Performance of Monte Carlo Event Generators for the Production of Boson and Multi-Boson States ATLAS Analyses

Fully leptonic VV + jets
- Baseline generators for Run 2:
  - **Sherpa 2.1**: multi-leg VV + 0j @ NLO + 1, 2j @ LO + ≥ 4j @ PS using OPENLOOPS, CT11nlo and authors' default tune.
  - **Sherpa 2.2**: multi-leg VV + 0j @ NLO + 1.2j @ LO + ≥ 5j @ PS using OPENLOOPS, NNPDF3.0nlo and authors' (new) default tune.

- MADGRAPH + PYTHIA8: Multi-leg VV + ≤ 4j @ LO, ≥ 5j @ PS with CKKW-L matching to PYTHIA8 using A14-based tune variations with NNPDF2.3lo (A') or NNPDF3.0lo (B')
- Also dedicated calculations for electroweak VV and loop-induced VV

Semileptonic VV + jets
- Baseline generators for Run 2:
  - **Sherpa 2.1**: multi-leg VV + 0j @ NLO + 1, 2j @ LO + ≥ 4j @ PS using OPENLOOPS, CT11nlo and authors' default tune.
  - **Sherpa 2.2**: multi-leg VV + 0j @ NLO + 1, 2j @ LO + ≥ 4j @ PS using OPENLOOPS, NNPDF3.0nlo and authors' (new) default tune.

- POWHEG + PYTHIA8: NLO POWHEGbox v2 (CT11nlo) showered with PYTHIA8 (CTEQ6L1) using AZNLO and EVTGEN
- Generally good agreement between generators
- Forward activity excess in SHERPA 2.1 problematic for VBS-sensitive analyses
- NLO-PS approach clearly insufficient to describe multi-jet configurations adequately
- ∼ 4–5% cross section uncertainty estimated using parton-level calculation (MCFM), explicit scale variations produced for SHERPA 2.1

Further documentation:
- ATLAS Collaboration, Monte Carlo Generators for the Production of a W or Z+/− Boson in Association with Jets at ATLAS in Run 2, ATL-PHYS-PUB-2016-003, and references therein
- ATLAS Collaboration, Multi-Boson Simulation for 13 TeV ATLAS Analyses, ATL-PHYS-PUB-2016-002, and references therein