NLO Tutorial

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FeynRules at NLO

- Download FeynRules 2.1
  - https://feynrules.irmp.ucl.ac.be
- Download FeynArts 3.7 or 3.8
  - http://www.feynarts.de
- Copy the SM directory and call it Tutorial and copy your Tutorial.fr there (SM in 2.1 is different)

FeynRules at NLO

- Load FeynRules 2.1 (Change the path)
- Load the model
- Renormalize the Lagrangian
  - Lren = OnShellRenormalization[LSM + LNew, QCDOnly -> True, FlavorMixing -> False];
- Export to FeynArts
  - SetDirectory["~/FeynArts-3.8/Models"];
    WriteFeynArtsOutput[Lren, GenericFile -> False, Output -> "Tutorial"];

NLOCT

- Quit[]
- Load FeynArts and then NLOCT
  - SetDirectory["~/FeynArts-3.8"];
    << FeynArts`
    SetDirectory[“~/feynrules-2.1"]
    << NLOCT`
- Compute the NLO vertices
  - SetDirectory[“~/feynrules-2.1/Models/Tutorial”]
    WriteCT["Tutorial/Tutorial", "Lorentz", QCDOnly -> True,
    Exclude4ScalarsCT -> True, ZeroMom -> {{aS, {F[14], V[4], -F[14]}}}]

UFO@NLO

- Quit[]
- Load FeynRules 2.1 and your model
- Load the NLO vertices
  - SetDirectory[“~/feynrules-2.1/Models/Tutorial”];
    Get["Tutorial.nlo"]
- Write the UFO
  - SetDirectory["~/mg5amcnlo/models"];
    WriteUFO[LSM + LNew, Output -> "Tutorial_NLO", R2Vertices -> R2$vertlist,
    UVCounterterms -> UV$vertlist]

aMC@NLO

- Download MadGraph5_aMC@NLO_v2.0.0 (release yesterday!)
  - https://launchpad.net/mg5amcnlo
- install external package
  - install MadAnalysis
  - install pythia-pgs

Generate sample at NLO

- compute the NLO cross-section for
  - p p > t t~
  - p p > uv uv~
- compute the K-factor for each of those processes
- Generate NLO events for
  - p p > t t~
  - make the decay of the top using MadSpin