RAPGAP

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Abstract

RAPGAP, originally developed to describe rapidity gap event in ep collisions, has evolved into a multi-purpose Monte Carlo event generator for diffractive and non-diffractive processes at ep colliders both for high Q^2 and in the photoproduction regime ($Q^2 \sim 0$) as well as hard (single diffractive and non-diffractive) processes for pp and $p\bar{p}$ colliders. A detailed description of the program as well as the source code can be found under [1]. In the following only new developments are described.

1 NLO and Order α_s matrix elements

The $\mathcal{O}(\alpha_s)$ matrix elements for light quarks are divergent for $p_T^2 \to 0$, and usually a p_T^2 cutoff is applied. The $\overline{MS}$ factorization scheme provides a description which finite parts of the matrix elements are treated explicitely and which parts are included in the parton distribution functions. A consistent implementation of the NLO formalism for F_2 in DIS including initial state parton showering is described in detail in [2]. The LO (α_s^0) and the NLO (α_s) part are treated according the $\overline{MS}$ subtraction scheme, reformulated such that it properly can be used together with initial and final state parton showers, avoiding any double counting [3]. When using this scheme, the NLO parton densities calculated in the $\overline{MS}$ scheme should be selected. The program then transforms the parton densities from the $\overline{MS}$ to the BS scheme for parton showers. However, at present only the BGF part is implemented.

2 Les Houches interface

A generic format for the transfer of parton level event configurations from matrix element event generators (MEG) to showering and hadronization event generators (SHG) [4] is provided by the *Les Houches interface*. RAPGAP gives the possibility to write the full parton level events to the file `rapgap.gen`, which can be read in directly by the PYTHIA and HERWIG programs to perform the hadronization. This option is best suited to estimate the uncertainty coming from hadronization correction.

3 Proton dissociation ala DIFFVM

Dissociation of the proton according to the model in DIFFVM [5] can be included for diffractive events. The proton dissociation part of the cross section is given by

$$\frac{d\sigma}{dM_Y^2\, dt\, dx_{I\!P}} \sim \frac{1}{M_Y^{2(1+\epsilon_Y)}} \exp\left(-B_{diss}|t|\right)$$

with ϵ_Y describing the dependence on the dissociation mass M_Y and B_{diss} the t-dependence. The dissociative system Y is split into a $quark - gluon - diquark$ system for masses $M_Y > 2$ GeV whereas for masses $0.939 < M_Y < 2$ GeV the system is fragmented according to the nucleon resonances as implemented in DIFFVM [5].

4 Future Plans

In the next future it is planned to include double diffractive scattering for pp collisions to allow simulation of diffractive Higgs production.

References

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