



Contribution ID: 34

Type: talks

# PARTON SHOWERS IN PRODUCTION OF Z BOSONS IN PROTON-PROTON COLLISIONS AT THE LHC

*Tuesday, January 21, 2025 12:30 PM (30 minutes)*

Production of muon pairs in junction with hadronic jets is studied under conditions of LHC experiments [1-3]. Hard parton processes are simulated with MadGraph5\_aMC@NLO [4,5] at the tree level and at Next-to-Leading order (NLO) in perturbative quantum chromodynamics (pQCD). The parton processes have  $n=0, \dots, 4$  light quarks or gluons in the final states. The generated parton events are showered with the help of Pythia 8 [6,7]. The MLM and CKKWL methods are applied to avoid double counting in treatment of processes, described by the matrix elements, and parton showers. The events with different multiplicities in the NLO calculations are merged in the framework of FxFx approach.

An area of the scale parameters in matching and merging, in which distributions of jets in the transverse momentum and the differential jet rates are smooth and the double counting is substantially reduced, is determined. The production of Z boson on the mass shell is considered with this end. While multiparton interactions and hadronization result in additional smearing of structures in the differential distributions due to double counting, the observables are shown to depend significantly on elimination of double counting in inclusion of the parton showers.

The obtained integral cross sections and the distributions of the muon pairs in the transverse momentum are compared with the ATLAS, CMS, and LHCb data [1-3]. Influence of processes beyond the leading order in pQCD on the distributions in the central and forward rapidity regions is discussed on the basis of consistent inclusion of the parton showers.

Results of the current research are of interest to determine sensitivity of the observables on parton distribution functions and for evaluation of background in searches of deviation from the Standard Model predictions.

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3. LHCb Collaboration. JHEP 07 (2022) 026.
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**Session Classification:** Session INVITED TALKS. "Ukraine for ESPP Update-2025"