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# Chapter 1

# Research Activities – Theory

## 1.1 Novel computational techniques in particle physics and phenomenological applications

*(Director: Prof. Dr. G. Zanderighi)*

Introduction of the group.

### 1.1.1 Event generators at the Large Hadron Collider

Section for predictions matched with parton shower in hadron-hadron colliders.

#### 1.1.1.1 B-hadron and jet algorithms

*(R. Gauld, A. Ratti, M. Wiesemann, G. Zanderighi)*

#### 1.1.1.2 Charm-quark pair production and netrino physics

*(R. Gauld, T. Giani, A. Mahr, A. Ratti, M. Wiesemann, G. Zanderighi)*

#### 1.1.1.3 A new class of NNLO+PS predictions with bbZ

*(M. Wiesemann)*

#### 1.1.1.4 Higgs production in association with a bottom-quark pair: a flavour-scheme study

*(C. Biello, A. Sankar, M. Wiesemann, G. Zanderighi)*

Example of citation [1] or ref. [1]. Example of a figure in figure 1.1.

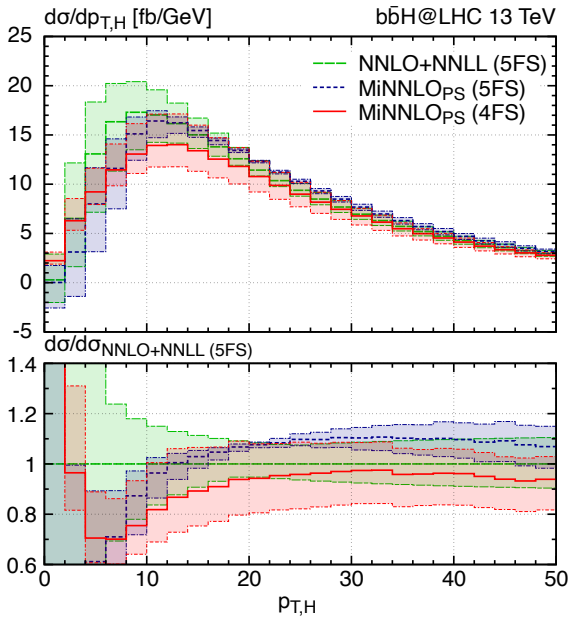


*Figure 1.1: Example plot.*

#### 1.1.1.5 Off-shell effects in top-quark pair production

*(C. Biello, C. Signorile-Signorile, M. Wiesemann, G. Zanderighi)*

#### 1.1.1.6 Off-shell studies in tt(+X) processes

*(G. Pelliccioli)*

#### 1.1.1.7 N-jettines formulation of MiNNLOPS

*(M. Ebert, M. Wiesemann, G. Zanderighi, S. Zanoli)*

#### 1.1.1.8 EW NLO+PS

*(G. Pelliccioli, M. Wiesemann, G. Zanderighi, S. Zanoli)*

#### 1.1.1.9 Polirised NLO+PS predictions and quantum info

*(G. Pelliccioli, G. Zanderighi)*

#### 1.1.1.10 Di-Higgs production

*(F. Garosi, M. Wiesemann, G. Zanderighi)*

## References

[1] Christian Biello et al. "Higgs boson production in association with massive bottom quarks at NNLO+PS". In: (Dec. 2024). arXiv: 2412.09510 [hep-ph].

### 1.1.2 Pushing the precision in Higgs studies

Space for a nice introduction.

#### 1.1.2.1 VBF $H \to b\bar{b}$ production

*(A. Behring, G. Zanderighi)*

#### 1.1.2.2 Two-loop amplitudes for Higgs plus jet

*(U. Haisch, M. Niggetiedt)*

#### 1.1.2.3 Exact top-quark mass dependence in Higgs production

*(M. Niggetiedt)*

#### 1.1.2.4 Higgs predictions with bottom-quark mass effects

*(M. Niggetiedt)*

#### 1.1.2.5 Next-to-soft threshold in $b\bar{b}$H

*(A. Sankar)*

#### 1.1.2.6 Rapidity distribution of pseudoscalar Higgs

*(A. Sankar)*

### 1.1.3 Tools and methods for higher-order predictions

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#### 1.1.3.1 New formulation of Nested Soft-Collinear Subtraction Scheme

*(C. Signorile-Signorile)*

#### 1.1.3.2 LASS: a new subtraction scheme method at NNLO

*(G. Pelliccioli, A. Ratti, C. Signorile-Signorile)*

#### 1.1.3.3 Strongly-ordered infrared counterterms from factorisation

*(C. Signorile-Signorile)*

#### 1.1.3.4 Soft function at N3LO

*(M. Delto, C. Wang)*

#### 1.1.3.5 Reclassifying Feynman Integrals as Special Functions

*(C. Wang)*

#### 1.1.3.6 Four-loop renormalisation of pseudoscalar operators

*(M. Niggetiedt)*

### 1.1.4 Not only proton-proton collisions

Space for a nice introduction and give me a better title for sure.

#### 1.1.4.1 NNLO+PS prediction for di-jet production at lepton colliders

*(F. Koenig, R. Schorer, M. Wiesemann, G. Zanderighi)*

#### 1.1.4.2 NLO+PS predictions for charged-lepton and neutrino induced DIS

*(R. Gauld, G. Zanderighi)*

#### 1.1.4.3 Strong-coupling constant determination

*(P. Nason, G. Zanderighi)*

#### 1.1.4.4 Time-like matching conditions at the threshold

*(C. Biello)*

#### 1.1.4.5 Mass power corrections for fragmentation functions

*(F. Ahmadova, R. Gauld)*

#### 1.1.4.6 Tetraquarks

*(C. Wang)*

#### 1.1.4.7 Neutrino content of the muon

*(F. Garosi)*

### 1.1.5 Beyond Standard Model seaches

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#### 1.1.5.1 Polarised NLO+PS predictions in SMEFT

*(J. Linder, G. Pelliccioli, M. Wiesemann, G. Zanderighi)*

#### 1.1.5.2 Z+jet SMEFT

*(R. Gauld, U. Haisch, J. Weiss)*

#### 1.1.5.3 NNLO+PS VH

*(R. Gauld, L. Schnell, U. Haisch)*

#### 1.1.5.4 New collider proposal for dark matter studies

*(R. Gauld)*

#### 1.1.5.5 $b \to s\gamma$ corrections for the physical value of the charm mass

*(M. Niggetiedt)*