of the particle multiplicity.

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Variable definitions + boundaries

- Evolution variables t^{MC}, z^{MC}, and 'dead zones' (DZ) are MC specific.

But the structure is general and developer-friendly: to implement a new MC one just needs to write few standardized routines in a single fortran file (montecarlocounter.f).

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HERWIG 6: complete

- Validated for all kinds of emission types against MC@NLO 4.0.
  Full agreement: not trivial since the structure of the codes is completely different.
- Moved to new more complex processes:
  - $pp \to t\bar{t}H \ / \ t\bar{t}A + X$
  - $pp \to b\bar{b}(W^{\pm *})/b\bar{b}(Z^*) \to b\bar{b}ll + X$
  - $p\bar{p} \to jj(W^+) \to jj\bar{l}\nu + X$
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HERWIG ++: almost complete

- All formulae implemented. Validated against MC@NLO 4.0 for ISR processes.
  Full agreement.
- Currently under validation against MC@NLO 4.0 and aMC@NLO/HERWIG 6 for more complicated processes.

aMC@NLO/PYTHIA: status

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PYHTIA 6 (virtuality-ordered): complete

- Validated against the few available MC@NLO/PYTHIA ISR processes. Full agreement.
- Produced new results: first time aMC@NLO/PYTHIA with FSR.
- The implementation is at the same level as aMC@NLO/HERWIG 6, so to date, the processes that can be produced with aMC@NLO/HERWIG 6 can be as well produced with aMC@NLO/PYTHIA 6. There is just less expertise.

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PYTHIA 8 (and PYTHIA 6 p_T-ordered in parallel): incomplete

- Formulae implemented just for ISR, and currently under validation against the few available MC@NLO/PYTHIA ISR processes.
- Just started to undertake the FSR implementation.

Plans and priorities

- aMC@NLO/HERWIG 6: nothing to be implemented.
- aMC@NLO/HERWIG ++: complete the validation (few weeks of work, middle priority).
- aMC@NLO/PYTHIA 6: nothing to be implemented (but very exciting to see how phenomenology differs from HERWIG 6).
- aMC@NLO/PYTHIA 8 (and PYTHIA 6 p_T): complete the implementation of FSR formulae and perform the whole validation (few months of work, high priority).

http://amcatnlo.cern.ch