Higher Orders and Jets for LHC

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** Mainz Institute for Theoretical Physics
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Scientific Programme

The focus of this program will be the frontier of high-precision predictions for the Large Hadron Collider (LHC) physics. It will mainly address shower Monte Carlo techniques and their matching to fixed order calculations, resummation techniques in QCD and jet physics.

One main topic will be to study the question of building NNLO accurate parton showers (i.e. NNLO+PS methods). This question is intimately related to the problem of merging NLO+PS samples with different multiplicity while preserving the NLO accuracy in all cases, which in turn is closely connected to resummation approaches in QCD. We plan discussing and comparisons of solutions to the merging problem.

A second aim will be to discuss NNLL resummations in QCD. In particular, we expect to have fruitful exchanges between Soft-Collinear Effective Theory (SCET) experts and experts in traditional resummation techniques. NNLL resummations have two strong links to the Monte-Carlo oriented part of the program. First of all, part of the NNLL resummation is in fact required to address the merging problem. Second, by comparing NNLL resummations to (N)NLO+PS generators it will be possible to validate their uncertainties.

Furthemore, we plan to discuss jets, both in the context of Monte Carlo programs (mainly soft jets) and in the context of New Physics searches (mainly properties and substructure of boosted jets). An important topic in collider physics is to understand the effect of jet vetoes, that are typically used in several LHC analyses to increase the signal strength. Jets also play a prominent role in the task of identifying ('tagging') a heavy particle that is produced with large transverse momentum. In the past few years boosted jet substructure techniques have proven to be extremely powerful. Last but not least, the high luminosity of the LHC is certainly beneficial for achieving a high production rate of heavy particles, but it also causes experimental problems because of the ensuing high 'pileup'. This contamination must be properly subtracted in order to perform accurate measurements, and jet-based techniques for this task will be discussed.