Monte Carlo modeling of Standard Model multi-boson production processes for \( \sqrt{s} = 13 \text{ TeV} \) ATLAS analyses
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Abstract
Multi-boson production measurements provide an important test of the electroweak sector of the Standard Model (SM). The production of multiple gauge bosons \( V(=W, Z, \gamma) \) opens up a multitude of potential decay channels categorized according to the number of charged leptons in the final state.

We present the Monte Carlo (MC) setup used by ATLAS to model multi-boson processes in \( \sqrt{s} = 13 \text{ TeV} \) proton-proton collisions. The baseline Monte Carlo generators are compared with each other in key kinematic distributions of the processes under study. Sample normalization and systematic uncertainties are discussed.

Generators: Sherpa v2.1.1/2.2, PowhegBox v2, MadGraph5_aMC@NLO, MC@NLO
Parton Shower (PS): Pythia8, Herwig++

Fully Leptonic qq → VV

Modeled process accuracies

<table>
<thead>
<tr>
<th>Process</th>
<th>Fully lep. qq → VV</th>
<th>Electroweak qq → VV</th>
<th>Loop-ind. gg → VV</th>
<th>Triboson qq → VVV</th>
</tr>
</thead>
<tbody>
<tr>
<td>VV + 0j</td>
<td>NLO</td>
<td>NLO</td>
<td>LO</td>
<td>LO</td>
</tr>
<tr>
<td>VV + 1j</td>
<td>NLO</td>
<td>LO</td>
<td>PS</td>
<td>PS</td>
</tr>
<tr>
<td>VV + 2j</td>
<td>NLO</td>
<td>LO</td>
<td>PS</td>
<td>PS</td>
</tr>
<tr>
<td>VV + 3j</td>
<td>NLO</td>
<td>LO</td>
<td>PS</td>
<td>PS</td>
</tr>
<tr>
<td>VV + ≥ 4j</td>
<td>NLO</td>
<td>LO</td>
<td>PS</td>
<td>PS</td>
</tr>
</tbody>
</table>

Modeled Process List
- Fully lepton qq → VV
- Electroweak qq → VV
- Loop-induced gg → VV
- Triboson qq → VVV
- Leptonic/Hadronic qq → Vy
- Skipped: Semileptonic qq → VV(jj)


Fully Leptonic qq → VV

Modeled process accuracies


Electroweak qq → VV

Modeled process accuracies


Triboson qq → VVV

Modeled Process List
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Public references