

Contact Interaction Studies with Event Generator

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A lot of non-standard model scenarios can be examined using PYTHIA. Contact interaction, phenomenologically introduced as a "residual interaction" which have its source in interactions between quark- and lepton-subconstituents, is also included in it. However, as same as for all other sub-processes, PYTHIA includes only helicity averaged cross sections for the contact interaction.

P. Taxil and J.-M. Virey studied the sensitivity of the contact interaction at RHIC and at pol-HERA in some spin asymmetries. The purpose of the present study is, based on their studies, to include the helicity-dependent matrix-elements into PYTHIA and to make an event generator-based study for RHIC-Spin program.

Using helicity-dependent matrix-elements for the polarized e-p collision, corresponding formula for Drell-Yan process can be obtained by crossing. Then we can get partonic-level asymmetries. Final hadronic spin asymmetries were estimated using weighted method. The weight factor consists of partonic-level asymmetries, polarized- and unpolarized-parton distribution-functions. The event generation was controlled by the unpolarized sub-processes, which were already included in PYTHIA as ISUB=1 for a standard model γ^*/Z production and ISUB=165 for a fermion pair creation via γ^*/Z production by the contact interaction.

The following results were obtained. Parity violating double spin asymmetry, $\bar{A}_{LL}^{PV} = \{\sigma(-+) - \sigma(+ -)\}/\{\sigma(-+) + \sigma(+ -)\}$, has the largest sensitivity on the contact interaction. However, the resultant beyond standard model asymmetry is rather small ($\sim 1\%$) if the compositeness scale Λ is larger than 3 TeV. Considering the experimental errors, quantitative sensitivity study at dilepton mass of around $M = 10 \sim 20$ GeV and around Z boson is necessary. The other parity violating double spin asymmetry, $A_{LL}^{PV} = \{\sigma(--) - \sigma(++)\}/\{\sigma(--) + \sigma(++)\}$, has very small difference from standard model even at $\Lambda = 1$ TeV. The usual double spin asymmetry A_{LL} has no sensitivity on the contact interaction. It is because all the matrix-elements are zero for the same helicity combination.

As for one jet production, it is considered to have larger sensitivity on contact interaction than Drell-Yan process. Therefore, the next step must be to include the corresponding quark scattering formula into PYTHIA. The procedure has been established. Then, for example, sensitivity on π^0 production can be examined soon.

All the newly obtained formula especially for Drell-Yan process can be found on my web page (<http://spin.riken.bnl.gov/~jiro>).