Modeling of Photon-induced processes at the LHC

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1 Introduction

The focus of the workshop is on the modeling of the photon-induced processes in p-p collisions at the LHC, focusing on cases when protons are not explicitly tagged with forward detectors.
Also, with heavy ions...

2 Experimental context

Historically, most of the attention has been given (both from the theory as well as experimental side) to photon-induced processes where the final state protons are detected by dedicated forward detectors. We'd like to summarize the state-of-art techniques for identifying photon-induced processes in p-p collisions using the central-detector information, summarizing and brainstorming about advantages, limitations and complementarity with the more traditional identification of forward protons.

Brief overview of the existing measurements, existing datasets (table) etc.

3 Software setup

Docker container, software versions...

4 Baseline yy-generators setup

The current implementation of specific photon-photon generators into a complete set of tools usable by large experiments require custom patches to the code to be applied and, from our experience, has been fragile with respect to changes of versions. Identifying potential developments to address the stability and generality of these programs can ensure the long-term sustainability and larger-base adoption of this interesting physics.

4.1 Pythia

??

4.2 Superchic+Pythia

Aleksandra, Angira, Lucian

Various options shown on the plots: Option 1 - diploeRecole = ON Option 2 - dipolreRecoil = OFF Option 3 - Enable survival Option 7 - ptDumpFudge 2 instead of 1 - does not seem to have effects (or maybe Plots?

Tried DIRE and VINCIA but does not work. Will be followed up by Ilka. requires ptDumMatch = 1 Is there an interference between ptDumpFudge and dipoleRecoil? Ilka and Lucian to give supervision which are the parameters to consider and what are their variations Progress?

*Author One was partially supported by Grant XXX

4.3 Madgraph+Pythia

??

4.4 Madgraph+Herwig

Aidin, Kristin

Madgraph is confused in cases when it's told to use LHAPDF together with Budnev (PDF index 0 or 2)

Progress?

4.5 Herwig

Kristin, Aidin

Elastic working, but proton is breaking. Was previously used in ATLAS, some commands probably missed (set /Herwig/Generators/EventGenerator:EventHandler:CascadeHandler:MPIHandler NULL??) Plots?

Showering using LHEF Herwig events possible - showering of Superchic events to be done. Lepton kinematic are weird - cuts to be check Progress?

4.6 Sherpa

Josh, Kristin, Peter Meinzinger

Peter will prepare SD runcards Systematic variations of QED showers: Soft photon resummation vs photons from the shower (Mark can prepare the card configuration) Progress? Plots?

4.7 Cepgen

Laurent Forthomme, Simone-Lorenzo

LHEF contains line with the name of the weight which has only one option when dumped from LPAIR, Rivet expects more (hacked by adding 'default' in as additional name in the text file), tall particles have negative mass. Rivet complains about it

Validating LPAIR against CepGen

Plots?

4.8 gamma-UPC

David d'Enterria, Lydia, Aleksandra, Shaun

Proton photon flux: Dipole fit modified to account for all existing elastic proton FF data (MAMI A1, JLAB PRad,...) Generated elastic only - worked! Newest Madgraph integrates gamma-UPC

Plots?

5 Hadronization and parton shower variations

Ilkka Helenius, Aleksandra, Angira, Luke

Interfacing photon-induced generators with Pythia is currently done through a set of parameters developed by generator authors and is available only for Pythia. Especially in the case of diffractive events, the way it's done tends to be rather "ad-hoc" and very sensitive to Pythia variations version by version. In practice we also found the final state observables can be very sensitive to the tuning of these parameters (more on this in the tuning topic below).

We would like to explore a robust way to interface photon-induced generators with parton shower programs, building upon the experience we had so far. What is needed from the generator side and what methods the interface with parton shower can offer (e.g. parameters tuning vs user-hooks, etc . . .).

Pythia vs Herwig

6 Tuning

Oldrich Kepka

Modelling of diffractive processes is certainly a non-trivial task. While historically a lot of attention has been given to the elastic contribution of photon-induced processes, we'd like to focus on a more inclusive approach and brainstorm of what data is available and what measurements can be done to improve our understanding of the non-elastic component of photon-induced processes.

7 Future ideas

Other topics could be potentially very interesting, but we have omitted to keep the workshop more focused. These included extending the discussion to synergies with forward detectors, as well as in heavy ion collisions, photon PDFs, leptons in PDFs, etc.. However, we're still very open to suggestions of topics that you think might fit well within the scope of this workshop and/or are high-priority for the field.

8 Conclusion

Acknowledgements

References

A MC configuration