The RAPGAP Monte Carlo generator: update and news

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- tools for calculating hadronization corrections
- proton dissociation

How-to calculate hadronization corrections

- hadronization correction
  applied to NLO parton level calculation for comparison with measurements at hadron level

$$C_{had} = \frac{\frac{d\sigma^{had}}{dX}}{\frac{d\sigma^{parton}}{dX}}$$

- hadron level ✔
- but what is parton level ???
  - ☛ purely hard parton level ? ➤ NO
  - ☛ parton shower level ?
  - but could be different for generator to generator
  - often compared in JETSET: MEPS with CDM option
  - ☛ different parton but same hadron level
- MUST compare same parton level with different hadronization
  ☛ feed same parton level for hadronization to PYTHIA and HERWIG

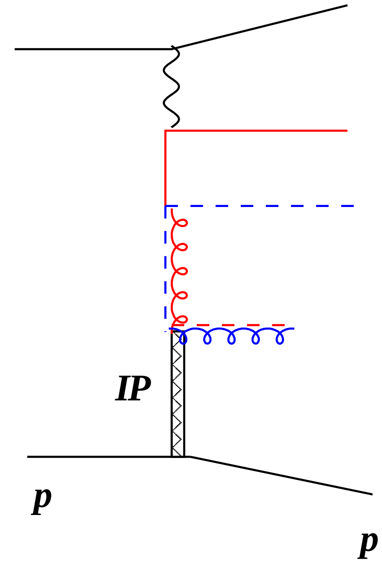
Les Houches event record: HEPRUP and HEPEUP

- Les Houches event record defines structure of event record including color information
- interfaces available in PYTHIA and HERWIG for reading parton level events
- NEW RAPGAP 3.1015 to be released soon uses this interface
  ☞ write full parton level event, including parton showers and remnant information
  ☞ to be read in by PYTHIA or HERWIG
- some tricks necessary to prevent PYTHIA or HERWIG from parton showering and remnant treatment

RAPGAP output

Event listing of user process at input (simplified)

I	IST	ID	Mothers		Colours		p_x	p_y	p_z	E	m
1	-1	11	0	0	0	0	0.000	0.000	820.000	820.001	0.938
2	-1	-11	0	0	0	0	0.000	0.000	-27.500	27.500	0.001
3	3	23	1	1	0	0	-2.447	1.021	-3.050	2.907	-2.808
4	1	-11	1	1	0	0	2.447	-1.021	-24.450	24.593	0.001
5	3	990	1	1	0	0	-0.124	-0.380	19.727	19.727	-0.405
6	3	21	1	1	0	0	-0.012	-0.037	1.903	1.904	0.000
7	3	21	1	1	0	0	-0.012	-0.037	1.903	1.904	0.000
8	3	4	1	1	0	0	-2.502	0.787	-1.293	3.287	1.500
9	3	-4	1	1	0	0	0.045	0.197	0.147	1.521	1.500
10	1	2212	1	1	0	0	0.124	0.380	800.273	800.273	0.938
11	1	4	1	2	501	0	-2.502	0.787	-1.293	3.287	1.500
12	1	21	1	2	502	501	-0.113	-0.342	17.823	17.827	0.000
13	1	-4	1	2	0	502	0.045	0.197	0.147	1.521	1.500



$\gamma p \rightarrow ccg$

- to prevent initial state parton showering ...
  ☛ define incoming particles as electrons.....

PYTHIA output

```
                         Event listing (summary)
    I particle/jet KS     KF  orig    p_x      p_y      p_z       E        m

    1 !e-!         21     11    0    0.000    0.000  820.001  820.001    0.001
    2 !e+!         21    -11    0    0.000    0.000  -27.500   27.500    0.001
 ==============================================================================
    3 !e-!         21     11    1    0.000    0.000  820.001  820.001    0.000
    4 !e+!         21    -11    2    0.000    0.000  -27.500   27.500    0.000
    5 !e-!         21     11    3    0.000    0.000  820.001  820.001    0.000
    6 !e+!         21    -11    4    0.000    0.000  -27.500   27.500    0.000
    7 !Z0!         21     23    0   -2.447    1.021   -3.050    2.907   -2.808
    8 !e+!         21    -11    0    2.447   -1.021  -24.449   24.593    0.001
    9 !pomeron!    21    990    0   -0.124   -0.380   19.728   19.727   -0.405
   10 !g!          21     21    0   -0.012   -0.037    1.903    1.904    0.000
   11 !g!          21     21    0   -0.012   -0.037    1.903    1.904    0.000
   12 !c!          21      4    0   -2.502    0.787   -1.293    3.287    1.500
   13 !cbar!       21     -4    0    0.045    0.197    0.147    1.521    1.500
   14 !p+!         21   2212    0    0.124    0.380  800.277  800.277    0.938
   15 !c!          21      4    0   -2.502    0.787   -1.293    3.287    1.500
   16 !g!          21     21    0   -0.113   -0.342   17.823   17.827    0.000
   17 !cbar!       21     -4    0    0.045    0.197    0.147    1.521    1.500
 ==============================================================================
   18 (Z0)         11     23    7   -2.447    1.021   -3.050    2.907   -2.808
   19 e+            1    -11    8    2.447   -1.021  -24.449   24.593    0.001
   20 (pomeron)    11    990    9   -0.124   -0.380   19.728   19.727   -0.405
   21 p+            1   2212   14    0.124    0.380  800.277  800.277    0.938
   22 gamma         1     22    1    0.000    0.000    0.000    0.000    0.000
   23 gamma         1     22    2    0.000    0.000    0.000    0.000    0.000
   24 (c)        A 12      4   15   -2.502    0.787   -1.293    3.287    1.500
   25 (g)        I 12     21   16   -0.113   -0.342   17.823   17.827    0.000
   26 (cbar)     V 11     -4   17    0.045    0.197    0.147    1.521    1.500
 ==============================================================================
   27 (string)     11     92   24   -2.571    0.642   16.677   22.635   15.072
   28 (D*0)        11    423   27   -1.854    0.670   -0.485    2.854    2.007
..........
```

HERWIG output

- HERWIG needs some further studies... technical problems ...

  Tool for hadronization corrections:

- different tunings needed ?
- try to estimate uncertainty of hadronization correction
  - what about initial/final state PS
  - what about remnant treatment

RAPGAP for $p\bar{p}$

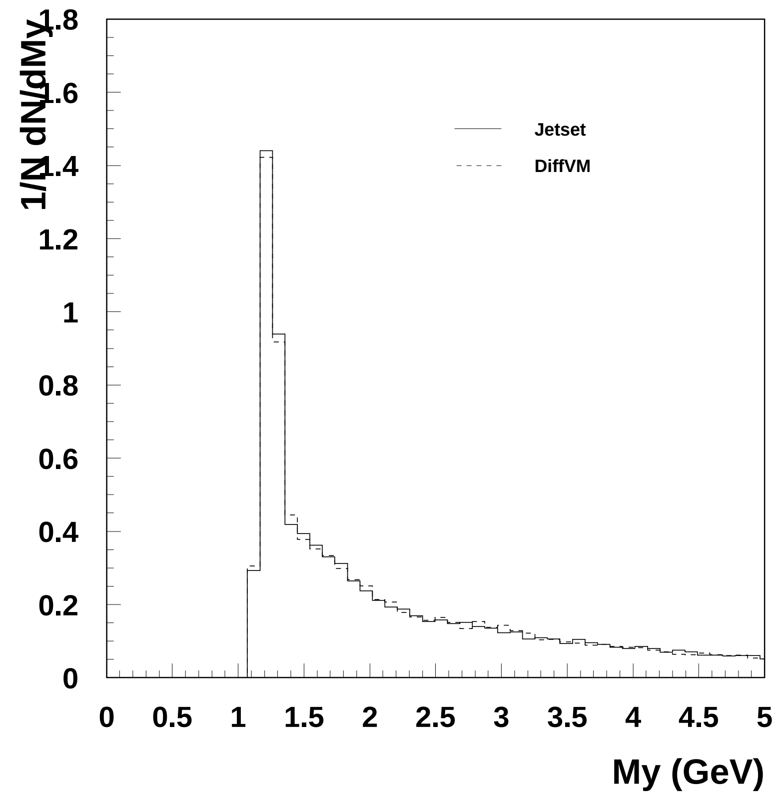
- applicable for non - diffractive and diffractive $p\bar{p}$ scattering
  - only single diffraction yet
- $O(\alpha_s^2)$ processes included (non-diffractive, single diffractive):
  - $gg \to q\bar{q}, Q\bar{Q}, gg$
  - $qg \to qg$
  - $q\bar{q} \to gg, q\bar{q}$
  - $qq \to qq$
- diffractive pdfs available (as published from HERA !)
- π exchange
- p-dissociation

Proton dissociation in RAPGAP

- p-dissociation

➤ different approaches,
tuned to measurements ala DIFFVM
B. List (Y. Coppens, P. Thompson)

- approach:
$\frac{d\sigma}{dM_y^2} \sim \frac{1}{m_y^{2(1+\epsilon}}$ with $\epsilon = 0$, tunable
$\frac{d\sigma}{dt} \sim \exp -B|t|$ with $B = 4.0$, tunable
  - ☞ dissociation of system M_y:
  - ☞ $1 < M_y < 2$ GeV:
    decay nucleon resonces explicitely
  - ☞ $M_y > 2$ GeV:
  - ☞ decompose into qqg state
    (done by Leszek Adamczyk)
    fragment either via KNO or JETSET



RAPGAP

- RAPGAP 3.1 check out for NEW versions
  `http://www.desy.de/~jung/rapgap/`
- using PYTHIA 6.2 for fragmenation
- easy-to-install tools available
- notice: further libs are needed
  - HERACLES (optional)
  - BASES 5.1
  - JETSET/PYTHIA