圈积分及相空间积分计算系列讲座

Report of Contributions

Contribution ID: **0**   Type: **not specified**

Introduction to sector decomposition

Saturday, 31 October 2020 01:00 (1 hour)

简要介绍 sector decomposition 的基本原理，其方法的优势及局限性，介绍几个主流的工具。

Presenter: 李钊

Session Classification: 数值计算

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

TBA

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

A Canonical Introduction to Feynman Integral Reduction

Thursday, 29 October 2020 01:00 (1 hour)

In order to get high order scattering amplitudes, it is essential to calculate corresponding Feynman integrals. However, for multi-loop orders, there will be a huge number of Feynman integrals for a physical process. Thanks to the integration-by-parts (IBP) identities, we can reduce these integrals to a small set of integrals, i.e., master integrals. Here I give an introduction on IBP identities and the Laporta algorithm, which is the standard algorithm for IBP reduction. I will also present the usage of FIRE6 — a popular software on automatic IBP reduction.

Presenter: 徐英轩 (Humboldt-Universitat zu Berlin)

Session Classification: 积分约化

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

Usage of public IBP reduction packages: FIRE and Kira

Thursday, 29 October 2020 02:00 (1 hour)

FIRE 和 Kira 是目前最常使用的积分约化开源程序包。两者都主要基于 Laporta 算法，多核多节点并行，但又各有特色，FIRE 吸收了非交换代数构造递推关系的技巧，而 Kira 在大稀疏矩阵消元策略/代数运算底层并行上有专长。两者都可以和现代有限域计算方法相结合，提高计算速度。这次报告中，报告人将在线演示如何使用这两种软件。

Presenters:　Mr LONG, Mingming;　Prof. ZHANG, Yang

Session Classification:　积分约化

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

Introduction to differential equation method for Feynman integral

Friday, 30 October 2020 01:00 (1 hour)

Feynman integrals are one of the important ingredients to provide precise theoretical predictions for process at the LHC. Recently, there is significant progress in calculating Feynman integrals using differential equation method. In this lecture, I will introduce the canonical form of differential equations, the corresponding integrals called canonical basis, and I will discuss how to solve the equations. Finally, I will review recent progress in constructing canonical basis.

Presenter: 徐小峰

Session Classification: 解析计算

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

EFT perspectives on Feynman integrals/Matching QCD currents(operators) onto SCET

Sunday, 1 November 2020 01:00 (1 hour)

Presenters: Prof. LI, Xin-Qiang; Prof. WANG, Yu-Ming

Session Classification: 积分行为

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

Phase space integration-overview/Slicing method and soft function at NNLO

Monday, 2 November 2020 01:00 (1 hour)

Presenters:　Prof. WANG, Jian；　Prof. LIU, Xiao-Hui

Session Classification:　相空间积分

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

pfd: a Singular Library to Simplify IBP Reduction Coefficients

Tuesday, 3 November 2020 01:00 (1 hour)

Presenter: Mr WU, Zihao

Session Classification: 程序使用

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pfd: a Singular Library to Simplify ...

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

Analytic calculation–traditional methods for integrals

Friday, 30 October 2020 02:00 (1 hour)

传统的积分方法在历史上起到了非常重要的作用。尽管目前微分方程的方法非常流行也非常强大，但是依然需要利用其它方法确定其边界条件。此外，在一些有效理论中出现的积分，微分方程的方法并不能很好的适用。此时，这些传统的方法便成为非常重要的处理手段。本次报告主要介绍三种传统的积分方法：parameterization，Mellin Barnes representation，Asymptotic expansions. 在报告中，报告人将分别介绍这些方法的基本概念和一些常用公式，并以一些简单的例子介绍如何在具体计算中使用这些积分方法。

Presenter:　Dr WANG, Guo-Xing

Session Classification:　解析计算

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

Calculation of master integrals using difference equation method

Saturday, 31 October 2020 02:00 (1 hour)

差分方程是计算主积分的一个重要方法。本次报告将介绍如何构建差分方程、求解差分方程，并给出科研中用到的具体例子。

Presenters: Mr LI, Zheng-Yang; Mr LIU, Zhi-Feng

Session Classification: 数值计算

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

Applications of conformal symmetry in QCD

Sunday, 1 November 2020 02:00 (1 hour)

Conformal symmetry provides significant simplifications to loop calculations in QCD for non-forward kinematics. In this talk, I will explain the relevant ideas detailing the procedures for applying conformal symmetry in QCD. I will review some recent results obtained through the conformal technique, which are immediately applicable to EIC physics, and meson decays.

Presenter: Dr JI, Yao

Session Classification: 积分行为

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

Calculation of phase-space integration of sufficient inclusive processes

Monday, 2 November 2020 02:00 (1 hour)

In this talk, I will introduce a systematic method (inverse unitarity+differential equations+auxiliary mass flow) to calculate phase-space integration for sufficient inclusive processes. With this method, we can get numerical results with high precision efficiently.

Presenter: ZHANG, Peng

Session Classification: 相空间积分

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

Introduction to FDC project

Tuesday, 3 November 2020 02:00 (1 hour)

Presenter: Prof. GONG, Bin

Session Classification: 程序使用

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

Syzygy for Feynman integral reduction

Thursday, 29 October 2020 03:00 (1 hour)

Presenter:　Prof. ZHANG, Yang

Session Classification:　积分约化

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

Regularization and calculation of rapidity divergent Feynman integrals systematically

Friday, 30 October 2020 03:00 (1 hour)

Presenter:　Dr YANG, Tong-Zhi

Session Classification:　解析计算

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

Solving Master Integrals via Numerical Differential Equations

Saturday, 31 October 2020 03:00 (1 hour)

Presenter: LIU, Xiao

Session Classification: 数值计算

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

Analyticity, renormalization, and evolution of the soft-quark function

Sunday, 1 November 2020 03:00 (1 hour)

Presenter: Dr WANG, Xiang-Peng

Session Classification: 积分行为

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

高精度现象学和减除法

Monday, 2 November 2020 03:00 (1 hour)

Presenter:　Dr CHEN, Xuan

Session Classification:　相空间积分

Contribution ID: **18**

Type: **not specified**

Introduction to FORM

Tuesday, 3 November 2020 03:00 (1 hour)

Presenter: Prof. LI, Zhao

Session Classification: 程序使用

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

Technique in Auxiliary Mass Flow

Thursday, 29 October 2020 04:00 (1 hour)

Presenter: Prof. LI, Zhao

Session Classification: 积分约化

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

IBP for gravitational wave physics

Thursday, 29 October 2020 05:00 (1 hour)

We describe the calculations of multi-loop scattering amplitudes in the context of binary black hole dynamics. The method of regions is used to expand the amplitudes in the limit of small $\hbar$. The expansion reduces the number of dimensionless kinematic variables from 3 to 1, which dramatically speeds up the subsequent IBP reduction, allowing us to calculate the 3-loop conservative dynamics of binary black holes. Additionally, Using reverse unitarity, phase space integrals for graviton emissions are treated like loop integrals using standard techniques like IBP and differential equations, allowing us to obtain analytic results for energy loss in black hole scattering.

Presenter: Prof. ZENG, Mao

Session Classification: 积分约化

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

Counting Master Integral: A Fascinating Problem

Thursday, 29 October 2020 06:00 (1 hour)

Presenter: XU, Jiuci

Session Classification: 积分约化

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

Bootstrapping a two-loop four-point form factor

Friday, 30 October 2020 04:00 (1 hour)

We explain a recent computation of a two-loop four-point form factor in planar N=4 SYM, which belongs to the class of two-loop five-point scattering observables with one off-shell color-singlet leg. A new bootstrapping strategy is developed to obtain this result by starting with an ansatz expanded in terms of master integrals and then solving the master coefficients via various physical constraints. We find that consistency conditions of infrared divergences and collinear limits, plus the cancellation of spurious pole, can fix a significant part of the ansatz. The remaining degrees of freedom can be fixed by one single type of two-double unitarity cut.

Presenter: Prof. YANG, Gang

Session Classification: 解析计算

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

Efficient NLO computation for gg->HH/ZH with top quark mass dependence

Friday, 30 October 2020 05:00 (1 hour)

Recently, we present a precise and efficient computation of the two-loop amplitudes entering gg->HH/ZH and present for the first time a calculation of the complete NLO corrections to the gg->ZH process. We use the method of small mass expansion to tackle the most challenging two-loop virtual amplitude, in which the top quark mass dependence is retained throughout the calculations. Our results are necessary ingredients towards reducing the theoretical uncertainties of the pp->ZH cross sections down to the percent-level, and provide important theoretical inputs for future precision experimental collider programs. In this talk, I will start with a brief introduction to to the HH/ZH production and method of the small mass expansion and then show our new results for the ZH production at the LHC.

Presenter:　Dr WANG, Guo-Xing

Session Classification:　解析计算

Contribution ID: **24**

Type: **not specified**

Compton Scattering at Next-to-leading Order

Friday, 30 October 2020 06:00 (1 hour)

The analytic form for the total QED scattering cross section of an electron and a photon at order \alpha^3 is computed. This includes both the double-Compton scattering real-emission contribution as well as the virtual Compton scattering part. When combined with the recent analytic result for the pair-production cross section, the complete \alpha^3 cross section is now known. Both the next-to-leading order calculation as well as the pair-production cross section are computed using modern multi-loop calculation techniques, where cut diagrams are decomposed into a set of master integrals that are then computed using differential equations.

Presenter: ZHANG, Xiaoyuan

Session Classification: 解析计算

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

圈积分的解析与数值计算若干方法与程序简介

Saturday, 31 October 2020 04:00 (1 hour)

本次报告将简单介绍圈积分的一些解析和数值计算方法，以及相关程序包的使用。例如微分方法方法来解析或数值计算圈积分，利用 DiffExp 程序包来数值计算微分方程。应用基于 sector decomposition 方法的 FIESTA 程序包来对积分进行数值计算，以及利用 GINAC 来数值计算 Goncharov Polylogarithms。

Presenter: Prof. CHEN, Long-Bin

Session Classification: 数值计算

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

On the evaluation of two-loop electroweak box diagrams for e+ e- to HZ production

Saturday, 31 October 2020 05:00 (1 hour)

Precision studies of the Higgs boson at future e+e- colliders can help to shed light on fundamental questions related to electroweak symmetry breaking, baryogenesis, the hierarchy problem, and dark matter. The main production process, e+ e- to HZ, will need to be controlled with sub-percent precision, which requires the inclusion of next-to-next-to-leading order (NNLO) electroweak corrections. The most challenging class of diagrams are planar and non-planar double-box topologies with multiple massive propagators in the loops. We generate a new technique for computing these diagrams numerically, by transforming one of the sub-loops through the use of Feynman parameters and a dispersion relation, while standard one-loop formulae can be used for the other sub-loop. This approach can be extended to deal with tensor integrals. The resulting numerical integrals can be evaluated in minutes on a single CPU core, to achieve about 0.1% relative precision.

Presenter: SONG, Qian

Session Classification: 数值计算

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

AMF method 程序 AMFlow

Saturday, 31 October 2020 06:00 (1 hour)

这将是首个能够高精度计算任意圈积分、相空间积分的程序。

Presenter: Dr LIU, Xiao

Session Classification: 数值计算

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

An introduction to the basics of SCET and method of regions

Sunday, 1 November 2020 04:00 (1 hour)

Soft collinear effective theory is an effective theory of QCD in the infrared regions. It has been used widely in the study of infrared divergnces of scattering amplitudes and of resummation of large logarithms in cross sectons. It helps one to obtain much information about the higher order corrections. The method of regions is another useful tool to calculate loop integrals up to certain power corrections, and can thus help to check the analytic result or to set the boundary constants for differential equations.

Presenter: Prof. WANG, Jian

Session Classification: 积分行为

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

Resummation of Super-Leading Logarithms

Sunday, 1 November 2020 05:00 (1 hour)

Jet cross sections at high-energy colliders exhibit intricate patterns of logarithmically enhanced higher-order corrections. In particular, so-called non-global logarithms emerge from soft radiation emitted off energetic partons inside jets. While this is a single-logarithmic effect at lepton colliders, at hadron colliders phase factors in the amplitudes lead to double-logarithmic corrections starting at four-loop order. This effect was discovered a long time ago, but not much is known about the higher-order behavior of these terms and their process dependence. We derive, for the first time, the all-order structure of these "super-leading logarithms" for generic 2->N scattering processes at hadron colliders and resum them in closed form.

Presenter:　Prof. SHAO, Ding-Yu

Session Classification:　积分行为

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

SCET factorization for the radiative leptonic B-meson decays

Sunday, 1 November 2020 06:00 (1 hour)

The radiative leptonic B-meson decays are extremely important to the study of the exclusive B-meson decays. I will concentrate on the factorization properties of the radiative leptonic B decay with an energetic photon in the final states. Employing the method of regions, we can derive the factorization formula of the decay form factors at the leading power. The factorization formula could be proved to be valid to all orders in QCD with the help of the soft collinear effective theory (SCET). The SCET also provides an elegant approach to obtain the evolution behavior of the factorization formula. In the framework of the SCET, we can further study systematically the factorization properties of the radiative leptonic B decay beyond the leading power.

Presenter: Dr WEI, Yan-Bing

Session Classification: 积分行为

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

Introduction to parton shower

Monday, 2 November 2020 04:00 (1 hour)

Monte-Carlo event generators have been widely used to simulate the processes in high-energy physics. Parton shower plays a central role in Monte-Carlo event generators which provides a reliable tool to perform the leading logarithms resummation. Precision prediction from parton shower requires more theory developments such as proof of NLL resummation and NLO shower framework. Beyond the resummation region, matching or merging with fixed-order calculations can improve the description of hard radiation. This talk will be aiming to give a comprehensive review of parton showers and matching/merging techniques.

Presenter: Dr LI, Hai-Tao

Session Classification: 相空间积分

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

Light-ray OPE in QCD

Monday, 2 November 2020 05:00 (1 hour)

Light-ray operators play an important role in various areas of physics and, in particular, are natural language for an interesting class of observables in collider physics, including energy-energy correlator (EEC). Similar to operator product expansion (OPE) of local operators, OPE of light-ray operators governs the collinear behavior of these observables. In this talk, I will first briefly review Hofman and Maldacena's basic idea about Conformal Collider Physics and recent development of light-ray OPE in conformal field theory. In the second part, I will describe the application of light-ray OPE in perturbative QCD and how it helps us understand jet substructures.

Presenter: CHEN, Hao

Session Classification: 相空间积分

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

The pion-photon transition form factor at two loops in QCD

Monday, 2 November 2020 06:00 (1 hour)

In this talk, I will report on our recent fully analytic calculation of the leading-power contribution to the photon-pion transition form factor at two loops in QCD. The applied techniques rely on hard-collinear factorization, together with modern multi-loop methods. I will focus both on the technical details, such as the treatment of evanescent operators, and the phenomenological implications. Our results indicate that the two-loop correction is numerically comparable to the one-loop effect in the same kinematic domain. I will also demonstrate that our results will play a key role in disentangling various models for the twist-two pion distribution amplitude thanks to the envisaged precision at future experimental facilities.

Presenter: Dr JI, Yao

Session Classification: 相空间积分

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

An introduction to the computer algebra system Singular

Tuesday, 3 November 2020 04:00 (1 hour)

Presenter: Prof. ZHANG, Yang

Session Classification: 程序使用

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

FiniteFlow 程序的物理和使用

Tuesday, 3 November 2020 05:00 (1 hour)

Presenters:　HE, Chuan-Qi；GUAN, Xin

Session Classification:　程序使用

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

Julia 编程语言介绍

Tuesday, 3 November 2020 06:00 (1 hour)

Presenter:　Prof. LI, Zhao

Session Classification:　程序使用