Introduction

- Tons of data (DUNE, T2HK, etc.)
- Testing of (neutrino) BSM theories:
  - Manually: time-consuming, prone to errors, infeasible.
- Automatic:
  - Separate $|M|^2$ into hadronic and leptonic tensors.
  - Focus on BSM physics within $L_\mu\nu$.
  - Event generators provide $H_\mu\nu$.
  - Easily interfaced to several generators.
- Novel program to automatically calculate leptonic tensors of neutrino BSM theories:
  - Requires only BSM Lagrangian.
  - Can be easily interfaced to several neutrino event generators.

Methods

- Based on COMIX generator from Sherpa.
- Universal FeynRules Output (UFO) files:
  - Contains all information about BSM theory.
  - Agnostic of a priori assumptions, flexible, output in Python modules.
- Berends-Giele recursive algorithm:
  - Recursive build up of Feynman diagrams.
  - Recycling of diagrams’ components within processes. Highly-efficient.
- Multichannel phase space integration:
  - Need to validate results.
  - $\sigma \propto \int d\Pi_n |M|^2$ → Monte Carlo integration.
  - Integration divided in $k$ channels with prob. distribution $g_i(\Pi_n)$ and probability $\alpha_i, i = 1, \ldots, k$.
  - Optimization of $\alpha_i$ reduces variance.

Preliminary Results and Conclusion

- Validation results of two SM processes: $e^-p^+ \rightarrow e^-p^+$ and $\nu_e p^+ \rightarrow \nu_e p^+$.

- Using $L_{\mu\nu}$ from code, we plotted $|M|^2$ vs. $\cos(\theta)$ for six $E_{\text{CM}} = \{20, 60, 100, 140, 180, 200\}$ (GeV) as well as $\sigma$ vs. $E_{\text{CM}}$.
- Correct off factors of calculations. Test more complex SM processes as well as BSM models.