

- MC@NLO with PYTHIA (instead of HERWIG) for HERA and LHC

MC@NLO is a MC generator combining a full NLO calculation with parton showers and hadronization, using herwig for the parton showering and hadronization. However to correctly calculate the effect and corrections which come from the parton showering and hadronization it would be desirable to have MC@NLO also using PYTHIA for parton shower and hadronization.

The MC subtraction terms have to be calculated for the PYTHIA parton shower case and then implemented into MC@NLO. The implementation should be done for the ep and pp case.

A person with experience with MC@NLO should be able to perform the calculations within 1-2 years. It would require close contact with the MC@NLO group at CERN as well as close interaction with T. Sjostrand in Lund.

- CASCADE and collinear NLO calculations

Using unintegrated pdfs and the frame of kt-factorization is a way to estimate higher order corrections. This approach is now being used to estimate the higher order corrections for Higgs, DY and heavy flavor production at LHC (see papers by S. Marzani and R. D. Ball. High Energy Resummation of Drell-Yan Processes. Nucl. Phys., B814:246–264, 2009. S. Marzani, R. D. Ball, V. Del Duca, S. Forte, and A. Vicini. Higgs production via gluon-gluon fusion with finite top mass beyond next-to-leading order. Nucl. Phys., B800:127–145, 2008.)

The correction to the kinematics coming from higher order corrections is highly reduced when using uPDFs, resulting in smaller correction factors.

A systematic study has to be performed to identify those terms which are common in the kt-factorization formulae and in the collinear NLO calculations. The aim is to improve the implementation of processes in CASCADE to consistently include NLO corrections making it a elegant and useful program for the main QCD processes at LHC.

A person with experience in uPDFs and/or NLO calculations should be able to perform this study within 1-2 years

- PDF4MC with neural network approach for initial conditions

The PDF4MC project will release the first PDF set for PYTHIA during summer 2009. However systematic studies are needed to bring this into a generally accepted PDF set. Proposals during the "Parton Shower and Resummation Institute" have been made to modify the the evolution equation (still keeping the overall structure) to allow for kinematic effect. In addition to this modification the effect and bias of the specific choice of the starting distribution has to be investigated. Promising results are being obtained from the NNPDF group in the frame of collinear NLO PDFs.

A similar approach can be performed with PDF4MC allowing for a realistic estimate of the uncertainties of the PDF4MC. A person with experience in computing and neural networks and with evolution equations should be able to perform this studies within 1-2 years. A close collaboration with the NNPDF group is necessary