Cutting Edge Monte-Carlo at Wuppertal

Malgorzata Worek

ITP Karlsruhe & ITP Wuppertal

Terascale MC Meeting Bonn

HELAC

http://helac-phegas.web.cern.ch/helac-phegas/

C. Papadopoulos & M. Worek

Monte Carlo Event Generator for All Parton Level Processes

- Used to efficiently obtain helicity amplitudes and total cross sections for arbitrary multiparticle processes in the Standard Model.
- Implementation of the algorithm based on **Dyson-Schwinger** recursive equations
- Full off-shell and finite width effects
- Spin and color correlations taken into account naturally
- Extended numerical precision possible
- Numerical predictions for amplitudes for arbitrary processes for phase-space points provided by the user
- Parton-level events with all necessary information, in the most recent **LHA** format
- Emission of secondary partons & translation of the emerging partons into primordial hadrons performed by interfacing to **PYTHIA**
- **MLM** matching procedure to combine fixed order tree level matrix element calculations with parton showers

HELAC

C. Papadopoulos & M. Worek

http://helac-phegas.web.cern.ch/helac-phegas/

- Fortran 95 and has been developed using the following compilers under Linux:
  Lahey Fujitsu, Intel Fortran, GNU gfortran and g95
- Stand-alone codes do not need any external library
- **LHAPDF** supported as an option

PLANS:

- Built with future extensions in mind !
- Straightforward to add new physics effects by including new models & couplings, etc.

VBFNLO

http://www-itp.particle.uni-karlsruhe.de/~vbfnloweb/

ITP Karlsruhe & M. Worek

NLO parton level Monte Carlo for processes involving gauge bosons

- Fully flexible parton-level MC simulation of vector boson fusion, double and triple vector boson production processes in hadronic collisions at **NLO QCD**
- **Leptonic** decays of vector bosons
- Possibility to calculate the corresponding process with one additional jet at LO
- Higgs- and vector boson decays with full spin correlations and all off-shell effects
- Production of a CP-even & CP-odd Higgs boson in gluon fusion associated with two jets (full top- & bottom-quark mass dependence in 2HDM)
- Several models for anomalous couplings of Higgs- and vector bosons and a warped Higgsless extra dimension model implemented for selected processes
- Offers the possibility to generate **LHA** event files for processes available at LO
- Arbitrary cuts can be specified as well as various scale choices
- PDF set can be used through the **LHAPDF** library

VBFNLO

http://www-itp.particle.uni-karlsruhe.de/~vbfnloweb/

ITP Karlsruhe & M. Worek

- **Hjj, Wjj, Zjj, WWjj, ZZjj, WZjj** in VBF at NLO
- **WWW, WWZ, ZZW, WW** at NLO
- **Hjj** via gluon fusion at LO

PLANS:

- Further processes at NLO QCD accuracy will be included
- New features to the already existing processes, e.g. anomalous triple and quartic gauge boson couplings and Warped Higgsless scenario for VVV processes
- Higgs-production in gluon fusion extended to include full mass dependence on scalar top and bottom quarks
- Matching the NLO QCD processes to a parton shower in NLO logarithmic accuracy
- Complete manual this year

NLO HELAC

M. Czakon & C. Papadopoulos & M. Worek

Automation of MC event generation at NLO

- Recent years dramatic development in the field
- **Unitarity cuts** methods improved and useful in practice
- **OPP** method in form of the computer code **CutTools**
  - numerical reduction of amplitude to scalar integrals times coefficients
  - numerator of Feynman diagrams needed as input
- Current work on automating numerator generation with Dyson-Schwinger recursion
- Current work on Dipole subtraction method within **HELAC**

Full automate in reach - massive QCD !

Contribute to ATLAS and CMS generator groups at all stages: interfacing, validation and tuning of those codes to make

HELAC & VBFNLO

options in the study of the LHC data