**Event Generation**

Event generators use hard-scattering matrix elements (ME) to calculate cross-sections up to a fixed-order. Parton showers (PS) model the fragmentation and hadronisation of partons. Generators differ on the procedure for calculating real and virtual amplitudes and in the matching of NLO radiation between ME and PS in order to preserve the total cross-section.

**Top at NLO**

A range of generators at leading and next-to-leading order interfaced to parton shower models are used by ATLAS and tested against unfolded top measurements. Comparisons among generators offer an handle to quantify modelling, shower and UE uncertainties.

**Herwig 7**

Herwig++ has been used to provide an alternative model of parton showering to Pythia. Initial comparisons of Herwig 7 have been shown to improve the modelling of the top quark and top quark pair kinematics.

**Powheg + Pythia 8 Studies**

The current default sample used in ATLAS top physics analyses is Powheg+Pythia 6. Optimisation of Powheg+Pythia 8 is necessary before transitioning from Pythia 6 to Pythia 8.

- The effect of A14 UE/PS tune variation uncertainties have been studied from the standpoint of top physics. Variation 3c which changes $\alpha_s$ in the eigentune by ±10% has been shown to have the largest impact and covers the size of the alternative variations.

This leads to the following generator uncertainty prescription foreseen for future ATLAS top analyses using Powheg+Pythia 8 as the nominal:

<table>
<thead>
<tr>
<th>Systematic</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation (High)</td>
<td>$0.5\mu$, A14 var3c up, $\hat{h}<em>{\text{amp}} = 2m</em>{\text{top}}$</td>
</tr>
<tr>
<td>Radiation (Low)</td>
<td>$2.0\mu$, A14 var3c down, $\hat{h}<em>{\text{amp}} = m</em>{\text{top}}$</td>
</tr>
<tr>
<td>NLO Subtraction Scheme</td>
<td>Powheg versus MG5_aMC@NLO</td>
</tr>
<tr>
<td>Fragmentation Model</td>
<td>Herwig++/7 versus Pythia 8</td>
</tr>
</tbody>
</table>

**Multi-Leg MadGraph**

Multi-leg LO+PS samples can be used to provide a more precise prediction than inclusive NLO samples at high jet multiplicities.

**FxFx Merging**

The FxFx merging technique allows the combination of multiple NLO+PS samples with different final state jet multiplicities. This can reach NLO precision in jet multiplicities beyond what is possible in an inclusive NLO sample.

Studies varying the FxFx merging scale ($\mu_F = 30, 50, 70$ GeV) have been performed using MG5_aMC@NLO+Pythia 8, where good agreement is observed with 7 TeV data.

**Summary at 13 TeV**

A range of top physics samples are available for Run-2 ATLAS analyses and further studies are ongoing.