Young Scientists Meeting of the CRC TRR 257

Report of Contributions

https://indico.kit.edu/e/4941

Contribution ID: **1** Type: **not specified**

Top-Yukawa-induced corrections to Higgs pair production

Tuesday, July 22, 2025 10:15 AM (20 minutes)

After the discovery of the Higgs boson in 2012, the measurements of the Higgs self coupling is still a challenge for current and future experiments in particle physics. Higgs-boson pair production via gluon fusion is a loop-induced process. In order to increase the accuracy of the theoretical predictions for this process, higher-order corrections are necessary to reduce theoretical uncertainties and to describe differential distributions reliably. The next-to-leading order (NLO) corrections involve the evaluation of two-loop Feynman diagrams. In particular, for electroweak (EW) corrections, many different mass scales appear in the calculation, such as the gauge boson, bottom, top quark, and Higgs boson masses. Further complications include numerical instabilities due to virtual thresholds which require careful treatment.

In my talk, I will present results for the EW corrections induced by the top Yukawa coupling with contributions from light-quark loops without using any reduction techniques to master integrals. The calculations are done by keeping the masses as fully symbolic parameters, allowing, in the future, for a study of parametric and mass scheme/scale uncertainties.

Authors: Dr BHATTACHARYA, Arunima (University of Valencia-CSIC); Prof. CAMPANARIO, Francisco (University of Valencia-CSIC); Mr CHANG, Jamie (Paul Scherrer Institut); Dr MAZZITELLI, Javier (Paul Scherrer Institut); Dr RONCA, Jonathan (University of Padua); Dr SPIRA, Michael (Paul Scherrer Institut); Prof. MÜHLLEITNER, Milada Margarete (Karlsruher Institut für Technologie - ITP); CARLOTTI, Sauro (Karlsruher Institut für Technologie - ITP)

Presenter: CARLOTTI, Sauro (Karlsruher Institut für Technologie - ITP)

Session Classification: Young Scientists Talks: Session 3

Contribution ID: **2** Type: **not specified**

Phasing-in dark matter

Tuesday, July 22, 2025 4:00 PM (20 minutes)

Despite being an elegant mechanism to explain Dark Matter (DM) production, freeze-in introduces challenges: If DM interacts via non-renormalizable operators, the predictions are highly sensitive to initial conditions, such as the reheating temperature of the universe. These issues are particularly relevant in models in which the universe deviates from radiation domination and the entropy of the Standard Model (SM) thermal bath is not conserved.
In this talk, I will present a general freeze-in scenario in which a scalar field dominates the energy density of the universe before undergoing a first-order phase transition and then slowly decaying to visible particles. The decays lead to a second phase of reheating of the radiation bath and to additional contributions to DM freeze-in. I will explore the conditions under which these late contributions dominate over the initial DM abundance produced at primordial reheating. In this scenario, referred to as \textit{phase-in}, the final abundance of DM is primarily determined by the details of the phase transition and subsequent reheating, and insensitive to the details of inflationary reheating.

Authors: Dr BENSO, Cristina (KIT - IAP); Prof. KAHLHOEFER, Felix (KIT - IAP); MANSOUR, Henda (Karlsruhe Institute of Technology)

Presenter: MANSOUR, Henda (Karlsruhe Institute of Technology)

Session Classification: Young Scientists Talks: Session 5

Contribution ID: **3** Type: **not specified**

Electroweak corrections to Higgs boson pair production: The light quark case

Tuesday, July 22, 2025 9:15 AM (20 minutes)

We present a fully analytic computation of the two-loop electroweak corrections to double Higgs production in gluon fusion, mediated by light quarks. The calculation is performed using the method of differential equations, employing a large mass expansion to generate boundary functions. We implement the results in the Powheg-Box-V2 framework for phenomenological studies. The corrections to the differential cross section are found to be sizable, reaching up to -15% near the production threshold. Additionally, we investigate the sensitivity of these corrections to variations of the triple Higgs self-coupling λ_{HHH}.

Authors: BONETTI, Marco (ITP IAP KIT); RENDLER, Philipp (Institute for Theoretical Physics, Karlsruhe Institute of Technology); Dr TORRES BOBADILLA, William J. (Department of Mathematical Sciences, University of Liverpool)

Presenter: RENDLER, Philipp (Institute for Theoretical Physics, Karlsruhe Institute of Technology)

Session Classification: Young Scientists Talks: Session 3

Contribution ID: **4** Type: **not specified**

Constraining Flavored Dark Matter: A Systematic Study in the DMFV Framework

Tuesday, July 22, 2025 4:20 PM (20 minutes)

The null results of dark matter searches targeting weakly interacting massive particles (WIMPs) put increasing pressure on the simplest realizations of WIMP models. In response, we explore an extended dark sector with a non-trivial flavor structure within the Dark Minimal Flavor Violation (DMFV) framework. These models extend the standard dark matter paradigm by introducing flavor-dependent interactions between dark matter and the Standard Model. Flavored dark matter models offer a rich phenomenology, linking dark matter properties to the flavor structure of the visible sector, which leads to distinctive signatures in cosmology, direct detection, flavor observables, and collider experiments. We therefore develop a framework to perform an automated systematic study of the phenomenology of different DMFV models. Using this framework, we analyze the viable parameter space of a specific flavored dark matter model and identify which constraints have a significant impact on the parameter space. Furthermore, we discuss new potential opportunities for searches for the model at colliders.

Author: RATHMANN, Lena

Presenter: RATHMANN, Lena

Session Classification: Young Scientists Talks: Session 5

Contribution ID: **5** Type: **not specified**

Higgs Mass Predictions in the CP-Violating High-Scale NMSSM

Monday, July 21, 2025 4:20 PM (20 minutes)

In a supersymmetric theory, large mass hierarchies can lead to large uncertainties in fixed-order calculations of the SM-like Higgs mass. A reliable prediction is then obtained by performing the calculation in an effective field theory (EFT) framework, involving the matching to the full supersymmetric theory at the high scale to include contributions from the heavy particles, and a subsequent renormalization-group running down to the low scale.

In my talk, I report on the prediction of the SM-like Higgs mass within the CP-violating Next-to-Minimal Supersymmetric extension of the SM in a scenario where all non-SM particles feature TeV-scale masses. The matching conditions are calculated at full one-loop order using two approaches. These are the matching of the quartic Higgs couplings as well as of the SM-like Higgs pole masses of the low- and high-scale theory. A comparison between the two methods allows for an estimate of the size of terms suppressed by the heavy mass scale that are neglected in a pure EFT calculation as given by the quartic-coupling matching. The calculation is implemented in a new version of the public program package NMSSMCALC.

Authors: Dr BORSCHENSKY, Christoph (Karlsruhe Institute of Technology); Dr DAO, Thi Nhung (PHENIKAA University); Dr GABELMANN, Martin (University of Freiburg); Prof. MÜHLLEITNER, Milada Margarete (Karlsruhe Institute of Technology); Prof. RZEHAK, Heidi (University of Freiburg)

Presenter: Dr BORSCHENSKY, Christoph (Karlsruhe Institute of Technology)

Session Classification: Young Scientists Talks: Session 2

Contribution ID: **6** Type: **not specified**

GeV scale strongly-interacting dark sectors at beam dump experiments

Tuesday, July 22, 2025 4:40 PM (20 minutes)

A natural dark matter candidate in many theories of strongly-interacting dark sectors is the dark pion π_D, which is a composite particle that is expected to have a mass close to or below the GeV scale. In many cases, these theories also contain a light vector meson, ρ_D, that can be produced together with dark pions through dark showers created in particle collisions. Cosmological and astrophysical arguments favor the scenario $m_{\rho_D} < 2m_{\pi_D}$, which implies visible decays of the mesons and makes the model testable at accelerators. In this talk I will show that beam-dump experiments sensitive to feebly-interacting long-lived particles can be a valuable tool for probing such strongly-interacting dark sectors and present the projected sensitivity of the upcoming SHiP experiment.

Author: HEMME, Nicoline (Karlsruher Institut für Technologie)

Co-author: KAHLHOEFER, Felix (KIT)

Presenter: HEMME, Nicoline (Karlsruher Institut für Technologie)

Session Classification: Young Scientists Talks: Session 5

Contribution ID: **7** Type: **not specified**

Power Corrections to N-Jettiness Slicing at NLO

Tuesday, July 22, 2025 9:55 AM (20 minutes)

The N-jettiness slicing method has become a key tool for precision QCD calculations over the past decade. However, efficient numerical implementation requires the inclusion of power corrections beyond leading power. In this talk, I will discuss the role of next-to-leading power (NLP) corrections in the zero-jettiness variable at next-to-leading order (NLO), focusing on processes with colorless final states at hadron colliders and beyond.

I will show how NLP corrections can be systematically computed and examine whether the process-independence observed at leading power extends to subleading orders. I will also present a master formula that allows one to calculate both soft and collinear subleading contributions in a generic way, enabling the computation of power corrections for high-multiplicity final states. Understanding these effects is crucial for improving the accuracy and broadening the applicability of N-jettiness slicing in collider physics.

Author: AGARWAL, Prem

Presenter: AGARWAL, Prem

Session Classification: Young Scientists Talks: Session 3

Contribution ID: **8** Type: **not specified**

Three-loop QCD corrections to heavy-to-light form factors and applications to inclusive B decays

Monday, July 21, 2025 2:20 PM (20 minutes)

In this talk, we discuss the computation of form factors for decays of heavy into light quarks at third order in QCD for various currents. We describe the different steps of the calculation and use the results to compute the hard matching coefficients in Soft-Collinear Effective Theory for all currents. Further, we extract the hard function in $\bar{B} \to X_s\gamma$ to three loops using the tensor coefficients at light-like momentum transfer and study the impact of three-loop QCD corrections on partial decay rates in charged-current semi-leptonic $\bar{B} \to X_u l\bar{\nu}$ decays, where the newly computed corrections to the vector and axialvector coefficients constitute an essential ingredient to carry out this analysis.

Authors: LANGE, Fabian; MÜLLER, Jakob; SCHÖNWALD, Kay; FAEL, Matteo; STEINHAUSER, Matthias; HUBER, Tobias

Presenter: MÜLLER, Jakob

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **9** Type: **not specified**

LoopScalla: A new multiloop setup

Tuesday, July 22, 2025 2:40 PM (20 minutes)

We report on a new framework for multiloop calculations that makes use of FORM and Mathematica. While FORM is employed for computationally heavy tasks such as amplitude evaluation or insertion of reduction tables, less performance-critical such as topology identification and minimization are done with FeynCalc. The interfaces to IBP-Reduction tools such as FIRE or KIRA are handled via the FeynHelpers add-on. The setup is fully open-source, designed to be extendable and is optimized for running jobs on a computer cluster administered via SLURM.

Author: Dr SHTABOVENKO, Vladyslav (University of Siegen)

Presenter: Dr SHTABOVENKO, Vladyslav (University of Siegen)

Session Classification: Young Scientists Talks: Session 4

Contribution ID: **10** Type: **not specified**

ggxy: NLO QCD corrections to top-loop induced $gg \to XY$ processes

Tuesday, July 22, 2025 3:00 PM (20 minutes)

We present the program package ggxy, which in its first version can be used to calculate partonic and hadronic cross sections to Higgs boson pair production at NLO QCD. The 2-loop virtual amplitudes are implemented using analytical approximations in different kinematic regions, while all other parts of the calculation are exact. This implementation allows to freely modify the masses of the top quark and the Higgs boson, as well as the renormalization scheme of the top-quark mass. Finally, we provide an overview of the future development of ggxy.

Author: STREMMER, Daniel (KIT)

Presenter: STREMMER, Daniel (KIT)

Session Classification: Young Scientists Talks: Session 4

Contribution ID: **11** Type: **not specified**

Explaining the γγ + X excesses at 152 GeV via the Drell-Yan production of a Higgs triplet

Monday, July 21, 2025 2:40 PM (20 minutes)

The discovery of the 125 GeV Higgs boson marked the final piece of the Standard Model (SM), but no new particles have been observed since. However, multi-lepton anomalies at the LHC hint at a new scalar between 145–155 GeV, decaying mainly to WW, with no corresponding ZZ signal—suggesting a neutral $SU(2)_L$ triplet. Recasting ATLAS Run-2 di-photon data reveals a 4σ excess near 152 GeV and a preferred di-photon branching ratio of (0.7 ± 0.2)%. If confirmed, this would be the strongest evidence yet for new physics at the LHC.

Author: ASHANUJJAMAN, Saiyad (TTP & IAP, KIT)

Presenter: ASHANUJJAMAN, Saiyad (TTP & IAP, KIT)

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **12** Type: **not specified**

Quark mass effects in gradient-flow observables

Tuesday, July 22, 2025 2:00 PM (20 minutes)

In recent years the perturbative approach to the short flow time expansion (STFX) of the gradient flow has been used in a variety of applications, such as meson mixing, for comparison to data from lattice field theory. These computations have usually utilised the method of projectors, which necessitates vanishing quark masses. However, it has been suggested by Hiromasa et. al. that the full mass effects of vacuum expectation values of operators within the SFTX can be used for precision determination of quark masses when used in conjunction with similar lattice results. While the mass effects of various processes are known in the literature to the two loop level, in this talk we discuss the computation of the vacuum expectation values of the flowed fermion and gluon condensates and the fermion kinetic operator within perturbation theory to the three loop level numerically using ftint.

Authors: HARLANDER, Robert (RWTH Aachen University); MASON, Robert (RWTH Aachen University)

Presenter: MASON, Robert (RWTH Aachen University)

Session Classification: Young Scientists Talks: Session 4

Contribution ID: **13** Type: **not specified**

Exploring the Fundamental Limits of Jet Classification

Wednesday, July 23, 2025 2:00 PM (20 minutes)

Jets are ubiquitous observables in collider experiments, composed of complex collections of particles that require classification. Over the past decade, machine learning-based classifiers have significantly enhanced our jet tagging capabilities, with increasingly sophisticated models leading to further improvements. This raises a fundamental question: How close are we to the theoretical limit of jet tagging performance? To explore this, we employ transformer-based generative models to produce realistic synthetic data with a known probability density function. By testing various state-of-the-art taggers on this datasets, we estimate the gap between their performance and the theoretical optimum for several jet types. Overall, we find that there remains room for improvement, particularly in cases where the theoretical optimum is higher. Our approach paves the way for investigating what modern classifiers lack in reaching optimal performance. The dataset and software are made publicly available to provide a benchmark task for future developments in jet tagging and other areas of particle physics.

Authors: MÜCK, Alexander (RWTH Aachen); NACHMAN, Benjamin; NISHANK, Gite; REYES-GONZALEZ, Humberto (RWTH Aachen); GEUSKENS, Joep; KRÄMER, Michael (RWTH Aachen University); KOLLER, Sarah (RWTH Aachen); MIKUNI, Vinicius

Presenter: REYES-GONZALEZ, Humberto (RWTH Aachen)

Session Classification: Young Scientists Talks: Session 7

Contribution ID: **14** Type: **not specified**

The B^+ - B^0_d Lifetime Difference At NNLO

Monday, July 21, 2025 3:00 PM (20 minutes)

We study the QCD corrections to the spectator effects in the lifetimes of weakly decaying heavy hadrons containing a bottom quark in the framework of the Heavy Quark Expansion (HQE). These effects come from the contribution of dimension-6 four-quark effective operators which, despite being $\frac{1}{m_b^3}$ suppressed, receive a phase-space enhancement. In our work, we neglect the light-quark masses and keep only the charm-quark mass, together with the bottom quark mass. The resulting masters integrals are then expressed in terms of an expansion in $x = \frac{m_c}{m_b}$. We present the state-of-the-art of our calculation of the Next-to-Next-to-Leading-Order Wilson coefficients that are obtained by matching the weak Hamiltonian with $\Delta B = 1$ operators onto an effective $\Delta B = 0$ Hamiltonian.

Author: MORETTI, Francesco (TTP)

Presenter: MORETTI, Francesco (TTP)

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **15** Type: **not specified**

The MINLO method as an alternative to conventional Fixed-Order NLO

Wednesday, July 23, 2025 11:00 AM (20 minutes)

In this talk, I will present the Multi-Improved NLO (MINLO) method as an alternative to the conventional fixed-order NLO approach, which depends on an arbitrary choice of renormalization and factorization scales. The MINLO framework dynamically determines these scales based on the most probable branching histories and incorporates Sudakov form factors to resum large double logarithms that arise in processes with widely separated energy scales. I will highlight the differences between the fixed-order NLO and MINLO approaches through a comparative study of top-quark pair production with up to three jets at NLO in QCD.

Author: DIMITRAKOPOULOS, Nikolaos (RWTH Aachen University)

Presenter: DIMITRAKOPOULOS, Nikolaos (RWTH Aachen University)

Session Classification: Young Scientists Talks: Session 6

Contribution ID: **16** Type: **not specified**

Extension of the Nested Soft-Collinear Subtraction Scheme to multi-partonic final states

Tuesday, July 22, 2025 9:35 AM (20 minutes)

We extend the Nested Soft-Collinear Subtraction Scheme to final states with any number of gluons and (anti)quarks and derive general analytical formulas for the infrared-finite NNLO QCD corrections to a generic hadron collider process with a single flavour of quarks (nf=1). We also discuss some ideas to move towards an extension with arbitrary nf.

Author: TRESOLDI, Matteo (KIT TTP)

Presenter: TRESOLDI, Matteo (KIT TTP)

Session Classification: Young Scientists Talks: Session 3

Contribution ID: **17** Type: **not specified**

Model agnostic optimisation of weakly supervised anomaly detection

Wednesday, July 23, 2025 11:20 AM (20 minutes)

Weakly supervised anomaly detection has been shown to find new physics with a high significance at low injected signal cross sections. If the right features and a robust classifier architecture are chosen, these methods are sensitive to a very broad class of signal models. However, choosing the right features and classification architecture in a model-agnostic way is a difficult task as the underlying signal versus background classification task is dominated by noise. In this work, we systematically study a number of optimisation metrics to understand which are most robust in realistic, noisy conditions. Our findings provide practical guidance for improving the stability and performance of weakly supervised anomaly detection, making it a more reliable tool for model-independent new physics searches.

Authors: MÜCK, Alexander (RWTH Aachen); SHIH, David; KASIECZKA, Gregor; MOUREAUX, Louis (Universität Hamburg); HEIN, Marie (RWTH Aachen University); KRÄMER, Michael (RWTH Aachen University); QUADFASEL, Tobias

Presenter: HEIN, Marie (RWTH Aachen University)

Session Classification: Young Scientists Talks: Session 6

Contribution ID: **18** Type: **not specified**

Energy Flow Polynomials for More Model-Agnostic Anomaly Detection

Wednesday, July 23, 2025 11:40 AM (20 minutes)

Weakly supervised anomaly detection has been shown to be a sensitive and robust tool for Large Hadron Collider (LHC) analysis. The effectiveness of these methods relies heavily on the input features of the classifier, influencing both model coverage and the detection of low signal cross sections. In this talk, we demonstrate that improvements in both areas can be achieved by using energy flow polynomials. To further highlight this, we introduce new benchmark signals for the LHCO RnD dataset, which is a widely used benchmark dataset in this field.

Authors: MÜCK, Alexander (RWTH Aachen); SHIH, David; KASIECZKA, Gregor; LANG, Lukas (RWTH Aachen University); HEIN, Marie (RWTH Aachen University); KRÄMER, Michael (RWTH Aachen University); MASTANDREA, Radha (University of California, Berkeley); DAS, Ranit (Rutgers University)

Presenter: LANG, Lukas (RWTH Aachen University)

Session Classification: Young Scientists Talks: Session 6

Contribution ID: **19** Type: **not specified**

Spontaneous CP violation and a new Higgs doublet below 500 GeV

Monday, July 21, 2025 4:40 PM (20 minutes)

It is common practice to study the phenomenology of extended Higgs sectors ad-hoc. This approach becomes much more convincing when the extension is required to address the fundamental puzzles of SM. We show that if CP violation originates from spontaneous symmetry breaking, an additional light Higgs doublet below about 500 GeV is needed, in the framework of minimal renormalizable SO(10). Its flavor-violating couplings are related to proton decay branching ratios. If the high-luminosity LHC and Hyper-Kamiokande can observe these signatures, a hint of minimal SO(10) will emerge in near future.

Author: GAO, Xiyuan (Institute for Theoretical Particle Physics, Karlsruhe Institute of Technology, Germany)

Presenter: GAO, Xiyuan (Institute for Theoretical Particle Physics, Karlsruhe Institute of Technology, Germany)

Session Classification: Young Scientists Talks: Session 2

Contribution ID: **20** Type: **not specified**

A composite grandcolor axion from a composite Higgs model

Monday, July 21, 2025 3:20 PM (20 minutes)

In this work we propose a unified model that simultaneously addresses the hierarchy problem and the strong CP problem by combining a composite Higgs scenario with an axion model. To do so, we construct a model in which both the Higgs and the axion arise as pseudo-Nambu-Goldstone bosons (pNGBs) from the same symmetry breaking. In particular, we work with an $SU(4)/Sp(4)$ composite Higgs model, since this coset also contains a CP-odd scalar singlet that can be used as an axion.

To maintain a low compositeness scale while simultaneously avoiding experimental bounds on the axion couplings, we increase the axion mass via additional small instanton contributions coming from a new hidden gauge sector with a confinement scale larger than Λ_{QCD}. Both the SM color group and the additional hidden sector are embedded into a larger non-Abelian grandcolor group. In this way, the topological angles of the two sectors are guaranteed to be the same at tree-level, while we show that other CP-violating sources can be controlled.

After examining the field content and the gauge structure, we study the pNGBs' spectrum, the fermion mass generation mechanism, the axion couplings, and the axion potential to understand under which conditions the CP-odd scalar singlet can solve the strong CP problem while maintaining a natural compositeness scale.

Authors: INCROCCI, Andrea (KIT); Dr GOERTZ, Florian (MPIK)

Presenter: INCROCCI, Andrea (KIT)

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **21** Type: **not specified**

Short-flow-time expansion of four-quark operators at NNLO QCD

Wednesday, July 23, 2025 10:40 AM (20 minutes)

An essential ingredient to the calculation of heavy meson lifetimes are non-perturbative matrix elements of four-quark operators. The gradient flow formalism provides a way for their calculation in lattice gauge theory. This requires the knowledge of the coefficients of the short-flow-time expansion of the corresponding operators, which can be calculated in perturbation theory. In this talk, the relevant four-quark operators and the calculation of the coefficients of their short-flow-time expansions through NNLO QCD will be described.

Authors: LANGE, Fabian; KOHNEN, Jonas (RWTH Aachen University); HARLANDER, Robert (RWTH Aachen University)

Presenter: KOHNEN, Jonas (RWTH Aachen University)

Session Classification: Young Scientists Talks: Session 6

Contribution ID: **22** Type: **not specified**

Complete NLO corrections to off-shell $\mathrm{t\bar{t}}$ production in the $\ell + j$ channel

Tuesday, July 22, 2025 2:20 PM (20 minutes)

I will show preliminary results for the complete NLO corrections to the $pp \to t\bar{t} + X$ process in the lepton+jets decay channel at the Run III energy of $\sqrt{s} = 13.6$ TeV at the LHC. The calculation includes all resonant and non-resonant Feynman diagrams, interference effects, and Breit-Wigner propagators as well as all higher-order QCD and EW effects. The integrated and differential cross sections for multiple observables will be presented. The talk will focus on defining the complete NLO corrections to the process, accounting for both QED and QCD divergences, in an infrared-safe manner using fragmentation functions and the photon-to-jet conversion function.

Authors: STREMMER, Daniel (KIT); MANS, Leon (RWTH Aachen University); WOREK, Malgorzata (RWTH Aachen University)

Presenter: MANS, Leon (RWTH Aachen University)

Session Classification: Young Scientists Talks: Session 4

Contribution ID: **23** Type: **not specified**

Ongoing Electroweak Corrections to Higgs Pair Production in Gluon-Gluon Fusion

Monday, July 21, 2025 5:00 PM (20 minutes)

Despite being a mainstay in particle physics textbooks throughout several decades, the actual shape of the Higgs potential is rather loosely constrained. Soon, through the high luminosity phase of the LHC program, our field will get the possibility to examine one process in particular: Higgs pair production from gluon-gluon fusion. Measuring this in an unprecedented precision will allow to tighten the bounds on the shape of the potential. At least, as long as the theoretical prediction is of comparable precision.
This requires the calculation of higher order corrections; in the present case the corrections in question are of electroweak nature. Extending upon last year's presentation of the Yukawa and self-coupling induced corrections at the YSM, this talk will show the status quo of our calculation for the full electroweak sector.

Authors: VESTNER, Augustin (ITP); HEINRICH, Gudrun (KIT); BONETTI, Marco (ITP IAP KIT); KERNER, Matthias (KIT); RENDLER, Philipp (Institute for Theoretical Physics, Karlsruhe Institute of Technology); JONES, Stephen (IPPP Durham); STONE, Tom (IPPP Durham)

Presenter: VESTNER, Augustin (ITP)

Session Classification: Young Scientists Talks: Session 2

Contribution ID: **24** Type: **not specified**

Towards HH at NNLO QCD: progress on the n_h^2 contribution

Monday, July 21, 2025 5:20 PM (20 minutes)

The virtual corrections for $gg \to HH$ at NLO QCD have been efficiently approximated using a Taylor expansion in the limit of a forward kinematics. The same method has been recently applied to the calculation of a subset of the NNLO corrections, which are desirable given the significant impact, at NLO, of the uncertainty due to the choice of the top mass renormalization scheme. In this talk, I will report on the progress in the calculation of another contribution at NNLO, given by diagrams in which the two Higgs bosons couple to different top quark loops. For this contribution a naive Taylor expansion cannot be used, and I will instead discuss an approach based on asymptotic expansions in different kinematic limits.

Author: VITTI, Marco (Karlsruhe Institute of Technology - TTP & IAP)

Presenter: VITTI, Marco (Karlsruhe Institute of Technology - TTP & IAP)

Session Classification: Young Scientists Talks: Session 2

Contribution ID: **25** Type: **not specified**

Registration

Contribution ID: **26** Type: **not specified**

Welcome Session

Contribution ID: **27** Type: **not specified**

Three-loop QCD corrections to heavy-to-light form factors and applications to inclusive decays

Presenter: MÜLLER, Jakob

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **28** Type: **not specified**

The B^+ - B^0_d Lifetime Difference At NNLO

Presenter: MORETTI, Francesco (TTP)

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **29** Type: **not specified**

A composite grandcolor axion from a composite Higgs model

Presenter: INCROCCI, Andrea (KIT)

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **30** Type: **not specified**

Explaining the γγ + X excesses at 152 GeV via the Drell-Yan production of a Higgs triplet

Presenter: ASHANUJJAMAN, Saiyad (TTP & IAP, KIT)

Session Classification: Young Scientists Talks: Session 1

Contribution ID: **31** Type: **not specified**

Higgs Mass Predictions in the CP-Violating High-Scale NMSSM

Presenter: Dr BORSCHENSKY, Christoph (Karlsruhe Institute of Technology)

Session Classification: Young Scientists Talks: Session 6

Contribution ID: **32** Type: **not specified**

Spontaneous CP violation and a new Higgs doublet below 500 GeV

Presenter: GAO, Xiyuan (Institute for Theoretical Particle Physics, Karlsruhe Institute of Technology, Germany)

Session Classification: Young Scientists Talks: Session 6

Contribution ID: **33** Type: **not specified**

Ongoing Electroweak Corrections to Higgs Pair Production in Gluon-Gluon Fusion

Presenter: VESTNER, Augustin (KIT-ITP)

Session Classification: Young Scientists Talks: Session 6

Contribution ID: **34** Type: **not specified**

Power Corrections to N-Jettiness Slicing at NLO

Presenter: AGARWAL, Prem

Session Classification: Young Scientists Talks: Session 3

Contribution ID: **35** Type: **not specified**

HD Talk 1

Session Classification: Young Scientists Talks: Session 7

Contribution ID: **36** Type: **not specified**

HD Talk 2

Session Classification: Young Scientists Talks: Session 7

Contribution ID: **37** Type: **not specified**

HD Talk 3

Session Classification: Young Scientists Talks: Session 7

Contribution ID: **38** Type: **not specified**

Extra Talk

Session Classification: Young Scientists Talks: Session 5

Contribution ID: **39** Type: **not specified**

Λ_b baryon LCDAs in the short-distance expansion

Tuesday, July 22, 2025 5:00 PM (20 minutes)

Light-cone distribution amplitudes (LCDAs) for the Λ_b baryon enter as universal hadronic matrix elements in QCD factorization approaches for energetic decays. Observables (e.g. form factors) can then be expressed as a convolution of the LCDA and a hard scattering kernel to the desired order in the strong coupling. The LCDAs are genuinely non-perturbative quantities that describe the low-energy dynamics of the hadronic bound state, which cannot directly be derived from first principles. In this work, we discuss the "radiative tail"of the 3-particle Λ_b LCDAs which can be computed in HQET perturbation theory by expanding in the light-cone separations between the light and heavy quarks in the baryonic bound state. Our results provide useful constraints on the modelling of Λb LCDAs in terms of a handful of HQET parameters.

Authors: VLADIMIROV, Daniel (Universität Siegen); Prof. FELDMANN, Thorsten (Universität Siegen)

Presenter: VLADIMIROV, Daniel (Universität Siegen)

Session Classification: Young Scientists Talks: Session 5

Contribution ID: **40** Type: **not specified**

Repurposing Large Language Models

Wednesday, July 23, 2025 2:20 PM (20 minutes)

Foundation models are a very successful approach to linguistic tasks. Naturally, there is the desire to develop foundation models for physics data. Currently, existing networks are much smaller than publicly available Large Language Models (LLMs), the latter having typically billions of parameters. By applying pretrained LLMs in an unconventional way, we introduce large networks for cosmological data.

Authors: ORE, Ayodele; HENEKA, Caroline; SCHILLER, Daniel (Institute for Theoretical Physics, Heidelberg University); NIESER, Florian; PLEHN, Tilman

Presenter: SCHILLER, Daniel (Institute for Theoretical Physics, Heidelberg University)

Session Classification: Young Scientists Talks: Session 7

Contribution ID: **41** Type: **not specified**

Deep Learning the QCD of Quark-Gluon Tagging

Wednesday, July 23, 2025 2:40 PM (20 minutes)

Established Machine learning taggers are a perfect challenge for explainability concepts in a fundamental physics context. For the theoretically challenging quark-gluon tagging, we first identify a small set of learned latent features that correlate strongly with physics observables. Then we use symbolic regression to derive compact analytic expressions to approximate the tagger in terms of these observables.

Authors: WINTERHALDER, Ramon (ITP Heidelberg); PLEHN, Tilman; VENT, Sophia

Presenter: VENT, Sophia

Session Classification: Young Scientists Talks: Session 7