

Les Houches 2015: Physics at TeV Colliders

Standard Model Working Group Report

| process | known | desired |
|--|---|--|
| $pp \rightarrow H$ | σ $N^3\text{LO}_{\text{HEFT}}+N^2\text{LO}_{\text{QCD}}\left(\frac{1}{m_t^6}\right)$ | |
| | $d\sigma$ NLO_{EW} | $d\sigma$ $N^3\text{LO}_{\text{HEFT}}+N^2\text{LO}_{\text{QCD}}$ |
| | $d\sigma$ $N^2\text{LO}_{\text{HEFT}}+N\text{LO}_{\text{QCD}}+\text{PS}$ | $+N\text{LO}_{\text{EW}}+N^{(1,1)}\text{LO}_{\text{QCD}\times\text{EW}}$ |
| $pp \rightarrow H + j$ | $d\sigma$ $N^2\text{LO}_{\text{HEFT}}$ | $d\sigma$ $N^2\text{LO}_{\text{HEFT}}+N\text{LO}_{\text{QCD}}+N\text{LO}_{\text{EW}}$ |
| | $d\sigma$ NLO_{EW} | |
| $pp \rightarrow H + 2j$ | $d\sigma$ $\text{NLO}_{\text{HEFT}}+\text{LO}_{\text{QCD}}$ | $d\sigma$ $N^2\text{LO}_{\text{HEFT}}+\text{LO}_{\text{QCD}}+N\text{LO}_{\text{EW}}$ |
| | $d\sigma$ $N^2\text{LO}_{\text{QCD}}(\text{VBF}^*)$ | $d\sigma$ $N^2\text{LO}_{\text{QCD}}(\text{VBF})+N\text{LO}_{\text{EW}}(\text{VBF})$ |
| | $d\sigma$ $\text{NLO}_{\text{EW}}(\text{VBF})$ | |
| $pp \rightarrow H + 3j$ | $d\sigma$ NLO_{HEFT} | $d\sigma$ $N\text{LO}_{\text{QCD}}+\text{LO}_{\text{QCD}}+N\text{LO}_{\text{EW}}$ |
| | $d\sigma$ NLO_{EW} | |
| $pp \rightarrow H + V$ | $d\sigma$ $N^2\text{LO}_{\text{QCD}}$ | $d\sigma$ $N^2\text{LO}_{\text{QCD}} + N\text{LO}_{gg\rightarrow HV} + N\text{LO}_{\text{EW}}$ |
| $pp \rightarrow HH$ | $d\sigma$ $N^2\text{LO}_{\text{HEFT}}$ | $d\sigma$ $N^2\text{LO}_{\text{HEFT}}+N\text{LO}_{\text{QCD}}+N\text{LO}_{\text{EW}}$ |
| | $d\sigma$ NLO_{QCD} | |
| $pp \rightarrow H + t\bar{t}$ | $d\sigma$ NLO_{QCD} | $d\sigma$ $\text{NLO}_{\text{QCD}}+N\text{LO}_{\text{EW}}$ |
| | $d\sigma$ NLO_{EW} | |
| $pp \rightarrow H + t$ $pp \rightarrow H + \bar{t}$ | $d\sigma$ NLO_{QCD} | $d\sigma$ $\text{NLO}_{\text{QCD}}+N\text{LO}_{\text{EW}}$ |

Table 1: Precision wish list: Higgs boson final states. VBF* refers to the computation using the factorised 'projection-to-Born' approximation.

| process | known | desired |
|-----------------------------------|---|--|
| $pp \rightarrow V$ | σ N ³ LO _{QCD} ($z \rightarrow 0$) | |
| | $d\sigma$ N ² LO _{QCD} | $d\sigma$ N ³ LO _{QCD} + N ² LO _{EW} |
| | $d\sigma$ NLO _{EW} | + N ^(1,1) LO _{QCD} ×EW + decays |
| | $d\sigma$ N ^(1,1) LO _{QCD} ×EW | |
| $pp \rightarrow VV'$ | $d\sigma$ N ² LO _{QCD} + decays | $d\sigma$ N ² LO _{QCD} + NLO _{EW} + decays |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow V + j$ | $d\sigma$ N ² LO _{QCD} | $d\sigma$ N ² LO _{QCD} + NLO _{EW} + decays |
| $pp \rightarrow V + 2j$ | $d\sigma$ NLO _{QCD} + decays | $d\sigma$ N ² LO _{QCD} + NLO _{EW} + decays |
| | $d\sigma$ NLO _{EW} + decays | |
| $pp \rightarrow VV' + 1, 2j$ | $d\sigma$ NLO _{QCD} + decays | $d\sigma$ NLO _{QCD} + NLO _{EW} + decays |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow VV'V''$ | $d\sigma$ NLO _{QCD} | $d\sigma$ NLO _{QCD} + NLO _{EW} + decays |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow \gamma\gamma$ | $d\sigma$ N ² LO _{QCD} | $d\sigma$ N ² LO _{QCD} + NLO _{EW} |
| $pp \rightarrow \gamma\gamma + j$ | $d\sigma$ NLO _{QCD} | $d\sigma$ N ² LO _{QCD} + NLO _{EW} |

Table 2: Precision wish list: vector boson final states. $V = W, Z$ and $V', V'' = W, Z, \gamma$.

| process | known | desired |
|--------------------------------|--|---|
| $pp \rightarrow t\bar{t}$ | $d\sigma$ N ² LO _{QCD} | |
| | $d\sigma$ NLO _{QCD} + decays | $d\sigma$ N ² LO _{QCD} + NLO _{EW} + decays |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow t\bar{t} + j$ | $d\sigma$ NLO _{QCD} + decays | $d\sigma$ N ² LO _{QCD} + NLO _{EW} + decays |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow t\bar{t} + 2j$ | $d\sigma$ NLO _{QCD} + on-shell decays | $d\sigma$ NLO _{QCD} + NLO _{EW} + decays |
| $pp \rightarrow t\bar{t} + V$ | $d\sigma$ NLO _{QCD} | $d\sigma$ NLO _{QCD} + NLO _{EW} + decays |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow t/\bar{t}$ | $d\sigma$ N ² LO _{QCD} (t -channel) | $d\sigma$ N ² LO _{QCD} + NLO _{EW} + decays |
| $pp \rightarrow 2j$ | $d\sigma$ N ² LO _{QCD} (gg,qq) | $d\sigma$ N ² LO _{QCD} + NLO _{EW} |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow j + \gamma$ | $d\sigma$ NLO _{QCD} | $d\sigma$ N ² LO _{QCD} + NLO _{EW} |
| | $d\sigma$ NLO _{EW} | |
| $pp \rightarrow 3j$ | $d\sigma$ NLO _{QCD} | $d\sigma$ N ² LO _{QCD} + NLO _{EW} |

Table 3: Precision wish list: top quark and jet final states