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GRANIITTI: Towards a deep learning enhanced MC event generator for high energy diffraction

Thursday, 29 September 2022 11:00 (20 minutes)

I will introduce the physics scope and state-of-the-art technology of GRANIITTI [github.com/mieskolainen/graniitti], a fully multithreaded C++17 language-driven Monte Carlo event generator designed especially for the central exclusive glueball searches and studies at the LHC and beyond. The extendable set of processes span currently from $\gamma\gamma$-EW and Durham QCD to non-perturbative 'minimal Pomeron' and 'tensor Pomeron' based.

For the low-mass central (semi)-exclusive pp-diffraction, GRANIITTI is currently the only fully open source generator providing multi-resonance & continuum scattering amplitudes with parametric spin correlations, simultaneously with differential screening (absorption) loop effects and forward proton excitation. I will compare the simulations against quite recent fiducial cross-section measurements of the process $pp \to p + X + p$ from the STAR experiment at $\sqrt{s} = 0.2$ TeV. These measurements include numerous differential distributions, for a pion-, kaon- and proton-pair central final states X together with measured forward protons. The crucial soft model parameter estimation or 'tuning' challenge is automated with HEPData input via cutting-edge gradient-free global optimization algorithms –used in deep learning for a model hyperparameter optimization –and integrated here as a new HPC-distributable part of the generator.

Finally, I will outline ambitious future directions towards GRANIITTI v2. These include utilizing deep learning for more flexible data-driven Lorentz covariant soft scattering amplitudes or individual building blocks, such as 'deep Pomeron' and more efficient MC importance sampling based on invertible high-dimensional density function networks.

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