Decay package in mg5

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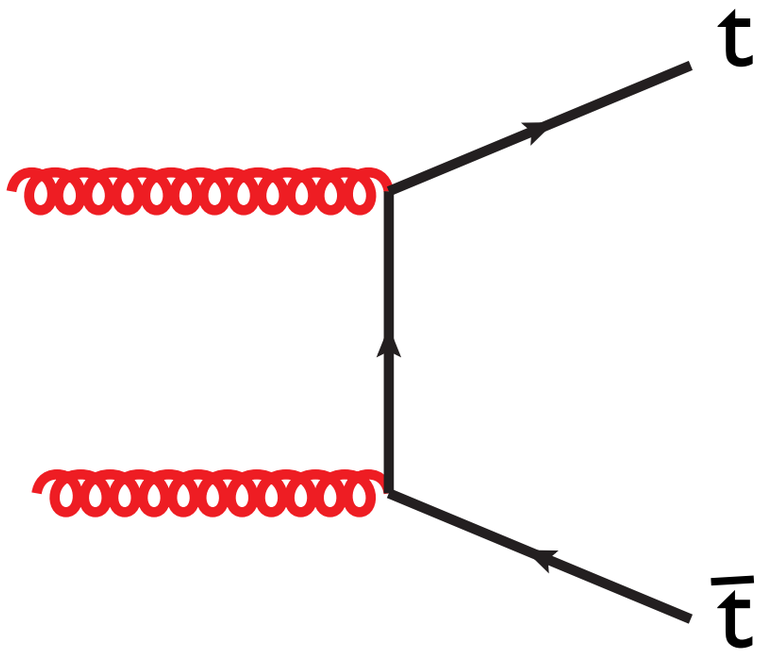
Idea

- Input: file of unweighted events associated with the production process

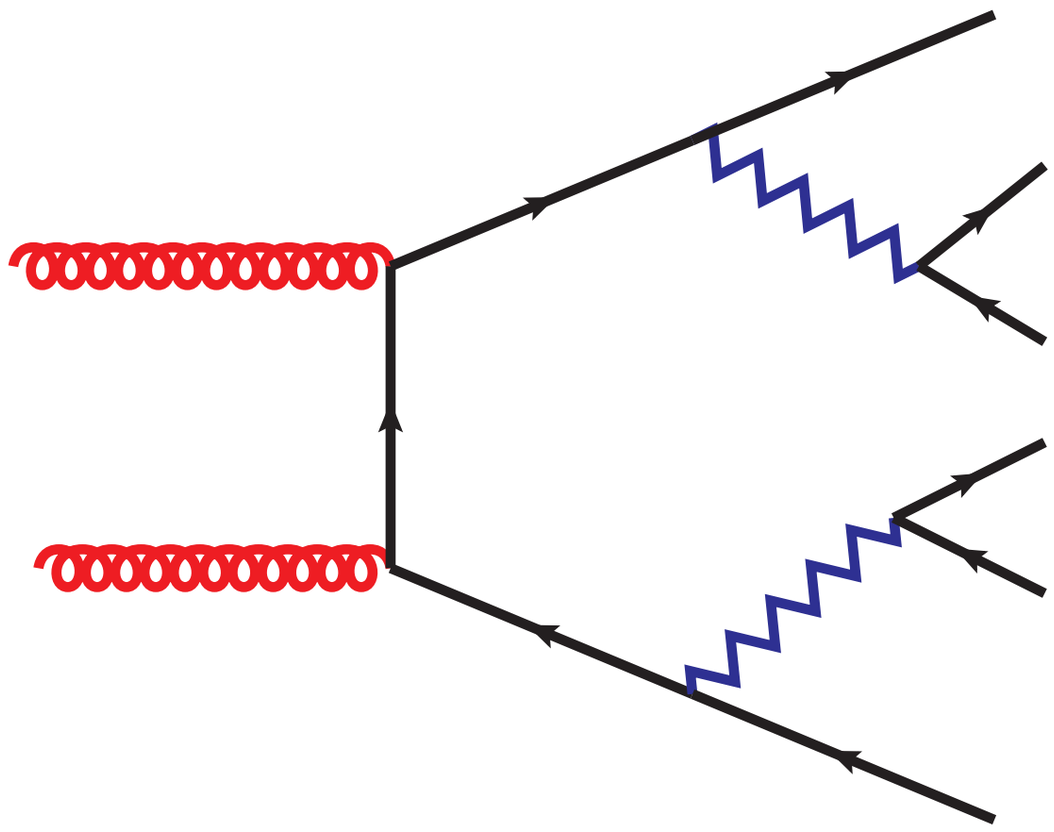
ex:



Idea

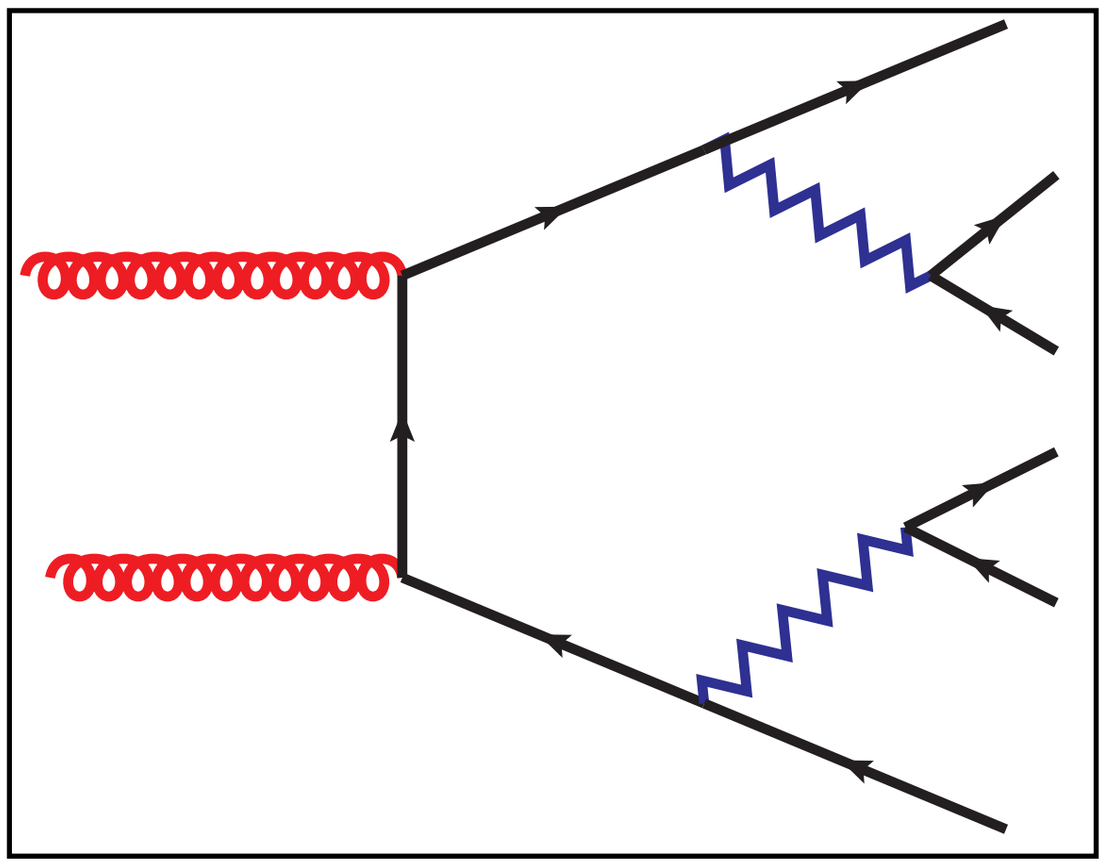
- Output: file of unweighted decayed events with all spin correlations included

ex:

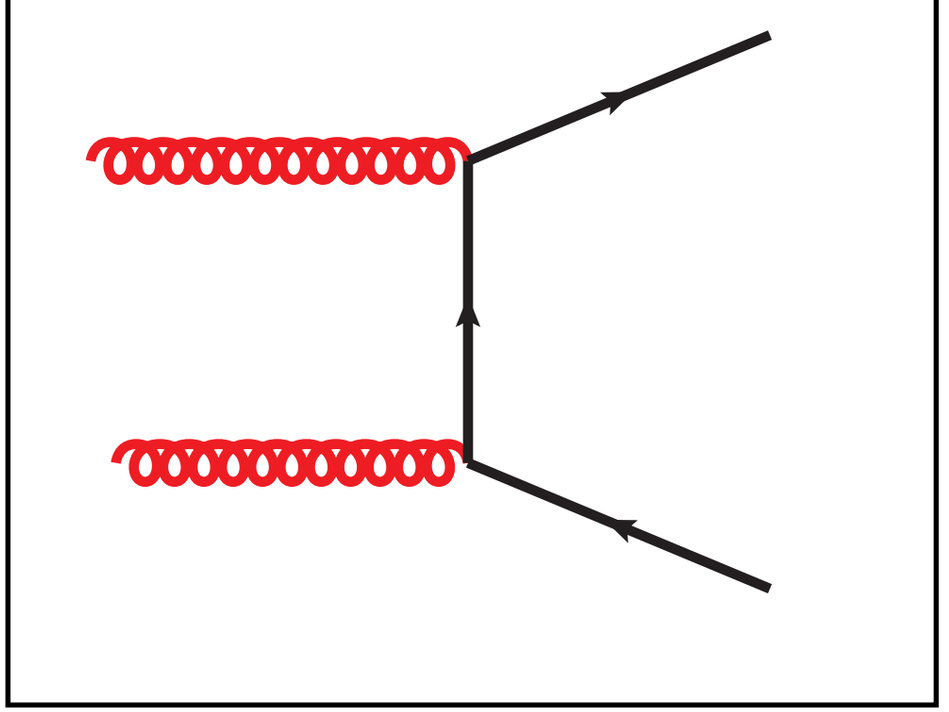


Notation

M_{full}



M_{prod}



Procedure

1. Read the banner, extract information about the process, the model, the run parameters and the model parameters.

Procedure

2. For each final-state parton, ask the user whether the particle should be decayed, if yes, ask the user to enter the definition of the decay process.

Procedure

3. Determine the maximum weight for the decay process.

This is achieved by generating 1000 decay configurations for the first event, and by retaining the largest value R_{max} of the ratio

$$R=|M_{full}|^2/|M_{prod}|^2$$

Procedure

4. For each production event **y** decay the events using a hit-and-miss procedure

a. generate randomly a decay configuration **x**

b. evaluate $R = |M_{full}(\mathbf{x})|^2/|M_{prod}|^2$

c. generate a random number $0<r<1$

d. if $R/R_{max} < r$: rejection, start again at a.
   if $R/R_{max} > r$: write the decayed event,
   go to next production event

Implementation in mg5

```
Enter the name of the input lhe file
> pp_wt_production_unweighted_events.lhe

Extracting the banner ...
process: p p > w- t
model:   sm
```

Implementation in mg5

```
decay the w- ? (yes/no)
> yes
enter the decay process (no parenthesis)
> w- > m- vm~
decay the t ? (yes/no)
> yes
enter the decay process (no parenthesis)
> t > b w+ , w+ > m+ vm
particles to decay:
{3: 'w-', 4: 't'}
Full process:
p p > w- t ,   w- > m- vm~   ,  ( t > b w+ , w+ > m+ vm )
```

Implementation in mg5

```
Estimating the maximum weight  |M_full|^2/|M_prod|^2 ...
(Considering the 5 first events only)
found a new production process:
b g > w- t
Max weight,  event 1:  0.00105234406477
Max weight,  event 2:  0.000975407635194
found a new production process:
g b > w- t
Max weight,  event 3:  0.00097421946953
Max weight,  event 4:  0.0010751811088
Max weight,  event 5:  0.00101586721522

maximum weight that we got is 0.001075181108
with a fluctuation of 0.000100961639269
-> add this fluctuation to the max. weight
```

Implementation in mg5

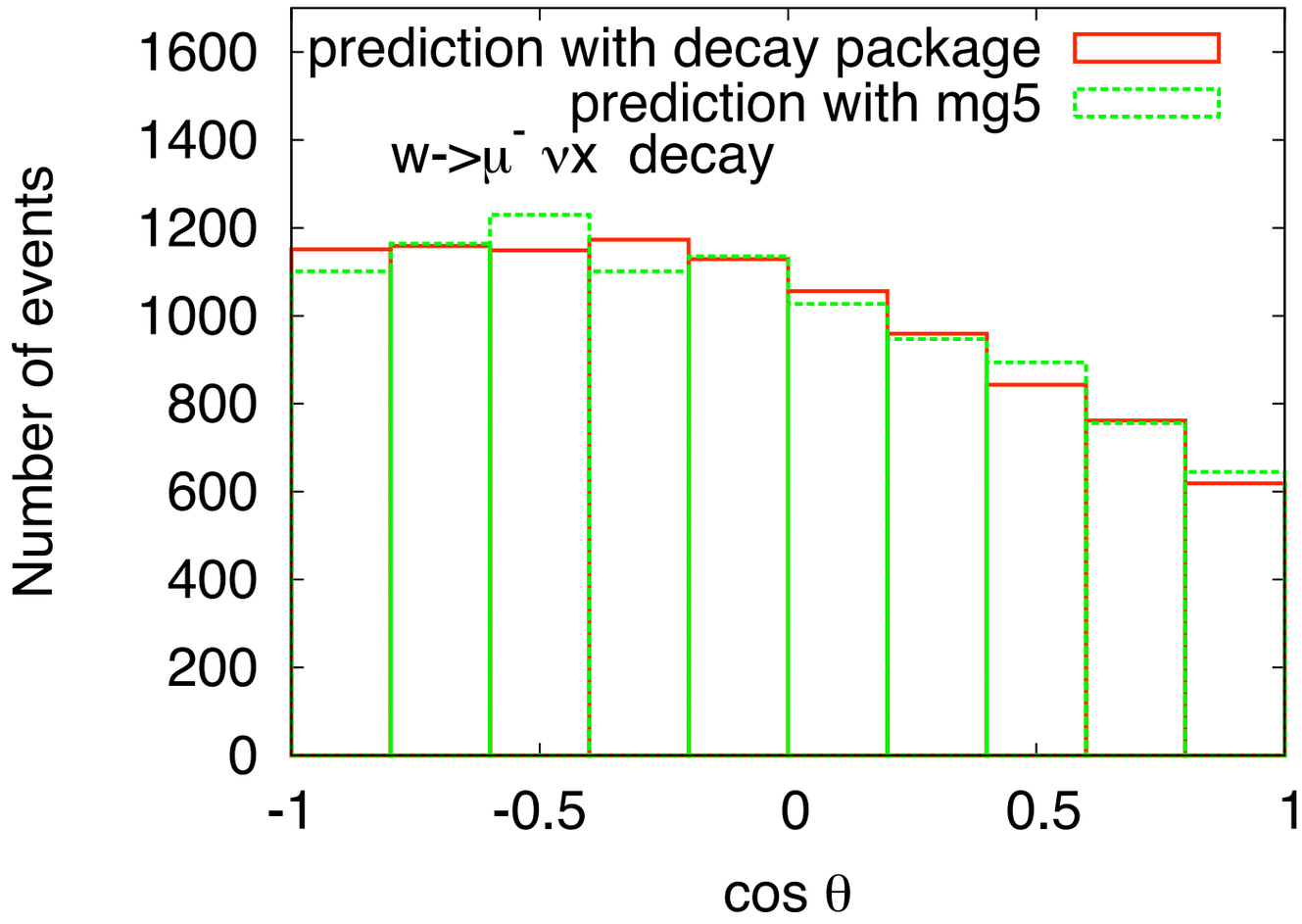
Decaying the events...

Efficiency of the unweighting procedure:

2.93 trials on average for tt~ (dileptonic)

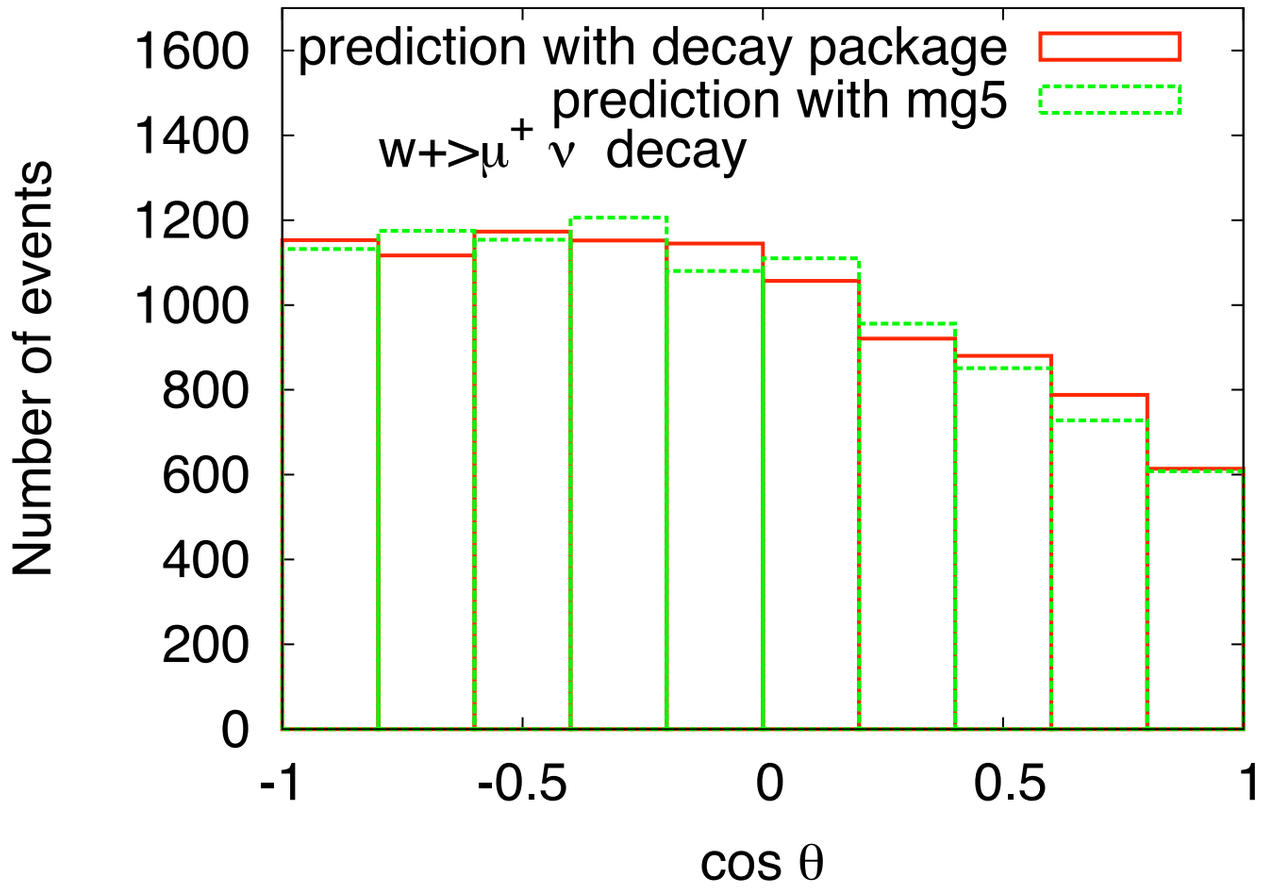
Validation

- tt~ (dileptonic)



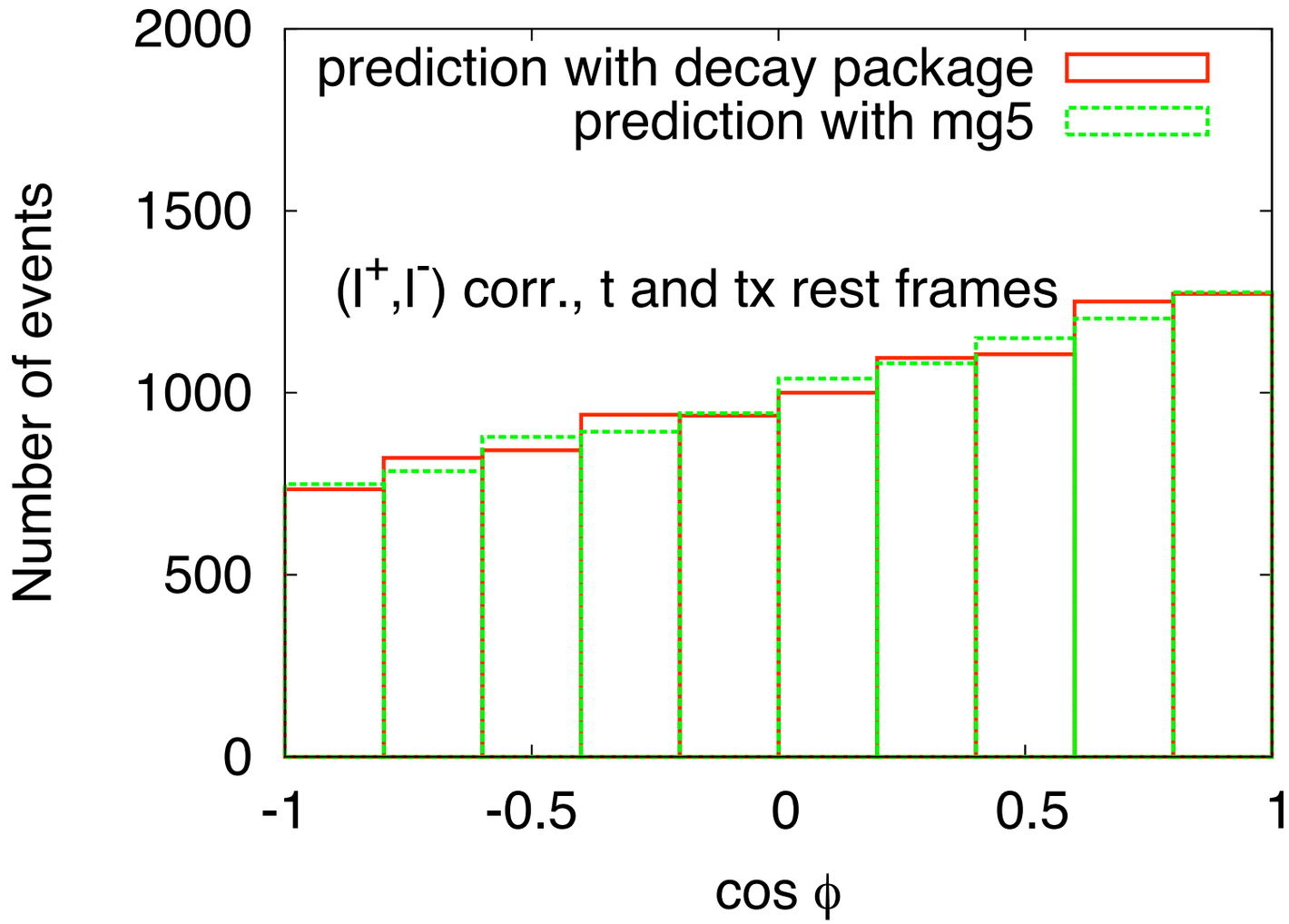
Validation

- tt~ (dileptonic)



Validation

- tt~ (dileptonic)



To-do list

- go beyond the narrow width approximation
- improve the speed (evaluation of $|M|^2$)
- interface with production at NLO