# 微扰量子场论研讨会

Friday, 14 May 2021 - Sunday, 16 May 2021

上海新世界丽笙大酒店

# Book of Abstracts

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**Session 7** / **1**

## Calculation of master integrals for single top quark hadron production

**Author:** Long-Bin Chen[1]

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none.

**Session 6** / **2**

## Scattering amplitudes, Feynman integrals, and Wilson loops

**Author:** Song He[1]

[1] *ITP-CAS*

**Corresponding Author:** songhe@itp.ac.cn

I will briefly review recent progress in computing multi-loop scattering amplitudes in planar N=4 super-Yang-Mills by exploiting the duality to Wilson loops, and how the method can be used to compute a wide range uniform-transcendental Feynman integrals.

**Session 9** / **3**

## 喷注过程方位角关联的精确计算

**Author:** Dingyu Shao[1]

[1] *Fudan University*

**Corresponding Author:** dyshao@fudan.edu.cn

The azimuthal decorrelation in vector boson+jet production due to soft and collinear QCD effects can be calculated to high precision by using recoil-free jet axes, such as the Winner-Takes-All (WTA) axis, alongside Soft-Collinear Effective Theory (SCET) methods. We present theoretical predictions at next-to-next-to-leading logarithmic accuracy for the azimuthal decorrelation and demonstrate that this result is robust when using charged tracks instead of calorimetry, and in the presence of large backgrounds, due to the features of the WTA axis. We further find contributions to the process from linearly-polarised gluon transverse momentum distributions (arising from spin superposition effects of a single incoming or outgoing parton), in both the initial and final state.

**Session 8** / **4**

## Parton Distribution Functions matching in LaMET

**Author:** Ruilin Zhu[1]

[1] *Nanjing Normal University*

**Corresponding Author:** rlzhu@njnu.edu.cn

In this talk, I will report the matching of parton distribution functions (PDFs)
in Large Momentum Effective Theory (LaMET). First I will report the matching of gluon and quark PDFs in regularization independent momentum subtractioin (RI/MOM) scheme. Then I will report the next-to-next-to-leading order (NNLO) corrections to the nonsinglet quark
quasi distribution functions.

**Session 4** / **5**

## QCD aspects of heavy quark decays

**Author:** Yu-Ming Wang[1]

[1] *Nankai University*

QCD aspects of exclusive heavy-hadron decays will be discussed with an emphasis on the perturbative factorization properties for the resulting hadronic matrix elements in the heavy quark expansion and on the systematic discussions of the distinct dynamical mechanisms governing the flavor-changing form factors beyond the leading-power approximation. Phenomenological implications of the technical improvements for evaluating the heavy hadron decay amplitudes will be further elaborated with a number of interesting exclusive processes accessible at the LHCb and Belle II experiments.

**Session 2** / **6**

## A Long Journey to a full NLO calculation in CGC formalism

**Author:** Bowen Xiao[1]

[1] *C*

Color Glass Condensate (CGC) formalism is an effective formalism in QCD, and it allows us to compute multiple scattering and evolution in dense gluon systems. Full NLO order calculations are usually very challenging in CGC, yet they also reveal rich QCD dynamics. The simplest case, which is the single hadron production in $pA$ collisions, involves DGLAP and BK evolutions as well as the threshold resummation. Besides, the numerical calculation of the NLO corrections requires a tremendous amount of work and many fun and creative tricks. After a long journey in this NLO calculation, we finally may be able to reach a reliable and complete NLO calculation in CGC soon.

**Session 1** / **7**

## Some results of one-loop reduction

**Author:** 波冯 [1]

[1] 浙江大学

Some results of one-loop reduction

**Session 9** / **8**

## Double logarithmic corrections at subleading power

**Author:** Tao Liu[1]

**Co-author:** Alexander Penin [2]

[1] *IHEP*

[2] *University of Alberta*

**Corresponding Author:** liutao86@ihep.ac.cn

Will discuss the double logarithimic corrections induced through the exchange of soft massive quarks at subleading power. Besides the known results, some finished but not published results will also be presented.

**Session 3** / **9**

## Bootstrapping a two-loop four-point form factor

**Author:** Gang Yang[1]

[1] *Institute of Theoretical Physics, CAS*

**Corresponding Author:** yangg@itp.ac.cn

We develop a new bootstrap method and compute for the first time a two-loop four-point form factor in N = 4 SYM, which belongs to the non-trivial class of two-loop 2->3 scattering amplitudes with one external leg being off-shell.

**Session 5** / **11**

## Three-loop color-kinematics duality and Higgs amplitudes

**Authors:** Gang Yang[1]; Siyuan Zhang[2]; 冠达林 [3]

[1] *Institute of Theoretical Physics, CAS*

[2] *University of Chinese Academy of Sciences*

[3] *Peking University*

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We compute full-color three-loop form factors by using color-kinematics duality and unitarity cut methods. These form factors may be understood as the $\mathcal{N} = 4$ SYM counterparts of Higgs plus three-gluon amplitudes and are also expected to provide the maximally transcendental part of the latter.

**Session 6** / **12**

## CGC forward hadron production

**Author:** Xiaohui Liu[1]

[1] *Beijing Normal University*

**Corresponding Author:** xiaohuiliu@gmail.com

In this talk, I will present the higher order predictions for forward hadron production within the color glass condensate (CGC) framework. I will also show preliminary results for forward jet productions in the small-x limit.

**Session 5** / **13**

## Three-loop color-kinematics duality and Higgs amplitudes

**Authors:** Gang Yang[1]; 冠达林 [2]

[1] *Institute of Theoretical Physics, CAS*

[2] *Peking University*

We compute full-color three-loop form factors by using color-kinematics duality and unitarity cut methods. These form factors may be understood as the N=4 SYM counterparts of Higgs plus three-gluon amplitudes and are also expected to provide the maximally transcendental part of the latter.

**Session 7** / **14**

## The Time-reversal Odd Side of a Jet

**Authors:** Hongxi Xing[1]; Xiaohui Liu[2]

[1] *South China Normal University*

[2] *Beijing Normal University*

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We re-examine the jet probes of the nucleon spin and flavor structures. We find for the first time the time-reversal odd (T-odd) component of a jet, conventionally thought to vanish, can survive due to the non-perturbative fragmentation and hadronization effects. This additional contribution of a jet will lead to novel jet phenomena relevant for unlocking the access to several spin structures of the nucleon, which were thought to be impossible by using jets. As examples, we show how the T-odd constituent can couple to the proton transversity at the Electron Ion Collider (EIC) and can give rise to the anisotropy in the jet production in $e^+e^-$ annihilations. We expect the T-odd contribution of the jet will have broad applications in high energy nuclear physics.

**Session 5** / **15**

## Efficient computation of NLO corrections for HH production and ZH production via gluon fusion

**Authors:** Lilin Yang[1]; Yongqi XU[2]; 国兴王 [1]; 宇轩王 [2]; 小峰徐 [3]

[1] *Zhejiang University*

[2] *Peking University*

[3] *school of physics Peking Uniersity*

Higgs boson pair(HH) production and Z boson and Higgs boson(ZH) associated production are both very important processes at the LHC. Their gluon fusion channel is a class of loop-induced process, whose NLO correction in QCD is quite challenging, due to the appearance of difficult two loop Feynman integrals. In this talk, I will show our progress of the NLO calculations of these two processes. Recently, we present a precise and efficient computation of the two-loop amplitudes entering HH and ZH production processes via gluon fusion. Our approach is based on the small-external-mass expansion while keeping the full dependence on the top quark mass and other kinematic invariants. We find that our method provides precision numeric predictions in the entire phase space, while at the same time is highly efficient as the computation can be easily performed on a normal desktop or laptop computer. Our method is valuable for practical phenomenological studies. Finally, I will show some preliminary phenomenological results for NLO ZH production via gluon fusion, which are unknown for us before.

**Session 3** / **16**

## Large-x resummation of off-diagonal deep-inelastic parton scattering

**Author:** Jian Wang[1]

[1] *Shandong University*

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We address the next-to-leading power (NLP) resummation of large double logarithms of 1 − x to all orders in the strong coupling, which are present even in the off-diagonal DGLAP splitting kernels. The appearance of divergent convolutions prevents the application of factorization methods known from leading power resummation. Employing d-dimensional consistency relations from requiring $1/\epsilon$ pole cancellations in dimensional regularization between momentum regions, we show that the resummation of the off-diagonal parton-scattering channels at the leading logarithmic order can be bootstrapped from the recently conjectured exponentiation of NLP soft-quark Sudakov logarithms. In particular, we derive a result for the DGLAP kernel in terms of the series of Bernoulli numbers found previously by Vogt directly from algebraic all-order expressions. We identify the off-diagonal DGLAP splitting functions and soft-quark Sudakov logarithms as inherent two-scale quantities in the large-x limit. We use a refactorization of these scales and renormalization group methods inspired by soft-collinear effective theory to derive the conjectured soft-quark Sudakov exponentiation formula.

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## Two-body hadronic B decays at NNLO

**Author:** Xin-Qiang Li[1]

[1] *Central China Normal University*

**Corresponding Author:** xqli@mail.ccnu.edu.cn

Hadronic B decays play an important role in testing the Kobayashi-Maskawa mechanism of quark flavor mixing and CP violation, as well as in deepening our understanding of perturbative and non-perturbative aspects of strong interactions. Thanks to the successful running of BaBar, Belle, LHCb and Belle II experiments, we are now entering an era of precision flavor physics. In this talk, I will review the status of NNLO QCD corrections to two-body hadronic B decays in the framework of QCD factorization, or its field-theoretical formulation within the soft-collinear effective theory.

After introducing briefly the theoretical framework for hadronic B decays, I will present the calculations of these higher-order QCD corrections, firstly to the tree and then to the leading QCD penguin amplitudes. With these NNLO corrections included, phenomenological analyses of the tree- and penguin-dominated two-body charmless B decays, as well as the class-I B decays into heavy-light final states are given.

**Session 8** / **18**

## The classification of high dimensional gluon operators

**Author:** Qingjun Jin[1]

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The contribution of high dimensional operators in effective field theory becomes important as the experimental precision increases in LHC and future colliders. However, it can be very difficult to generate and classify these operators since the number of operators increases very fast as dimension increases. We propose a systematical method to generate and classify pure gluon operators with a given length to arbitrary high dimensions. A diagramatic representation of gluon operators is proposed to manifest their symmetries and relations. The infinite set of high dimensional operators are generated from a finite set of "primitive operators" by adding pairs of covariant derivatives. The possible redundancy among the operators are removed with the help of Groebner basis. The representations of permutation groups are used to dress the color factors. We explicity constructed primitive operators and Groebner basis for length-2,3,4,5 operators in D-dimensions.

**Session 5** / **19**

## A new method for amplitude with multi fermion line

**Author:** Feng Zhang[1]

[1] *IHEP*

**Corresponding Author:** zhangfeng@ihep.ac.cn

A new method for amplitude with multi fermion line is given. The new method is mainly focusing on simplifying the fermion line calculation, including the simplification of the spinor, Dirac matrices product and others. The comparison with other programs is given and the results show that the new method surely greatly improves the calculation speed and one can expect that the more final states, the better improvement.

**Session 1** / **20**

## Theoretical calculations for muon g-2

**Author:** 旭冯 [1]

[1] *Peking University*

TBD

**Session 2** / **21**

## Angularity in DIS

**Author:** Daekyoung Kang[1]

[1] *Fudan University*

TBD

**Session 8** / **22**

## NLO EW corrections to ee->Zh/H in THDM

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**Session 7** / **23**

## Progress in FDC Project

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**Session 5** / **24**

## New structure for Feynman integrals in N=4 SYM

**Author:** Zhenjie Li[1]

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TBD

**Session 2** / **25**

## Development of auxiliary mass flow method

**Author:** Yan-Qing Ma[1]

[1] *Peking University*

TBD

**Session 4** / **26**

## PDFs with lattice input

**Author:** Tie-Jiun Hou[1]

[1] *Northeastern University*

TBD

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## Recent progress on calculating partonic structure of hadrons from large momentum effective theory

**Author:** Jianhui Zhang[1]

[1] *Beijing Normal University*

TBD

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## Two-loop Feynman integrals with masses

**Author:** Lilin Yang[1]

[1] *Zhejiang University*

TBD

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## Openning Remarks

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## Recent applications of PMC

**Author:** Shengquan Wang[1]

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TBD

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## Exploring jet substructure with the celestial conformal symmetry

**Author:** Hao Chen[1]

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TBD

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## Compton Scattering Total Cross Section at NLO

**Author:** Xiaoyuan Zhang[1]

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